

AN INTELLIGENT CHATBOT FOR GOVERNMENT SCHEMES

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Abstract— In today's digital age, the vast amount of online information creates significant challenges for citizens seeking accurate details about government programs. Indian educational initiatives, which focus on promoting learning, skill enhancement, and universal access, require clear communication channels. To address this need, we have created a sophisticated Question and Answer (Q&A) chatbot system designed to deliver precise, pertinent, and swift answers regarding Indian government educational programs. This solution combines advanced Language Learning Models (LLMs) and customized BERT (Bidirectional Encoder Representations from Transformers) technology to understand and deliver contextually appropriate responses. Utilizing Python's robust capabilities for data management and model integration, this platform delivers optimal performance while addressing the linguistic and regional diversity of India's population.

The Q&A system implements LoRA (Low-Rank Adaptation) technology to optimize the BERT model, enabling precise handling of education-related queries. LoRA enables efficient model adaptation with reduced computational requirements, improving its capability to process specific questions about government educational initiatives. The integration of sector-specific information during model optimization ensures more precise and targeted responses, delivering comprehensive answers to user questions..

The platform features a user-friendly interface developed using HTML, CSS, and JavaScript technologies. The frontend connects seamlessly with Django framework, enabling efficient communication between users and the chatbot system, ensuring quick and logical information exchange. The website demonstrates responsive design principles, functioning effectively across various devices and screen sizes. The interface emphasizes simplicity and accessibility.

This advanced chatbot platform marks a crucial step forward in government information distribution, particularly within the education sector. It functions as an accessible and reliable information source, supporting inclusivity through immediate assistance for education-related questions.

Keywords— LLM (Large Language Model), BERT (Bidirectional Encoder Representations from Transformers), LoRA (Low-Rank Adaptation), Q&A Chatbot (Question and Answer Chatbot), Django (High-level Python Web Framework).

I. INTRODUCTION

The education landscape in India has undergone significant transformation recently, with the government introducing multiple initiatives to ensure education reaches all segments of society effectively. Many citizens, particularly those in remote areas or disadvantaged communities, find it difficult to understand these educational programs comprehensively. Technology offers a solution to this challenge. Modern developments in AI and ML technologies enable the creation of smart systems that can

effectively deliver information instantly and accurately. Our AI-powered Q&A chatbot serves this purpose precisely. Built using cutting-edge language technologies including LLM and BERT, this system provides dependable information about India's educational initiatives. The implementation of LoRA for model optimization with scheme-specific information ensures highly accurate and contextual responses, enabling the system to address queries from users across different demographics and knowledge levels.

The system features a well-designed web interface, constructed using HTML, CSS, and JavaScript technologies, with Django handling backend operations. This architecture delivers smooth performance, enabling instant communication and information retrieval. The Django framework not only manages data effectively but also provides flexibility for future expansion and simple maintenance. Users can easily access details about scheme qualifications, application steps, advantages, and important dates through this platform. This intelligent chatbot, powered by sophisticated AI and deep learning systems, serves as an essential tool for improving public understanding of educational opportunities, helping create a better-informed population.

This initiative marks an important advancement in utilizing AI technology to make information about Indian government education schemes more accessible. The chatbot simplifies complex details and provides easy access, helping citizens better understand their educational possibilities. The sophisticated backend system, utilizing LLM and BERT technologies enhanced with LoRA-based optimization, ensures precise and contextual responses to user inquiries, making each interaction valuable.

Django's implementation in the backend structure enables efficient data processing and seamless AI model integration, ensuring sustainable operation and growth potential. The user interface, developed with HTML, CSS, and JavaScript, presents an accessible platform that combines visual appeal with practical functionality, making it suitable for users from all backgrounds. These elements combine to create an effective, user-friendly system that enhances awareness about government education initiatives, supporting the goal of making education accessible throughout India.



Figure 1: Tech Stacks

II. RELATED WORKS

In the paper The implementation of advanced language models, particularly BERT (Bidirectional Encoder Representations from Transformers), has seen widespread adoption in Q&A system development, owing to their exceptional capability in comprehending human language nuances. BERT's strength in contextual analysis enables accurate interpretation of citizen inquiries about various governmental programs. Through specialized fine-tuning approaches such as LoRA (Low-Rank Adaptation), these systems can be efficiently trained on extensive datasets using minimal computational resources, making them particularly suitable for specialized domains like Indian government schemes.

