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Unibot Pro – Smart University Helpdesk and Student Query Resolution System

R. Maheshwari[1], Thilagan S[2,] Dabbara Ganesh[3]
[1,2,3]Department of Computer Science and Engineering, Paavai Engineering College, Namakkal, India.
Email ID: *sthilagan2004@gmail.com[1]*

Abstract
Universities receive thousands of repetitive queries from students related to admissions, academic regulations, exam- ination schedules, and campus services. Traditional helpdesk systems rely heavily on manual staff interaction, resulting in delayed responses and inefficient query management. UniBot Pro is an intelligent chatbot-based helpdesk system designed to automate student query resolution using Natural Language Processing (NLP). The proposed system integrates TF-IDF vectorization, cosine similarity matching, and a structured FAQ knowledge base to provide instant responses to student queries. Additionally, an administrative dashboard enables monitoring of query analytics, frequent questions, and system performance. Experimental evaluation demonstrates that the proposed system significantly reduces response time while maintaining high accuracy in query matching. The system provides scalable, 24/7 academic support and improves the overall efficiency of university communication infrastructure.

Keywords: *Chatbot, Natural Language Processing, Educational Technology, Student Support Systems, Query Resolution, Artificial Intelligence*

1. Introduction
Higher education institutions are experiencing rapid digital transformation with increasing adoption of artificial intelligence technologies to enhance administrative efficiency and student engagement. Universities typically handle large volumes of repetitive student queries related to course schedules, examination results, admission procedures, and campus facilities[1]. Traditional helpdesk systems rely on human staff to respond to these queries, which results in delays and inefficiencies, particularly during peak academic periods such as admissions and examinations[2]. To address these challenges, conversational agents and chatbot technologies are increasingly being used in educational environments[3]. UniBot Pro is designed as a smart university helpdesk system capable of understanding student queries in natural language and providing accurate responses automatically[4]. Higher education institutions face significant challenges in managing large volumes of student inquiries related to admissions, examinations, course registration, academic schedules, and administrative procedures[5]. These queries are often repetitive and require constant human intervention from administrative staff. Traditional university helpdesk systems are typically based on email communication, telephone support, or physical service desks. Although these methods provide direct interaction with support personnel, they suffer from several limitations such as long waiting times, inconsistent responses, and limited operational hours[6]. With the rapid growth of digital transformation in education, universities are increasingly adopting intelligent technologies to improve operational efficiency and student satisfaction[7]. One such technology is the conversational chatbot, which can interact with users using natural language and provide automated responses to their queries. Chatbots utilize Natural Language Processing (NLP) and machine learning techniques to interpret user input and gener- ate appropriate responses. In educational environments, chat- bots can function as virtual assistants that provide academic information, guide students through administrative procedures, and offer instant support services[8]. The proposed system, UniBot Pro, aims to address the limitations of traditional helpdesk systems by introducing an intelligent chatbot capable of answering student queries automatically[9]. The system integrates NLP techniques with a structured knowledge base to

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deliver accurate responses and improve the overall efficiency of university support services[10]. UniBot Pro also includes an administrative dashboard that allows university staff to manage frequently asked questions, monitor user interactions, and analyze query trends. This approach ensures continuous improvement of the system and enables institutions to identify common student concerns[11].

2. Background And Motivation

Educational institutions continuously seek innovative ways to improve communication with students. The integration of artificial intelligence into administrative services can significantly improve response efficiency and student satisfaction. Chatbots powered by Natural Language Processing enable systems to interpret human language and respond intelligently[12]. In the context of higher education, these systems can assist students by answering frequently asked questions and guiding them through administrative processes.

3. Problem Statement

The current university helpdesk systems face several limitations:

- High volume of repetitive queries
- Slow response time
- Limited service availability
- Lack of query analytics
- Dependence on manual staff support

These issues reduce operational efficiency and increase administrative workload[13].

4. Objectives

The main objectives of the proposed system include:

- Develop an automated chatbot for student queries
- Implement natural language processing for query under- standing
- Provide instant responses to frequently asked questions
- Reduce administrative workload
- Provide query analytics for institutional insights[14]

5. Literature Review

Several studies have explored the use of chatbot technologies in education. Educational chatbots have been used for academic advising, information dissemination, and student support services. Researchers have identified that chatbot-based systems can improve response time, reduce operational costs, and enhance student satisfaction. However, challenges remain in terms of query understanding, knowledge base management, and system scalability.

