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Voice Activated Information Assistant for College

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Abstract - This project presents a web-based application for managing and retrieving student, faculty, placement, course, and event details using AWS DynamoDB as the backend database. The system integrates a chatbot with voice interaction functionality, allowing users to fetch information efficiently. The chatbot processes queries by searching records in DynamoDB and utilizing FAISS (Facebook AI Similarity Search) for fast and accurate retrieval. The Sentence Transformers model (all-MiniLM-L6-v2) is employed to enhance query matching, ensuring relevant results. The frontend is developed using HTML, CSS, JavaScript, and Bootstrap, providing an interactive and user-friendly experience. Users can navigate through different sections via dedicated icons for students, faculty, placements, events, and courses, each supporting filtering options for refined searches. Additionally, the chatbot facilitates voice-based interactions using browser speech recognition and text-to-speech features, enhancing accessibility and ease of use. The integration of cloud-based storage with efficient retrieval mechanisms ensures scalability and improved performance, making the system a reliable solution for educational institutions.

Key Words: AWS DynamoDB, FAISS, Chatbot, Sentence Transformers, Voice interaction.

1. INTRODUCTION

In today's digital world, voice assistants have transformed the way we interact with technology. Over the decades, computing has evolved from mainframe computers (1977) to desktops (1987), the internet (1997), mobile computing (2007), and now voice-enabled assistants (2017). This shift highlights the increasing demand for hands-free, intelligent, and efficient interaction with digital systems. In the fast-paced educational environment, quick and reliable access to academic information is crucial for students and faculty. Traditional methods of retrieving data can be time-consuming and inefficient. Educational institutions require efficient systems to manage and retrieve vast amounts of student, faculty, placement, course, and event information. Traditional database management systems often struggle with scalability, speed, and ease of access. To address these challenges, this project introduces a web-based application that integrates cloud storage, a chatbot, and voice-based interactions to provide seamless information retrieval.

Fig -1: Timeline and icons of various voice assistants

2. CHATBOT WITH VOICE FEATURE

The advancement of artificial intelligence and cloud computing has significantly transformed the way information is accessed and processed. Voice-enabled chatbots have become a crucial component in modern applications, providing hands-free, interactive, and efficient solutions for various domains, including education. A chatbot with a voice feature is an advanced conversational AI system that interacts with users through both text and voice commands. Unlike traditional chatbots that rely solely on text-based communication, voice-enabled chatbots allow users to speak their queries and receive spoken responses, making interactions more natural and intuitive. It integrates speech recognition to convert spoken words into text, processes the query using Natural Language Processing (NLP) or a predefined database, and then responds using text-to-speech (TTS) synthesis, allowing the chatbot to speak its reply. This enhances user experience by making interactions more natural and hands-free.

Voice-enabled chatbots have significantly transformed human-computer interaction by making communication more intuitive and efficient. Unlike traditional text-based interfaces, voice-based assistants provide seamless, hands-free, and real-time interactions, benefiting various domains, including education, healthcare, customer service, and business automation.

3. LITERATURE REVIEW

The evolution of artificial intelligence and speech recognition has led to the widespread adoption of voice-enabled chatbots, significantly transforming the way users

interact with digital systems. Traditional text-based chatbots required manual input, which could be time-consuming and less intuitive. To enhance accessibility and efficiency, several well-known voice assistants have been developed, including Siri, Google Assistant, Alexa, and Cortana. These assistants use advanced natural language processing (NLP) techniques and machine learning algorithms to understand and respond to user queries effectively. They have demonstrated the feasibility of voice interaction for various applications, including task management, information retrieval, and home automation.

Apart from these general-purpose voice assistants, several other models have been used in voice-enabled applications. BERT-based models help in understanding context more accurately, while T5 and GPT-based models enhance text generation and conversational abilities. Open-source frameworks like Rasa allow customization of voice assistants for specific domains. Many existing chatbots rely on relational databases like MySQL and SQLite for structured data storage. However, these databases may not be efficient when handling large datasets or complex queries in real-time environments.

To overcome these limitations, this project introduces a voice-activated information assistant tailored for educational institutions. It utilizes Amazon DynamoDB for scalable cloud storage, ensuring quick and efficient access to student, faculty, placement, and event details. The integration of FAISS (Facebook AI Similarity Search) enables fast and accurate retrieval of information, while sentence transformers improve the chatbot's ability to understand user intent beyond keyword matching. Additionally, browser-based speech recognition and synthesis enhance accessibility by enabling hands-free interaction. This system provides a more efficient and user-friendly way of accessing academic information, reducing the time required for students and faculty to retrieve relevant details.

