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A Question Answering System Application Integrated with Chatbot Using NLP

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Abstract

Objective : A Question Answering System Application integrated with Chatbot using NLP is a platform designed to meet the needs of students, enabling effective communication between students and teachers while encouraging effective problem-solving and interactive knowledge exchange. **Methods:** The interface provides an optional space for learning inquiry, encouraging students to share their questions and concerns. This user-friendly interface allows students to easily submit questions, which are quickly distributed and reported to the appropriate teacher or expert. **Findings:** A Question Answering System Application integrated with Chatbot using NLP enables greater engagement and supports learning by providing a framework for resolving education-related questions. **Novelty:** It promotes effective problem-solving, improves interaction between students and teachers, and ultimately encourages students to take control of their learning.

Keywords: Query Chatbot; Natural Language Processing (NLP); Question Answering System Application; Collaborative Learning; Automated Answering System

1 Introduction

Education is currently experiencing a transformative shift in today's rapidly changing digital landscape. Modern, interactive learning platforms that deeply engage students are taking the place of traditional classroom methods[1]. One such innovative creation is the Question-and-Answer Interface, designed specifically for children. By combining natural language processing and machine learning techniques, this state-of-the-art application provides a dynamic learning environment where students can actively participate in their academic journey.

This application provides a novel interface between students and management / teaching faculty to mutually interact without any physical presence. Natural Language Processing is used in order to understand the zest of question raised and to answer accordingly.

The development of this Question-and-Answer Interface is a response to the growing demand for personalized, interactive learning experiences. As the educational field becomes more diverse, it is essential to cater to a wide range of learning styles and preferences[2]. In addition to addressing the needs of contemporary students, this interface also addresses the limitations of traditional teaching methods, where time constraints often hinder the exploration of specific questions. A study delves into the inception, design, and implementation of an interactive platform that bridges the gap between information creators and knowledge seekers.

By fostering a culture of curiosity and active engagement, this interface allows students to freely ask questions and receive prompt, accurate, and personalized responses[3]. This overview sets the stage for a comprehensive exploration of the Question-and-Answer Interface, highlighting the urgent need for such interactive technologies in today's educational landscape and emphasizing the potential transformative impact on student learning outcomes[4]. As we delve deeper into the inner workings of this groundbreaking platform, we uncover significant implications for pedagogy, cognitive development, and the future of education[5]. Ultimately, this question-and-answer system features an AI chatbot to effectively engage with users.

2 Methodology

2.1. Review of Literature:

Question and Answer Interface for Students

1. *Online Learning Management Systems (LMS)*: Students can ask questions in discussion forums and Q&A sections on platforms like Moodle, Canvas, and Blackboard, and professors or other students can react. These systems are more comprehensive, yet they do include Q&A exchanges.

2. *Educational Chatbots*: There are chatbot applications for education that use natural language processing to respond to questions from pupils[6]. These chatbots can be incorporated into learning platforms or websites for education to give students immediate answers to their questions and interactive learning references.

3. *Peer-to-Peer Learning Platforms*: Students can ask questions and get answers from peers or experts on websites like Stack Exchange, Quora, or specific forums devoted to academic subjects. These platforms enable interactive Q&A even though they are not specifically made for students.

4. *Interactive Learning Apps*: Many educational applications have a Q&A part where users may ask questions and get answers from instructors or experts, especially those geared for test preparation or specific courses.

5. *Virtual Learning Environments (VLEs):* Some academic organizations, including universities, have their own unique virtual learning environments with interactive Q&A capabilities[7]. These are frequently customized to the institution's and its courses' unique demands.

2.2. Proposed Methodology:

In this technological world, humans want to make their work easier and more productive, so they are updating themselves by using different tools machines, robots, etc.

As this, the information plays a crucial part when more accurate results form, then the effective and perfect product will develop[8]. Our system is to design a more user-interactive platform called an interactive question and answering system where the user can know the various answers related to, the domain this query-answering interface has developed with AI integrated chatbot using natural language processing technique with some deep learning concepts.

This proposed system is used to interact with users very effectively both by user-to-user communication and also with user-to-chatbot communication so that users can interact with AI and another user to get an accurate answer[9].

A. Working process:

Step 1: The user should open the question-and-answer query webpage in the browser.

Step 2: If the user is already registered to that website, he/she can log in with the login credentials if not user should go to the register page.