The LoRA fine-tuning methodology enables these models to effectively process specific government-related terminology, abbreviations, and policy language. By introducing minimal additional parameters, LoRA facilitates model adaptation without requiring substantial computational power. This methodology has demonstrated significant success in developing models capable of addressing complex questions about educational policies by comprehending context, meaning, and user objectives.

Given India's rich linguistic landscape, contemporary research has emphasized developing multilingual models capable of understanding and generating responses in various regional languages. Through the fine-tuning of BERT or LLM models for Indian languages using LoRA or similar efficient techniques, researchers strive to enhance accessibility for citizens who don't speak English. This approach ensures wider reach of Q&A systems, promoting more comprehensive distribution of government information.

Django, a powerful web development framework, has proven invaluable in creating Q&A chatbot backends due to its robust scalability, security features, and integration capabilities. Within these systems, Django efficiently manages user interactions, session handling, and API integrations while maintaining the necessary structure and adaptability for processing diverse user queries. Furthermore, Django's ORM (Object-Relational Mapping) streamlines database operations, essential for efficient storage and retrieval of scheme-related information.

The user interface components, constructed using HTML, CSS, and JavaScript, prioritize creating an intuitive and interactive chatbot experience. The interface design emphasizes accessibility across all age groups and technical proficiency levels. Through responsive design principles and JavaScript-enhanced interactivity, the chatbot interface delivers an engaging experience, enabling users to efficiently navigate complex scheme information.

Transformer architectures, including BERT and LLMs, have become increasingly prevalent in public sector applications due to their sophisticated natural language processing capabilities. Contemporary research explores transformers' ability to analyze and interpret extensive government datasets, making them perfectly suited for real-time Q&A applications. These models excel at extracting specific scheme details from text, addressing user queries, and converting complex regulatory information into easily understandable responses.

A crucial consideration in implementing public-facing government information Q&A chatbots is ensuring data security and user privacy. Current research emphasizes the significance of secure data management, particularly considering the sensitive nature of government platform interactions. The implementation of Django's security features and encrypted communication protocols represents industry best practices that strengthen user confidence and ensure regulatory compliance.

Recent developments in machine learning, particularly the integration of Rank-based retrieval models and attention mechanisms, have significantly enhanced the accuracy of these systems' responses. By implementing sophisticated ranking algorithms, the chatbot evaluates potential answers based on contextual relevance, semantic similarity, and overall applicability. This methodological approach minimizes response ambiguity and substantially improves user experience by delivering precise,

scheme-specific information.

The incorporation of adaptive learning algorithms enables the Q&A system to deliver personalized responses based on individual user profiles and interaction histories. For example, users who regularly inquire about educational scholarships automatically receive tailored updates and suggestions about related opportunities. This level of personalization significantly enhances user engagement and satisfaction, establishing the chatbot as an indispensable resource for citizens seeking regular updates on government initiatives.

In the context of government sector Q&A systems, maintaining high accuracy and relevance remains paramount. Contemporary research emphasizes continuous.

In recent years, there has been a significant push towards creating intelligent systems capable of handling specific domains like government education schemes. These systems aim to streamline the process by which citizens access relevant information, thus saving time and reducing dependency on bureaucratic channels. With the help of BERT-based models, these Q&A systems can interpret questions related to policy details, eligibility criteria, application processes, and much more, offering citizens easy access to the information they need.

One of the key factors driving the adoption of AI-powered Q&A systems in the government sector is their ability to scale. Traditional methods of information dissemination, such as call centers and public notices, can be limited by human resources and time. On the other hand, AI-driven systems can handle a large number of queries simultaneously, reducing wait times and improving user experience. This scalability ensures that more people are served efficiently, especially in a country like India, where large populations are often geographically dispersed.

A major area of research has also focused on enhancing the interpretability of machine learning models used in public sector chatbots. While models like BERT and LLM are effective in understanding complex language patterns, they can sometimes lack transparency in how they arrive at their conclusions. Various efforts have been made to incorporate explainable AI techniques, helping users understand why specific answers are provided and how the system processes queries. This approach fosters trust and ensures accountability, especially when dealing with sensitive government information.

