A

Major Project

On

AI-BASED FAQ CHATBOT WITH VOICE ASSISTANCE

(Submitted in partial fulfillment of the requirements for the award of Degree)

BACHELOR OF TECHNOLOGY

In

COMPUTER SCIENCE AND ENGINEERING

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

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April, 2025.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project entitled "**AI-BASED FAQ CHATBOT WITH VOICE ASSISTANCE**" being submitted by **B. Baskar Raju (217R1A0513), B. Narsimha (217R1A0507) & S. Vinayak (217R1A0554)** in partial fulfillment of the requirements for the award of the degree of B.Tech in Computer Science and Engineering to the Jawaharlal Nehru Technological University Hyderabad, during the year 2024-25.

The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

This project is titled as “AI-Based FAQ Chatbot with Voice Assistance”. The chatbot is designed to provide instant and accurate responses to user queries, enhancing accessibility and user experience. By incorporating natural language processing (NLP) techniques, the system can understand and interpret user input with high accuracy, ensuring relevant and context-aware answers.

One of the key features of this chatbot is its voice assistance capability, which allows users to interact with the system using spoken language, making it more convenient for individuals with disabilities or those who prefer voice-based interactions. The chatbot supports text-to-speech (TTS) and speech-to-text (STT) technologies, enabling seamless communication between the user and the system.

This AI-driven chatbot can be integrated into various domains, including customer support, education, healthcare, and e-commerce, to streamline information retrieval and reduce human intervention. It is designed to continuously learn and improve over time through machine learning algorithms, ensuring better responses and enhanced efficiency.

Additionally, the system can be deployed on multiple platforms, such as websites, mobile applications, and smart assistants, making it highly versatile and accessible. By automating FAQ handling, the chatbot significantly reduces response time, improves user engagement, and enhances overall customer satisfaction.

Furthermore, the chatbot is designed to be highly adaptable, allowing administrators to customize and update the FAQ database based on user needs and evolving requirements. Through continuous learning and AI-driven enhancements, the system can refine its responses and expand its knowledge base over time. The integration of advanced speech recognition and natural language understanding ensures that the chatbot can process complex queries with greater accuracy, making interactions more seamless and intuitive. Additionally, the chatbot is equipped with multilingual support, enabling users from diverse linguistic backgrounds to access information effortlessly. By reducing the dependency on human support agents, the system not only enhances operational efficiency but also minimizes costs for businesses. With its user-friendly interface, intelligent response generation, and scalable architecture, the AI-Based FAQ Chatbot with Voice Assistance represents a significant step forward in automated query resolution, setting new standards in digital assistance and customer interaction.

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1. INTRODUCTION

1. INTRODUCTION

In today's digital era, artificial intelligence (AI) has revolutionized the way businesses and users interact with technology. One of the most significant advancements in AI-driven communication is the development of intelligent chatbots, which provide automated responses to user inquiries. The **AI-Based FAQ Chatbot with Voice Assistance** is designed to enhance user experience by offering instant, accurate, and context-aware responses to frequently asked questions (FAQs). By integrating natural language processing (NLP) and speech recognition technologies, the chatbot enables seamless text and voice-based interactions, making it a powerful tool for customer support, education, healthcare, and various other industries. This system not only improves accessibility but also reduces response time, ensuring efficient query resolution without the need for human intervention.

The addition of voice assistance further enhances the chatbot's usability by allowing users to communicate through speech, making it convenient for individuals who prefer verbal interactions or have difficulty using text-based interfaces. The chatbot utilizes speech-to-text (STT) and text-to-speech (TTS) technologies to facilitate natural, conversational communication. Moreover, it is designed to continuously learn and improve through machine learning algorithms, ensuring that responses become more refined over time. The chatbot can be deployed across multiple platforms, such as websites, mobile applications, and smart assistants, making it highly versatile. By automating FAQ handling and enhancing user engagement, this AI-driven system offers a cost-effective, scalable, and intelligent solution to streamline information retrieval and improve overall service efficiency.

1.1 PROJECT PURPOSE

The purpose of the AI-Based FAQ Chatbot with Voice Assistance project is to develop an intelligent system that can efficiently handle frequently asked questions (FAQs) through both text and voice interactions. By integrating voice recognition and natural language processing (NLP) technologies, the chatbot aims to provide a seamless, interactive experience for users seeking information. This project enhances accessibility by allowing users to engage with the system using voice commands, making it ideal for environments where typing is inconvenient, such as mobile devices, home assistants, or customer service centers. The goal

is to improve user experience, reduce response time, and provide accurate, real-time answers to common queries.