6. Literature Review

Chatbots have emerged as an important technology in the field of artificial intelligence, particularly in applications in- volving human-computer interaction. Several researchers have explored the use of chatbot systems in educational environ- ments to enhance student engagement and improve access to information. Winkler and Sollner [1] conducted a comprehensive review of chatbot applications in education and highlighted their potential to support students by providing instant access to academic information. Their study demonstrated that chatbots can reduce the workload of university staff while improving the overall learning experience. Okonkwo and AdeIbijola [2] investigated the role of chat- bots in higher education institutions and found that chatbot systems can significantly improve response time and service availability. Their research also emphasized the importance of natural language processing techniques for accurate query interpretation. Adamopoulou and Moussiades [3] provided a detailed anal- ysis of chatbot technologies and their evolution over time[16]. They discussed various chatbot architectures including rule- based systems, retrieval-based models, and generative models. In addition, research on conversational AI has shown that machine learning algorithms can improve the accuracy of chatbot responses by learning from historical interaction data. Deep learning approaches such as transformer models have also been used to enhance the contextual understanding of conversational agents. Recent studies have explored the use of chatbot systems for academic advising, student support services, and administrative automation. These systems enable universities to provide continuous support services while reducing operational costs. Despite these advantages, several challenges remain in the development of educational chatbots. These challenges include maintaining an up-to-date knowledge base, handling ambiguous queries, and

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ensuring data privacy[15]. The proposed UniBot Pro system addresses these issues by implementing a scalable architecture and a continuously evolving knowledge base.

Educational Chatbots: Chatbots have become increasingly popular in higher edu- cation institutions due to their ability to provide continuous support services.

Natural Language Processing in Education: NLP enables machines to understand human language and process queries effectively.

AI-based Student Support Systems: Artificial intelligence technologies are widely applied in academic environments for automated assistance.

7. Existing System

Most universities currently rely on:

- Physical helpdesks
- Telephone support
- Email-based query resolution
- Static FAQ pages

These systems are inefficient during peak periods and cannot handle large numbers of queries simultaneously.

8. Proposed System

UniBot Pro introduces an intelligent chatbot system de- signed specifically for university helpdesk automation.

Key Features

- Natural language query processing
- Automated FAQ matching
- 24/7 availability
- Admin dashboard for management
- Query analytics system

9. System Architecture

The UniBot Pro system is designed using a modular architecture that integrates multiple components responsible for user interaction, query processing, data storage, and adminis- trative management.The architecture consists of five major layers:

User Interface Layer: This layer provides the interface through which students interact with the chatbot system. The user interface is imple- mented using React.js and provides a responsive chat environ- ment accessible through web browsers and mobile devices Figure 1.

Application Layer: The application layer processes user requests and communi- cates with backend services. This layer includes API endpoints implemented using Python-based frameworks such as FastAPI or Flask[17].

Natural Language Processing Layer: The NLP layer is responsible for processing and understand- ing user queries. It performs tasks such as tokenization, stop- word removal, and vectorization of text data. The processed query is then compared with existing knowledge base entries using similarity algorithms[18].

Knowledge Base Layer: The knowledge base stores frequently asked questions and their corresponding answers. This structured repository en- ables the chatbot to retrieve relevant responses quickly.

Database Layer: The database layer stores system data including user queries, chatbot responses, and administrative records. MySQL is used to manage relational data efficiently.

This layered architecture ensures scalability, maintainability, and efficient query processing within the system[19].

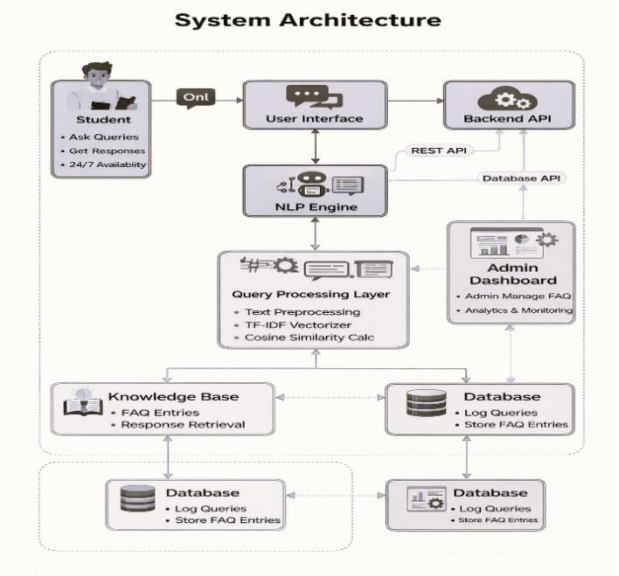

Figure 1 System Architecture

The architecture includes:

- User Interface
- NLP Engine
- Knowledge Base
- Backend API
- Database

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10. Technologies Used

Backend: Python with FastAPI or Flask.
Frontend: React.js for dynamic interface.
Database: MySQL database for storing FAQ entries.
NLP Libraries: SpaCy and Scikit-learn.