Another challenge that arises when creating chatbots for government schemes is the accuracy and timeliness of the information provided. Government policies and schemes undergo frequent changes, and it is crucial for these systems to be regularly updated with the latest data. Some research efforts have incorporated active learning techniques, where the chatbot learns from user feedback and interactions, continuously improving its responses over time. This dynamic adaptation ensures that the information provided by the chatbot remains current and relevant.

While the chatbot may handle a significant portion of queries, it is important to integrate fallback mechanisms that guide users to human support when necessary. This is particularly crucial when the system encounters highly specific or complex queries that require domain expertise. Research in this area has explored hybrid models that combine the strengths of automated systems with human intervention, allowing the chatbot to escalate certain cases to customer support agents when appropriate.

Finally, the future of AI-powered Q&A systems in the government sector may involve more sophisticated natural language understanding capabilities, such as sentiment analysis and emotion detection. By incorporating these features, chatbots could better gauge the user's emotional state, providing empathetic responses when users express frustration or confusion. This advancement would enhance the user experience further, fostering a positive interaction with the government and encouraging citizens to make use of these digital services.

III. PROPOSED SYSTEM

System Overview

The platform utilizes an intelligent Q&A chatbot to deliver precise and pertinent details about Indian government education programs. Users interact with the frontend interface, constructed using HTML, CSS, and JavaScript with Django integration, by submitting queries about educational initiatives. These questions are transmitted to the backend system, where LLM (Large Language Model) and BERT (Bidirectional Encoder Representations from Transformers) technologies collaborate to analyze and comprehend the query context.

The LORA methodology is utilized to fine-tune the pre-trained models, improving their precision and specialization in the government education scheme domain. This optimization ensures the system comprehends specific aspects of scheme-related information, including qualification criteria, advantages, submission procedures, and additional details. Upon receiving a query, the models assess its context and purpose to extract the most applicable information from the available data.

The information repository containing government education scheme details is organized to facilitate effective matching between user inquiries and relevant content. This database comprises structured documentation, frequently asked questions, and comprehensive scheme descriptions. The system leverages BERT's natural language processing capabilities to recognize essential terms and themes within user questions, connecting them to corresponding database information.

After identifying the appropriate information, it undergoes processing and is presented to users in a clear, digestible format. The website's frontend displays these responses, providing comprehensive, accurate, and accessible answers. LLM technology enables conversational response generation, while BERT ensures contextual accuracy in relation to user inquiries.

The process features seamless coordination between frontend and backend components, delivering an efficient user experience. The frontend, built with Django and JavaScript, manages user input collection and result presentation. The backend employs LORA-optimized, fine-tuned LLM and BERT models to process queries, search the database for relevant content, and generate appropriate responses. This comprehensive system ensures users receive current and pertinent information regarding Indian government education schemes.

The system maintains high standards of accuracy and relevance while providing a user-friendly interface for accessing information about educational opportunities. Through the integration of advanced language models and efficient data processing, it serves as a reliable resource for individuals seeking details about government education initiatives in India.

System Architecture

The educational scheme Q&A chatbot for Indian government programs functions through an interactive web platform where visitors can access information about various initiatives. The platform utilizes large language models (LLMs) and BERT, enhanced through Lora fine-tuning techniques. The system's backend evaluates incoming questions by examining user inputs instantly, delivering responses that align with the query's context.

The chatbot's user interface employs HTML, CSS, and JavaScript to create an intuitive and responsive design. Users enter their questions about government education programs in the designated text field, and the interface provides immediate responses, enabling fluid communication. The system integrates Django, a Python web framework, which effectively bridges the frontend and backend components, allowing the chatbot to operate as an embedded tool.

In the backend process, each submitted question undergoes preprocessing to extract key terms and determine purpose. The LLM, trained on extensive text data, processes this input to comprehend the query's meaning. BERT, specifically trained with

government education scheme data, enhances this understanding, ensuring accurate context-based responses.

The Lora fine-tuning process involves model training using specialized information about Indian government education initiatives. This dataset contains comprehensive details about programs, qualification requirements, application steps, and related information. This specialized training ensures the chatbot delivers precise responses specific to educational programs, enhancing its reliability for users seeking details about government initiatives.