Step 3: In register page it asks whether the user is a student or management of that college.

Step 4: if the user is a student, then the respective details, he/her should be filled if he/her is management then they should fill the respective details and login.

Step 5: then the management will get the secret key so this key helps to answer the student's query this key is only for the management. They will get the key via email or SMS.

Step 6: if the user enters a question it goes to the management portal if the management wants to answer the question, then only it is visible to the local students or user if the user doesn't want to answer the question, they can simply delete that question

so it cannot visible to any user.

Step 7: if the user is not satisfied with the management answer he can ask the chatbot which is specially trained to give any answer about the college or that specific area or field this chatbot will give effective results based on the user query and also suggest a roadmap to that specific area like a location identification[10].

B. Features:

Blueprint: Interactive webpage with an integrated chatbot for college queries, the route map feature plays a crucial role in assisting users. When a user asks about the route map to the hostel, the chatbot can provide a seamless and user-friendly experience. The chatbot should promptly generate and display a visual map with clear directions from the user's current location to the hostel. It should also include relevant landmarks, distances, and estimated travel times. Additionally, the chatbot can offer options for different transportation modes if applicable, such as walking, biking, or public transportation. This feature enhances user satisfaction by simplifying navigation on campus, ensuring students and visitors can easily find their way to the hostel without any hassle.

Virtual campus tour: A Virtual Campus Tour feature is an immersive and informative component of your interactive webpage that allows prospective students, visitors, and even current members of the college community to explore the campus from the comfort of their own devices. Through a combination of interactive maps, 360-degree photos, videos, and detailed descriptions, this feature provides an engaging and visually rich experience. Users can virtually stroll through key locations, academic buildings, dormitories, recreational areas, and other important spots on campus[11]. It serves as an invaluable resource for those considering enrollment, helping them get a feel for the campus layout and facilities even before setting foot on the grounds. This feature not only aids in attracting potential students but also enhances overall accessibility and inclusivity by accommodating those who may not have the opportunity to visit in person.

Feedback and Surveys: The Feedback and Surveys feature is a valuable tool within your interactive webpage and chatbot system that facilitates communication between the college and its community members. It allows students, faculty, and staff to provide feedback, opinions, and suggestions on various aspects of campus life, academics, and services. Users can participate in surveys designed to gather insights on their experiences, helping the institution make data-driven improvements[12]. This feature fosters a sense of inclusion and responsiveness, as it demonstrates the college's commitment to actively listening to the needs and concerns of its stakeholders. It also serves as a mechanism for continuous improvement, enabling the institution to adapt and enhance its offerings based on the valuable input provided by its community members[13].

Campus News and Updates: The Campus News and Updates feature is an integral part of your interactive webpage and chatbot system, keeping students, faculty, staff, and visitors informed about the latest developments, events, and announcements within the college community. It provides a central hub for accessing news articles, press releases, event notices, and important updates directly from the college administration. Users can stay up-to-date on academic achievements, campus initiatives, upcoming events, and relevant campus news. This feature fosters a sense of connectedness and community engagement, ensuring that everyone is well informed about the happenings on campus and can actively participate in events and activities that interest them. It's a vital tool for communication and transparency within the college environment[14].

C. Algorithm for Proposed System:

Certainly, here's the algorithm broken down into step-by-step instructions:

Step 1: User Query

The user enters a query through the interactive webpage.

Step 2: Query Submission

The query is sent from the webpage to the management portal for review.

Step 3: Management Review

In the management portal, management staff can review incoming queries.

Step 4: Management Decision

Management staff decides whether to:

a) Approve the query and provide an answer.

b) Reject the query (no answer will be provided).

c) Mark the query for further review.

Step 5: Answer Approval

If Management approves the query and provides an answer, it is saved in a database or content management system.

Step 6: Display on the Website

Approved queries and their corresponding answers are displayed on the website for users to see.

Step 7: User Feedback

Users can view the answers on the website. If a user is unsatisfied with an answer, they have the option to ask the chatbot the same question[15].

Step 8: Chatbot Interaction

When a user asks the chatbot the same question, the chatbot responds based on the stored answer or interacts with the management portal to request an answer if it has not been previously provided[16].

Step 9: Query Status Tracking

Keep track of the status of each query (approved, rejected, or pending). Store all queries, whether answered or not, in a database for reference.

Step 10: Notification to Management

When a new query is submitted, management staff can receive notifications to review and respond promptly.