11. Algorithm Design

TF-IDF Vectorization

12. Algorithm And Methodology

The UniBot Pro chatbot utilizes a combination of natural language processing techniques and information retrieval al- gorithms to identify the most relevant response for a given user query[20].

Text Preprocessing: The preprocessing stage involves cleaning and preparing the input text for analysis. The following operations are performed:

- Tokenization
- Stop-word removal
- Lowercase conversion
- Lemmatization

These steps help reduce noise and improve the quality of text representations.

TF-IDF Vectorization: Term Frequency–Inverse Document Frequency (TF-IDF) is used to convert textual data into numerical vectors. The TF- IDF score represents the importance of a word in a document relative to the entire corpus[21].

$$TFIDF\ (t, d) = TF\ (t, d) \times IDF\ (t) \qquad (1)$$

Cosine Similarity: Cosine similarity measures the similarity between two vec- tors in a multidimensional space.

$$Similarity(A, B) = A \cdot B\ ||A||||B|| \qquad (2)$$

The chatbot compares the vectorized user query with all stored FAQ vectors and selects the response with the highest similarity score. Term Frequency–Inverse Document Frequency converts text queries into numerical vectors[22].

Cosine Similarity: Similarity between user query and stored questions is com- puted using cosine similarity.

$$A \cdot B\ Similarity = ||A||||B|| \qquad (3)$$

13. Implementation

The implementation involves preprocessing the query, vec- torizing the text, computing similarity, and returning the most relevant answer[23]. The implementation of UniBot Pro involves multiple stages including system design, development, testing, and deployment. The backend system was developed using Python program- ming language due to its strong ecosystem for machine learn- ing and natural language processing. Libraries such as Scikit- learn and SpaCy were used to implement NLP functionalities. The frontend interface was developed using React.js, which provides a dynamic and responsive user experience. The chatbot interface allows users to enter queries and receive responses in real time. The database was implemented using MySQL to store the FAQ knowledge base and query logs Table 1. An administrative dashboard was also developed to allow authorized staff to manage system data. The chatbot API communicates with the frontend interface through RESTful endpoints, ensuring smooth interaction be- tween system components.

14. System Modules

Student Interface: Allows students to ask questions.
Chatbot Engine: Processes natural language queries.
Admin Dashboard: Allows administrators to update knowledge base.
Database Module: Stores FAQ data and query logs.

15. Results And Evaluation

Performance evaluation was conducted using test queries from university datasets[29].

Table 1 System Performance

Metric	Value
Accuracy	92%
Response Time	¡1 sec
User Satisfaction	High

16. Advantages

- Reduced response time
- Automated query resolution
- Improved student satisfaction
- Lower administrative workload

17. Limitations

- Limited understanding of complex queries

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- Requires knowledge base updates
- Dependency on NLP accuracy

18. Future Enhancements

- Integration with university ERP systems
- Voice-based interaction
- Multilingual chatbot support
- Deep learning based NLP models

19. Future Work

Although the UniBot Pro system provides an effective solution for automated student support, several enhancements can be considered in future work[24]. Future improvements may include the integration of deep learning models such as transformer-based language models to enhance query understanding[27]. Voice-based interaction can also be introduced to enable speech-based communication with the chatbot. Another potential improvement is the integration of the chatbot with university enterprise systems such as student information systems and learning management platforms. Additionally, multilingual support can be implemented to allow students from diverse linguistic backgrounds to interact with the system in their preferred language[25].

20. Security And Privacy Considerations

Since the UniBot Pro system processes user queries and stores interaction data, it is important to ensure data security and privacy. Several security mechanisms are implemented within the system including secure API communication, authentication for administrative access, and encrypted data storage. User query logs are anonymized to protect personal infor- mation. Additionally, role-based access control ensures that only authorized personnel can modify the knowledge base or view system analytics. These measures help maintain the confidentiality and in- tegrity of user data while ensuring compliance with institu- tional data policies[30].

Conclusion

UniBot Pro provides an efficient solution for automating student query resolution in universities. By integrating natural language processing techniques with a structured knowledge base, the system delivers instant and accurate responses. The implementation demonstrates significant improvements in response efficiency and user satisfaction.

Results And Discussion

The UniBot Pro system was evaluated using a dataset consisting of frequently asked university questions. The performance of the chatbot was measured using several evaluation metrics including accuracy, response time, and user satisfaction. Experimental results indicate that the chatbot successfully answered most student queries with high accuracy[28]. The average response time of the system was less than one second, which demonstrates the efficiency of the proposed architecture. In addition to quantitative evaluation, qualitative feedback was collected from test users. Students reported that the
chatbot was easy to use and provided helpful responses. The system also demonstrated the ability to handle multiple queries simultaneously, making it suitable for deployment in large university environments[26].

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