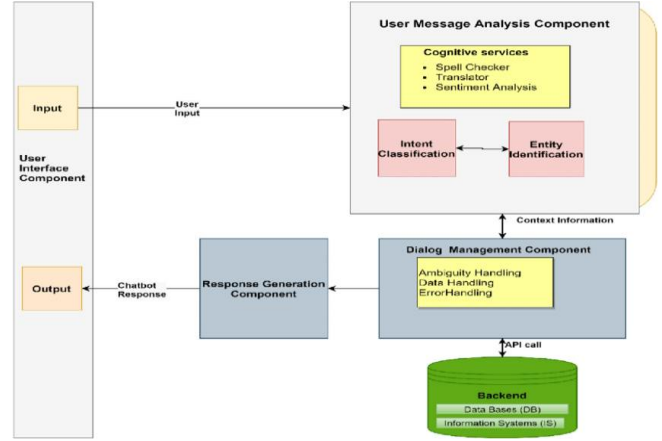


Figure 2: Architecture of the Project

After processing a query, the backend conducts searches using semantic matching methods. The system evaluates the question, scans the fine-tuned database for relevant content, and orders potential answers based on query relevance. This ranking methodology ensures users receive the most appropriate information first.

The platform incorporates a feedback mechanism to enhance response quality over time. Users can indicate when answers are inadequate or unclear, providing input that helps improve the model's understanding and future performance. This continuous feedback loop enables the chatbot to become increasingly accurate and effective.

To summarize, the chatbot's operation combines sophisticated AI models, refinement techniques, and user-centered design. The integration of LLMs, BERT, and Lora fine-tuning allows the system to process complex inquiries about government programs and generate accurate, contextual answers. The architecture ensures smooth coordination between the user interface, data management system, and AI components, efficiently addressing questions about Indian government education schemes.

The chatbot's precision in connecting user inquiries to appropriate datasets relies on advanced NLP methodologies. The Large Language Model, having learned from extensive data sources, comprehends human communication patterns, while BERT excels at interpreting questions within educational contexts. The synergy between these models ensures accurate interpretation of both straightforward and complex queries. This combined methodology delivers superior response quality, providing accurate information across various educational programs.

Django serves as the core framework, optimizing data transmission between frontend and backend components. Its Object-Relational Mapping capabilities facilitate smooth database operations, enabling swift information retrieval and presentation. This structure minimizes response delays, essential for optimal user interaction. The platform's adaptable nature accommodates future expansion as additional government programs enter the database.

The system incorporates sophisticated error management protocols. When encountering queries beyond its knowledge base or failing to identify suitable matches, it provides alternative suggestions or requests additional details. This approach maintains conversational continuity while ensuring comprehensive responses. The backup systems direct users toward queries that align better with the system's capabilities.

Data protection forms a crucial component of the infrastructure. Given the system's handling of confidential user information, particularly regarding government program applications, robust security features are implemented. Information safety is maintained through advanced encryption systems, protected storage solutions, and rigorous verification methods. These safeguards protect user confidentiality throughout all system interactions.

User Interface Design

The website's frontend utilizes HTML, CSS, and JavaScript to deliver a seamless and adaptable user interface. The layout prioritizes clarity, making it straightforward for visitors to browse the platform and find desired information. HTML provides a well-structured content framework, while CSS implements visual enhancements, including fluid animations, balanced color palettes, and accessible layouts. JavaScript enables dynamic features, allowing content updates to occur without page refreshes when users receive responses to their inquiries.

Django functions as the backend infrastructure, establishing a robust foundation for request processing and chatbot operation management. It facilitates efficient communication between the frontend interface and the backend AI model. When users submit questions regarding government education schemes, the frontend captures these queries and transmits them to the backend via HTTP requests. Django then processes this information and generates appropriate responses based on the available dataset.



Figure 3: Q & A Section

The platform incorporates user-friendly features like predictive search suggestions, which anticipate potential queries as users type. This functionality enhances navigation efficiency and helps visitors locate information more effectively. The interface adapts seamlessly across various devices, from desktop computers to mobile phones, ensuring broad accessibility for all users.

A prominent chatbot interface enables users to input questions and receive immediate answers. The system employs sophisticated NLP techniques, leveraging LLM and BERT models to comprehend and analyze user queries. Model fine-tuning through LoRA ensures accurate and contextually appropriate responses specific to government education schemes.