Table -1: Comparison of existing model and proposed model

Feature	Existing models	Proposed model
Primary use case	General-purpose voice assistants (Siri, Google Assistant, Alexa, Cortana) and educational chatbots	Academic voice assistant for retrieving student, faculty, course, placement, and event details
Voice Interaction	Yes, used for general queries & commands	Yes, it is designed specifically for educational queries
Model Used	BERT (Bidirectional Encoder Representations from Transformers**)**, and other models	Sentence Transformers (MiniLM) & FAISS (Facebook AI Similarity Search) Index
Database Used	Cloud-based storage, MySQL, SQLite	Amazon Web Services DynamoDB (NoSQL)

4. PROPOSED SYSTEM

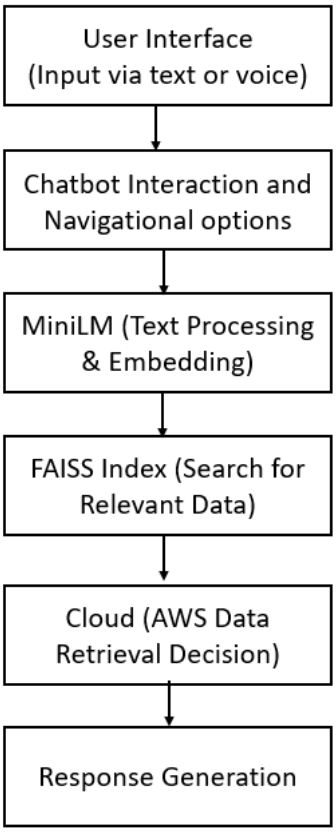

Fig -2: Proposed work flow

4.1 WORKING

The voice-activated chatbot application is designed to provide quick and efficient access to academic information for students and faculty using speech and text inputs. The user initiates a query either by typing or speaking, with the browser's SpeechRecognition API converting voice input into text. The query is then processed using Sentence Transformers (MiniLM), which converts it into a numerical vector representation. This vector is passed to FAISS (Facebook AI Similarity Search), which performs a high-speed similarity search to find the most relevant information stored in AWS DynamoDB. If a match is found within the predefined similarity threshold, the corresponding details are retrieved and formatted into a structured response. If no relevant match is found, the system may utilize external APIs like OpenAI to generate a response. The output is then displayed on a Bootstrap-based user interface and optionally converted into speech using the SpeechSynthesis API, enabling voice-based responses.

The frontend page is designed using HTML, CSS, and Bootstrap to provide a user-friendly and interactive experience. It consists of a navigation bar with icons that allow users to access different sections, including student details, faculty information, courses, placements, and events. Each section retrieves relevant details from DynamoDB and includes a filter option, enabling users to search for specific records based on parameters like name, branch, or year. The chatbot interface is seamlessly integrated into the application, allowing users to

interact using both voice and text. It provides instant responses by fetching the required data and ensuring an efficient information retrieval process. The combination of a structured navigation system, filtering options, and AI-powered chatbot enhances the accessibility and usability of the application in an educational setting.

4.2 SENTENCE TRANSFORMERS (all-MiniLM-L6-v2)

Sentence Transformers is a deep learning-based model designed to convert textual queries into dense vector representations. all-MiniLM-L6-v2 is a pre-trained machine learning model from the Sentence Transformers library. It is used to convert text (like user queries or database records) into numerical vectors, also called embeddings. When a user types or speaks a query, the sentence is converted into an embedding using all-MiniLM-L6-v2. This embedding is a 384-dimensional vector, representing the meaning of the sentence. These embeddings are then used to search in the FAISS index to find the most relevant data.

1.Architecture: MiniLM (Minimal Language Model) is a compact transformer model trained using knowledge distillation from larger transformer models like BERT. L6 indicates that the model has 6 layers, making it smaller and faster than traditional BERT-based models. v2 signifies an improved version, fine-tuned on large datasets to enhance sentence embeddings.

2. Capabilities: It Converts input text into a fixed-size vector representation. Captures semantic meaning rather than just keyword-based matching and efficient in processing large-scale similarity search and retrieval tasks.

3. Benefits: The all-MiniLM-L6-v2 model is a lightweight transformer designed for fast and efficient text processing. It enables accurate semantic search, making it ideal for chatbot interactions. Integrated with FAISS, it helps retrieve student, faculty, and event details from AWS DynamoDB. Its low computational cost ensures smooth and responsive performance, improving user experience in real-time queries.