Step 11: Regular Review and Updates

Management periodically reviews queries marked for further review and updates answers as necessary to ensure accuracy and relevance.

Step 12: User Notifications

Inform users about the status of their queries (approved, rejected, or pending) through email or notifications on the website.

Step 13: Security and Privacy

Implement strong security measures to protect user data and ensure that only authorized personal can access the management portal.

Step 14: User Authentication

Implement user authentication on the interactive webpage, allowing users to create accounts or log in. This enables personalized interactions, access to query history, and notifications about query status. And the email generation plays a key role in this project, where the secret key only gives you access to answer the question[17].

Step 15: User Profile

Allow users to customize their profiles by providing preferences and settings related to notifications, language preferences, and areas of interest.

Step 16: Knowledge Base Expansion

Periodically update and expand the chatbot's knowledge base to include new information and address emerging queries or topics. So, every time, the data will be updated from time to time, so the answer will be clearer and more accurate[18].
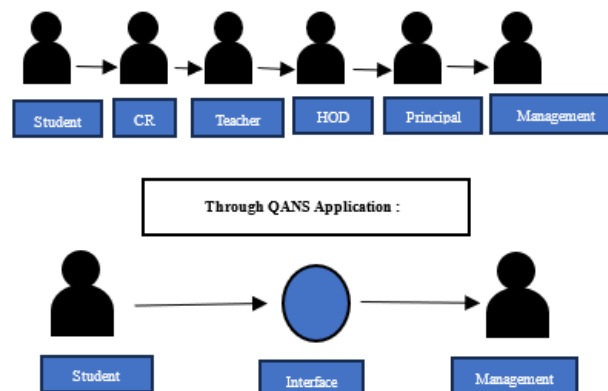
D. Proposed Model:

Fig 1. Proposed model

E. System Architecture:

The block diagrams explain the whole operations of the system. Starts with the user interaction by raising a question to the management portal. The refined query is then forwarded to the management level, where the decision such as Approve / Reject / Further review is taken. If the question isn't answered, it will be marked as unanswered and will be forwarded to the chatbot where the query is processed by the chatbot and the answer is generated and displayed parallelly. The query processing is clearly explained in the below section.
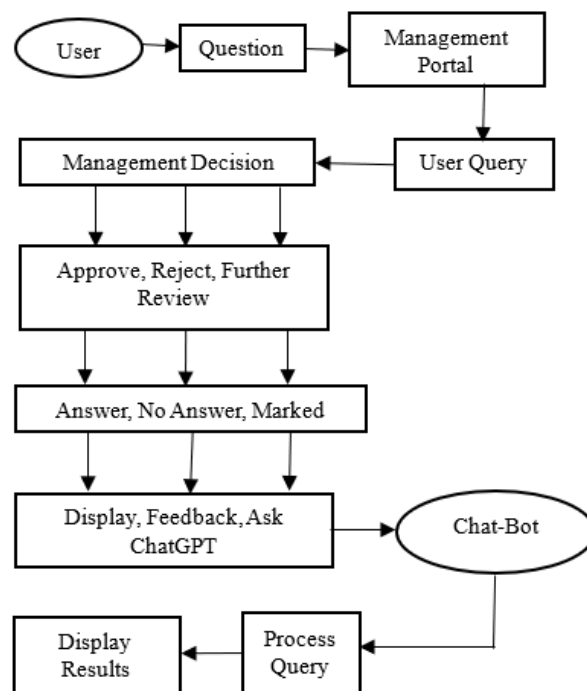
F. NLP Preprocessing Pipeline:
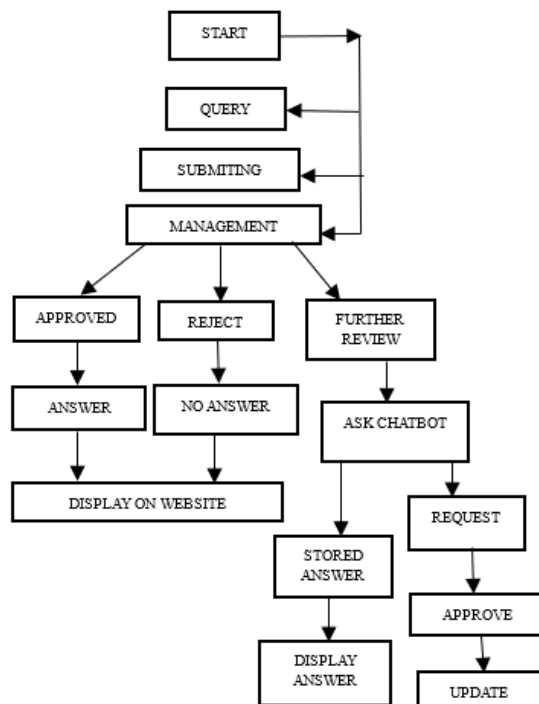
Fig 2. Block Diagram