The platform implements comprehensive error-handling systems to maintain smooth operation even when queries are unclear. The chatbot provides helpful suggestions or requests clarification in such situations, helping users formulate more precise questions. This approach ensures continued usefulness and engagement despite potentially ambiguous inquiries.

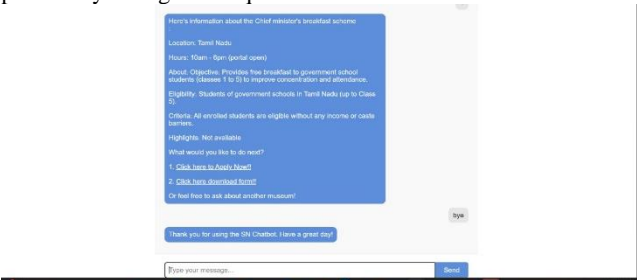


Figure 4: Response Section

Accessibility features include high-contrast text options and keyboard navigation support, accommodating users with visual impairments or other accessibility needs. The website's performance optimization ensures quick loading times despite handling extensive datasets, which is essential for maintaining user engagement.

The interface adopts a streamlined, minimalist design approach, focusing on clear and organized information presentation. The chatbot interface is prominently positioned, allowing users to begin their inquiries immediately without unnecessary complications. The frontend design works in harmony with backend functionality to provide an efficient, responsive, and user-friendly platform for accessing information about

System Workflow

When a visitor interacts with the website and poses a question about government education schemes, the system initiates by recording the query through the user interface developed with HTML, CSS, and JavaScript technologies. The question travels to the backend infrastructure, where Django handles the request and directs it to the AI model for comprehensive analysis. The input undergoes preliminary processing to sanitize and standardize the text, including the removal of extraneous characters and conversion into a format suitable for the language model.

Following pre-processing, the system employs both LLM (Language Model) and BERT (Bidirectional Encoder Representations from Transformers) to examine the text thoroughly. BERT excels at comprehending the contextual nuances and semantic meaning of the question, allowing the system to accurately interpret user intentions even in sophisticated queries. The LLM utilizes its extensive training on comprehensive datasets to construct appropriate responses based on its query interpretation. The implementation of LoRA (Low-Rank Adaptation) fine-tuning enables the model to be customized with sector-specific information, improving its precision and pertinence in addressing questions about government education schemes.

The process then incorporates the retrieval-augmented generation (RAG) model, which explores the pre-established database containing comprehensive details about government education schemes. The RAG model utilizes the question's context to identify pertinent information pieces and guarantees that the response aligns with the most precise data available in the database. This repository encompasses various educational schemes, qualification requirements, application procedures, and benefits, specifically focused on education in India.

After retrieving the relevant information, the system produces a natural language response that specifically addresses the user's inquiry. The answer is formulated by integrating the retrieved data with the model's capability to express it in a coherent manner. This approach ensures that responses are not only relevant but also easily comprehensible for users.

The formulated response returns to the Django backend before being transmitted to the frontend for presentation. The answer appears on the website, delivering the requested information about education schemes to the user. The frontend's design and interface ensure information accessibility, presenting content in a user-friendly format with appropriate styling and interactive elements.

Furthermore, the chatbot provides references to official sources or government portals for additional information, maintaining authenticity and currentness. For subsequent questions or clarification requests, the process repeats, enabling the system to refine its responses based on additional input, ensuring sustained interaction and responsiveness.

To facilitate continuous enhancement, the system records interactions and user feedback. This information supports further model refinement and improvement. Through analysis of common queries and user satisfaction levels, the AI system undergoes retraining or optimization to deliver enhanced responses, becoming more proficient at handling new questions and providing relevant information.