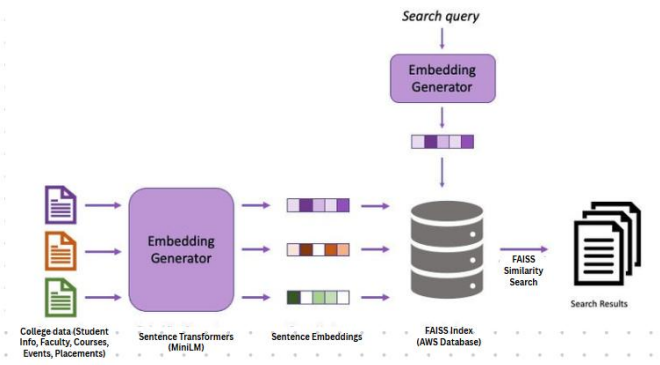

Fig -3: Semantic Search Workflow

4.3 FAISS INDEX

FAISS (Facebook AI Similarity Search) is a library developed by Meta's AI Research lab that's designed for efficient similarity search and clustering of dense vectors. In simpler terms, it's a tool that helps to quickly find data points that are similar to each other within a large dataset.

1.Dense Vectors: FAISS works with dense vectors, which are numerical representations of data points. These vectors capture the essential features of the data, allowing for comparisons of similarity. Sentence Transformers (MiniLM) is used to convert text data (student information, faculty details, etc.) into dense vectors (sentence embeddings). These sentence embeddings are then stored in a FAISS index.

2. Similarity search: The core function of FAISS is to perform similarity searches. Given a query vector, FAISS efficiently finds the vectors in a dataset that are most similar to it. For example, When a user asks a question, the application converts the question into a sentence embedding. FAISS then quickly searches the index to find the sentence embeddings that are most similar to the query embedding. This allows the application to retrieve the most relevant information in response to the user's question.

3. The FAISS index: A FAISS index is a data structure that organizes the dataset's vectors in a way that enables fast similarity searches. Instead of comparing the query vector to every single vector in the dataset (which would be very slow for large datasets), FAISS uses indexing techniques to narrow down the search to a smaller subset of vectors. FAISS offers a variety of indexing methods, each with different trade-offs between speed, accuracy, and memory usage.

4. Benefits: FAISS is optimized for speed, allowing for real-time similarity searches even on massive datasets. It can handle datasets exceeding available RAM, making it suitable for large-scale applications. FAISS provides options for both exact and approximate nearest neighbor (ANN) searches, allowing for a balance between speed and accuracy based on application requirements.

4.4 CLOUD STORAGE WITH AMAZON DYNAMODB

Cloud integration plays a crucial role in enhancing the scalability, accessibility, and efficiency of this voice-activated chatbot application. By leveraging cloud services, the system ensures seamless data storage, retrieval, and processing, making it more reliable and efficient.

The application uses Amazon DynamoDB, a fully managed NoSQL database service provided by AWS, designed for high availability, scalability, and low-latency performance. In this application, DynamoDB plays a crucial role in storing and managing faculty, student, placement, course, and event details efficiently. Unlike traditional relational databases like MySQL or SQLite, DynamoDB offers a flexible schema, enabling quick data retrieval using key-value access patterns.

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DynamoDB allows the chatbot to fetch relevant details dynamically based on user queries. The navigation icons in the frontend leverage DynamoDB's filtering and query capabilities, allowing users to retrieve information based on specific attributes like branch, name, or roll number. Additionally, DynamoDB seamlessly integrates with FAISS indexing to enhance the speed of similarity searches by linking vector embeddings with stored records.

One of the key advantages of DynamoDB is its auto-scaling and high availability, ensuring smooth operation even under heavy workloads. As a serverless database, it eliminates the need for manual maintenance, making it an ideal choice for cloud-based applications. Security is ensured through AWS IAM roles and encryption, keeping sensitive educational data safe. With its ability to handle large volumes of structured and semi-structured data, DynamoDB significantly enhances the performance and reliability of this voice-based chatbot application.