Fig 3. Workflow Diagram

A Natural Language Processing (NLP) preprocessing pipeline is a critical component in NLP workflows that involves a series of steps to clean, format, and prepare raw text data for analysis or machine learning tasks. This pipeline typically includes tasks such as tokenization, lowercasing, removing stop words, stemming or lemmatization, and handling special characters or symbol recognition[19].
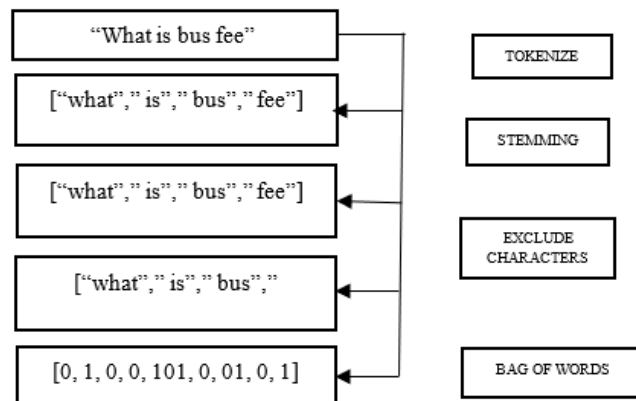

Fig 4. NLP Preprocessing pipeline

Repaired linear unit and softmax activation function formulas, which function as pattern analyzers and match related sequences, are used in chatbot training.

Rectified linear unit Function:

Neural networks use a basic activation function known as the Rectified Linear Unit (ReLU) function. The formula is as follows: $f(x) = max(0, x)$

The formula says as follows: f(x) is the ReLU function's output, x is the input value, and max (0, x) indicates that the output is the maximum of the input value, x, and 0 paired. The outcome is x if x is positive and 0 if x is negative. ReLU is widely used because it adds non-linearity to neural networks and helps effective learning of complex patterns and representations.

SoftMax Function:

For multi-class classification tasks, machine learning and deep learning often use the SoftMax function, a mathematical function. it builds a probability distribution over a number of categories for a vector of real numbers as input.

$$\sigma(\vec{z})_i = \frac{e^{z_j}}{\sum_{j=1}^{k} e^{z_j}}$$

Σ = SoftMax, $\vec{z}$ = input vector

e^{z_i} = standard exponential function for input vector

K = number of classes in the multi-class classifier

e^{z_j} = standard exponential function to output vector

3 Results and Discussions

Comparative study

A. Integrating voice assistance

B. Facial recognizing systems

C. Information passing (Event notifications)

D. Attendance system

E. 2a communication system

1. Multimodal Capabilities: Integrate voice recognition and natural language understanding, allowing users to interact with the chatbot through speech in addition to text.

2. Personalization: Implement machine learning algorithms to personalize responses and recommendations based on the user's historical interactions and preferences.