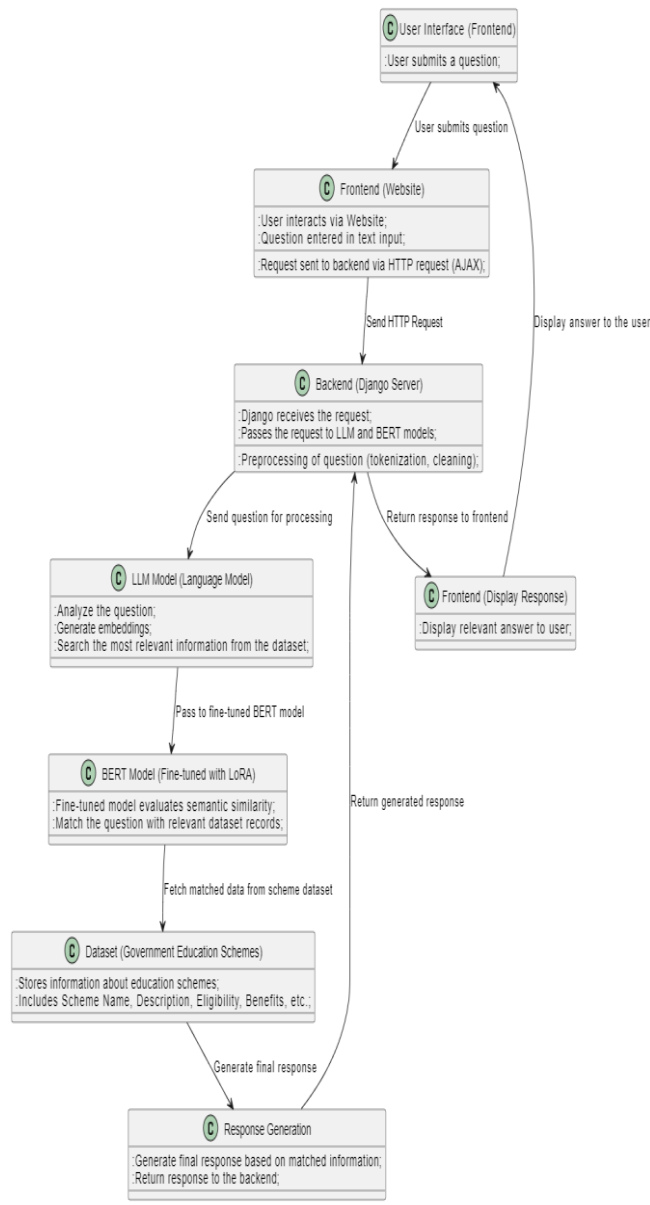


Figure 7: DFD of the Proposed System

IV. WORKING PRINCIPLE

Introduction to System Workflow

The advanced Q&A chatbot created for Indian government education programs aims to simplify information access for citizens. The system incorporates cutting-edge technologies including large language models (LLM), BERT, and LoRA for optimization. This platform enables users to receive precise responses about various educational initiatives from the government, improving accessibility to public services. The integration of these models allows the chatbot to comprehend and handle natural language questions efficiently.

Users can access the chatbot through a website featuring an easy-to-use interface built with HTML, CSS, and JavaScript. The backend system, constructed using Django, manages user queries and transmits them to AI models for processing. Django's implementation in the backend proves valuable due to its capability to efficiently process user requests and communicate with AI models instantaneously.

The system implements a preprocessing phase before sending questions to AI models to ensure response accuracy. This stage involves text standardization and cleanup to prepare it for proper analysis. The processed question then moves to BERT, which evaluates the query's meaning and purpose, leading to more precise interpretations of user questions.

Following BERT's analysis, the LLM processes the input using its extensive dataset training to create appropriate responses. The system employs LoRA for specialized model refinement using sector-specific information. This optimization ensures comprehensive understanding of government education initiatives, resulting in more focused and applicable answers for users.

The platform implements retrieval-augmented generation (RAG) technology to enhance its information extraction capabilities from an existing knowledge repository. This database contains detailed information about government education schemes, covering qualification criteria, advantages, application steps, and other crucial details. RAG implementation enables the system to deliver precise and current information matching user inquiries.

After gathering relevant data, the system creates a natural language response, ensuring clarity and comprehensibility. The answer travels through the Django backend to the frontend interface for display. The user interface features an accessible design, helping citizens obtain necessary information in an easily understandable format.

Algorithm

Step 1: User Query Input

- The user submits a query on the website using a search box or chat interface.

Step 2: Preprocessing the Query

- The query is cleaned by removing stop words, punctuation, and normalizing text for tokenization.

Step 3: Query Vectorization

- The cleaned query is vectorized using a pre-trained language model like BERT or an embedding model to transform it into numerical form.

Step 4: Dataset Matching

- The vectorized query is compared with the dataset of government education schemes using a similarity algorithm, like cosine similarity or nearest neighbor search.