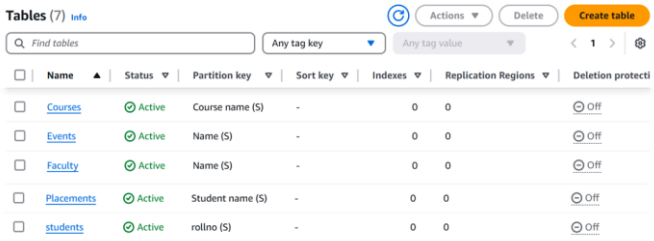

Fig -4: Tables created in AWS DynamoDB

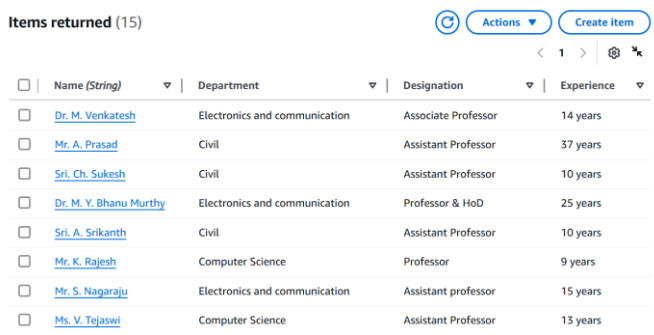

Fig -5: Items in faculty table

5. RESULT

1. Homepage: The system presents a clean, user-friendly web interface with clear navigation. It organizes the information into key categories: Students, Faculty, Courses, Events, and Placements. These are the icons for navigating to different sections. Clicking on any of these icons takes the user to a separate page where they can view and filter detailed information. It aims to provide easy access to essential information for students, faculty, and visitors.

Fig -6: User interface

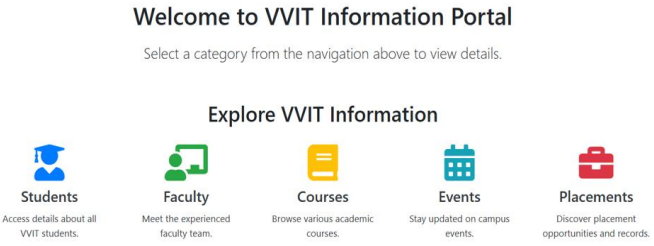

Fig -7: Navigational icons

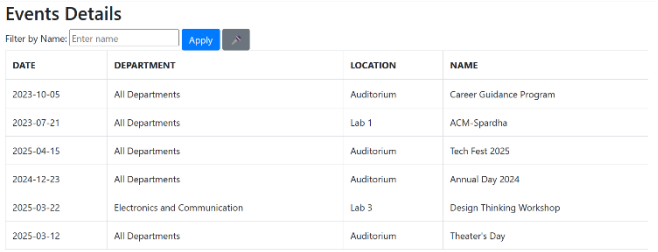

Fig 8-: Filterable Event Details Table (Voice/Text Input)

2. FAQs and Contact Information: The system includes a Frequently Asked Questions (FAQs) section to address common user queries. It provides contact information for the institute, including address, phone numbers, and email. It also contains a chatbot icon, that allows for an interactive support feature.

Fig -9: Footer section

3. Chatbot: The system features a chatbot that can retrieve and display specific information based on user queries. It supports both text and voice input. It presents information in a structured and readable format. It is able to retrieve student placement information.

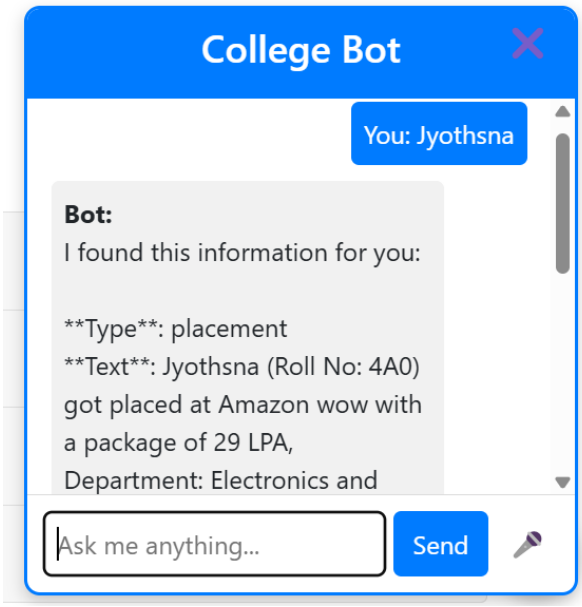

Fig -10: Chatbot

6. CONCLUSIONS

In conclusion, this voice-activated information assistant enhances information retrieval in educational institutions by integrating speech recognition, FAISS indexing, and AWS DynamoDB. The use of all-MiniLM-L6-v2 ensures efficient query processing, enabling quick and accurate responses. The application's frontend design, featuring navigational icons and filter options, allows users to seamlessly explore data related to students, faculty, courses, placements, and events. This eliminates the need for manual searches and significantly improves accessibility.

The chatbot's ability to handle both text and voice inputs makes it highly user-friendly, catering to a diverse audience. It streamlines information retrieval, reducing response time and improving efficiency in educational institutions. The integration of FAISS indexing further optimizes search operations, ensuring rapid and precise responses to queries. Overall, this project successfully demonstrates how semantic search, machine learning models, and voice-enabled chatbot technology can enhance information systems in educational institutions.

Future enhancements could include multilingual support, integration with additional cloud databases, and advanced NLP models for even more refined responses. By leveraging AI and cloud computing, this system sets a strong foundation for future advancements in smart education technology.

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