3. Augmented Reality (AR): Develop an AR feature that uses a smartphone camera to overlay directional information onto the real world, making campus navigation even more immersive and intuitive[20].
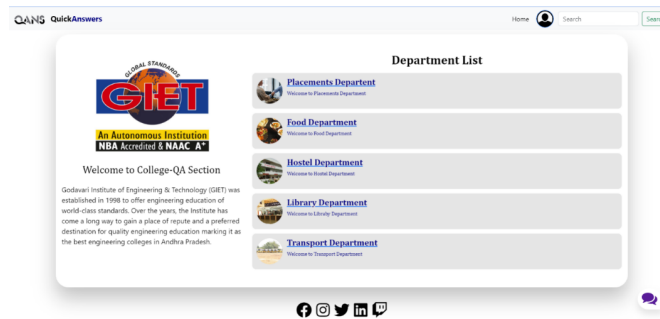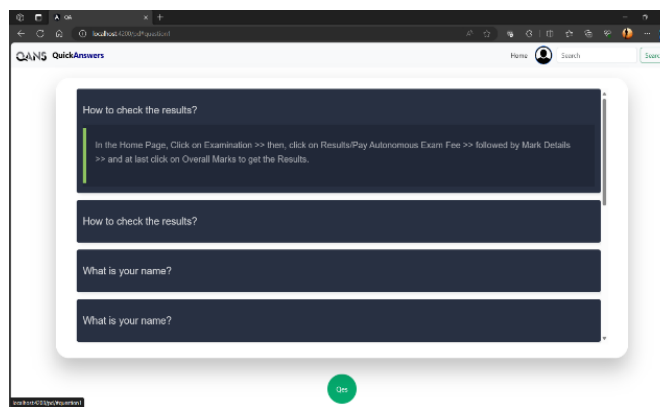
Fig 5. Web interface
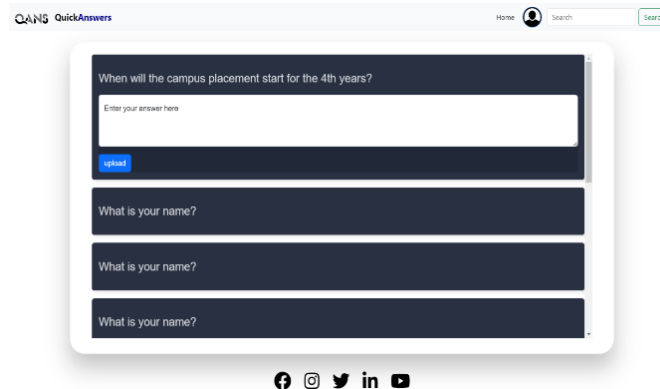

Fig 6. Student portal

Fig 7. Management portal

4. IOT Integration: Incorporate the Internet of Things (IoT) to provide real-time updates on room occupancy, shuttle bus locations, or cafeteria menu availability.

5. Natural Language Generation (NLG): Use NLG to automatically generate informative and contextually relevant responses to a broader range of college-related queries.

6. Chatbot Expansion: Expand the chatbot's capabilities to answer questions related to campus events, news, academic resources, and student services.

7. Data Analytics: Implement data analytics to gain insights into user behaviour, feedback, and frequently asked questions, allowing for continuous improvement of the chatbot and the website.

8. Integration with Smart Devices: Enable users to interact with the chatbot and access campus information through smart speakers, such as Amazon Echo or Google Home.

9. Real-time Updates: Provide real-time notifications for important campus alerts, such as class cancellations, emergency situations, or event reminders.

10. Integration with Academic Systems: Connect the chatbot with the college's academic systems, enabling students to check grades, register for classes, and access course materials.

11. Language Support: Extend language support to cater to international students and non-native speakers, making the chatbot more inclusive.

12. Accessibility Features: Ensure that the webpage and chatbot are fully accessible to users with disabilities, complying with accessibility standards.

13. Community Engagement: Enhance the chatbot to facilitate student and faculty interactions, promote student organizations, and encourage community engagement.

14. Virtual Assistants: Explore the integration of virtual assistants like Siri or Google Assistant to provide a seamless user experience.

15. Collaborations and Partnerships: Collaborate with other departments and institutions to create a comprehensive information ecosystem for students.

Table 1. Comparison between Existing and Proposed model

Existing model	Proposed model
1. Existing models contains either direct interaction or with chatbot.	1. Proposed system is combination of both direct peer-to-peer communication and also chat with AI.
2. Integrates into existing educational settings.	2. Standalone platform not tied to specific institutions.
3. AI is not the primary focus across all systems.	3. Strong emphasis on AI and natural language processing.
4. Relies on a mix of forums, chatbots, and peer interactions.	4. Emphasizes AI chatbot interactions.

4 Conclusion and Future Scope

This project has successfully developed an interactive webpage with an integrated chatbot for college query handling. The system incorporates various features, including query submission, management portal review, dynamic website updates, and chatbot interactions. It enhances user experience by providing real-time information and assistance on college-related queries. The system also prioritizes security, data privacy, and user feedback for continuous improvement. With its user-friendly interface and robust architecture, this project is poised to streamline college information dissemination, foster community engagement, and serve as a valuable resource for students, faculty and visitors. The work can be extended to level beyond the focal point of college or and educational institution to a general level question answering system.

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