Step 5: Retrieval of Relevant Data

- The most relevant records or entries from the database or knowledge base are retrieved based on the query match.

Step 6: Fine-Tuned Response Generation

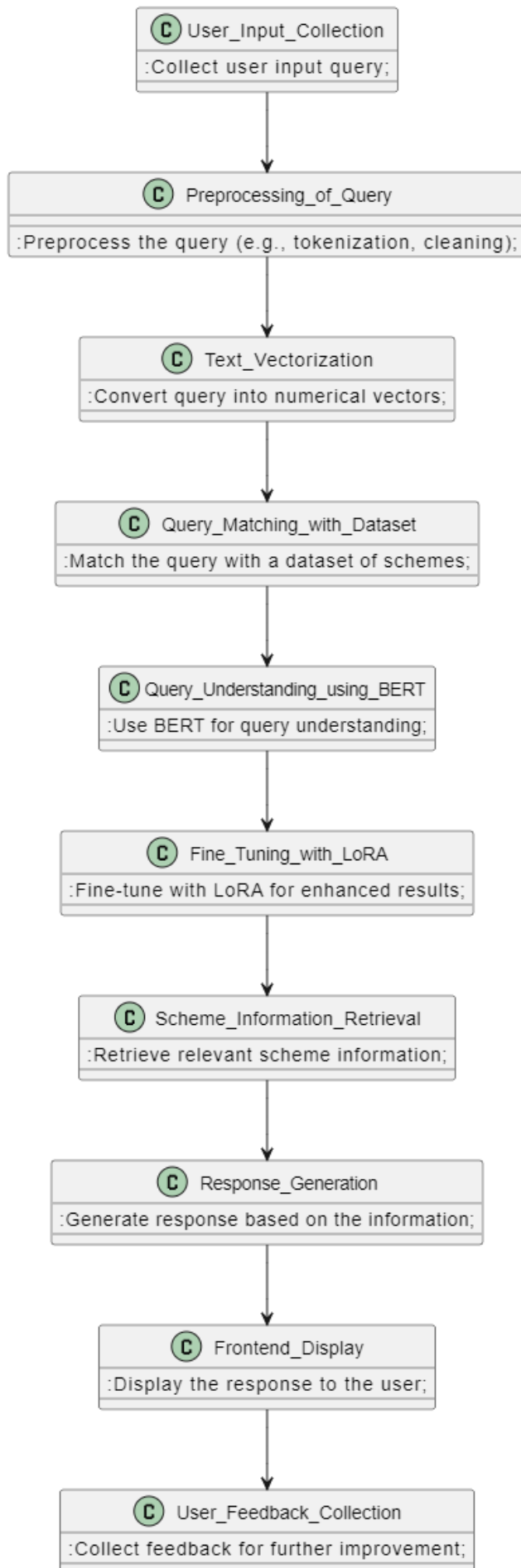
- The relevant information is passed through a fine-tuned LLM model (using LoRA) to generate a detailed, user-friendly response.

Step 7: Response Formatting

- The response is formatted to ensure clarity, coherence, and relevance to the original query before presenting it to the user.

Step 8: Response Delivery

- The response is displayed on the website or sent back to the user through the chat interface, completing the interaction.
- This process ensures that the chatbot provides accurate, contextually appropriate answers based on user



V. RESULT AND CONCLUSION

Result

The implemented smart Q&A chatbot for Indian government education programs combines LLM and BERT architectures to comprehend and analyze user questions. The system uses LoRA for model fine-tuning, improving its precision and performance in handling subject-specific inquiries. Users interact through a web interface, where their questions are analyzed and compared against a curated database of educational program information to generate contextually appropriate answers. The user interface, developed with HTML, CSS, and JavaScript, integrates smoothly with the Django-based backend to display responses interactively. This process ensures users obtain accurate, specific, and current details about government educational initiatives when they submit their questions.

Conclusion

In summary, the AI-powered chatbot effectively combines sophisticated machine learning algorithms with a comprehensive web architecture, delivering a practical and accessible platform for Indian citizens to obtain information about government educational programs. Through the implementation of cutting-edge AI technology for language processing and its integration with a dependable web platform, the system provides precise, relevant answers to diverse user inquiries, creating a smooth experience for individuals researching educational opportunities.

Figure 8: Algorithm of System

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