1.2 PROJECT FEATURES

Natural Language Processing (NLP): The chatbot is equipped with advanced NLP capabilities, enabling it to understand and interpret user queries expressed in natural language. This enhances the conversational aspect and allows users to interact with the chatbot as if they were conversing with a human agent.

FAQ Repository: The system is integrated with a comprehensive FAQ repository that contains information about common queries, procedures, and relevant details. The chatbot leverages this repository to provide accurate and timely responses to user inquiries.

Voice Assistance: Users have the option to interact with the chatbot using voice commands. The voice assistance feature incorporates automatic speech recognition (ASR) technology to convert spoken language into text, allowing the chatbot to process and respond to voice-based queries.

Multi-Platform Integration: The chatbot is designed for multi-platform integration, making it adaptable for use on websites, mobile applications, and other digital platforms. This ensures a seamless user experience across various channels.

Learning and Adaptation: The system incorporates machine learning algorithms to continuously learn from user interactions. This adaptive learning enables the chatbot to improve its responses over time, ensuring that it stays relevant and effective in addressing user queries.

2. LITERATURE SURVEY

2.LITERATURE SURVEY

The development of chatbots has a long history, but the integration of artificial intelligence into these systems has only become a prominent research area in recent years. Early chatbot systems, like ELIZA and ALICE, were primarily rule-based and could only respond to predetermined patterns of input. These systems lacked the flexibility to handle diverse or unexpected queries and could not evolve over time. However, with the emergence of machine learning and, more recently, deep learning, chatbots have become far more intelligent, capable of understanding complex user queries and providing relevant answers.

Recent advancements in Natural Language Processing (NLP) have significantly contributed to the improvement of AI-based chatbots. NLP techniques like tokenization, part-of-speech tagging, syntactic parsing, and semantic analysis are now commonly used to help chatbots better understand user queries and respond more appropriately. For instance, a study by Vaswani et al. (2017) introduced the transformer architecture, which revolutionized NLP tasks by enabling models like GPT-3 and BERT to generate more accurate, context-aware responses. These transformer-based models leverage attention mechanisms to consider the entire context of a sentence, making them highly effective in understanding complex queries and maintaining coherent conversations.

Furthermore, the advent of machine learning and deep learning has enabled chatbots to learn from interactions with users. These systems do not rely solely on pre-programmed responses but improve by observing patterns and behaviors over time. In 2018, the introduction of reinforcement learning (RL) provided another dimension to chatbot capabilities. Chatbots trained with RL can refine their responses based on user feedback, ensuring that the system's performance improves continuously. On the voice assistance front, Automatic Speech Recognition (ASR) technologies have seen tremendous advancements. Earlier ASR systems required users to speak in a structured format, with limited vocabulary and simple commands. However, modern ASR systems, powered by deep neural networks, can now recognize natural speech patterns and a broader range of accents and dialects. For example, systems like Google Assistant and Apple's Siri use advanced speech-to-text algorithms, transforming spoken words into written text for further processing. These systems use deep learning techniques like Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) networks to interpret and process continuous speech data. The integration of

ASR with NLP models creates chatbots that can process both written and spoken queries, enabling users to interact with systems more naturally.

A study by Bhatia and Gupta (2019) highlighted the role of voice-based AI chatbots in enhancing customer experiences in various sectors, particularly in e-commerce, where customers could ask for product recommendations, check order statuses, or even complete transactions using voice commands. In healthcare, AI-based chatbots with voice assistance have been deployed for purposes such as patient monitoring, appointment scheduling, and medical consultations. The ability of voice-activated systems to interact hands-free has proven beneficial for patients with mobility issues, allowing them to access healthcare services effortlessly. Zhao et al. (2021) demonstrated how voice-enabled chatbots are helping patients retrieve medical information, receive post-discharge instructions, and even request prescriptions, all through voice interactions. This combination of voice recognition and NLP technology has also been applied to virtual assistants for elderly care, where patients can ask questions about their medications or seek emergency assistance.

While these advancements have significantly improved the utility of voice-activated chatbots, challenges remain. The ability of chatbots to understand regional accents, noisy environments, and speech variations across demographics is still a work in progress. Moreover, maintaining context across multi-turn conversations is a persistent issue. As noted by Bender et al. (2020), the complexity of human language, including sarcasm, idioms, and ambiguous queries, requires a more sophisticated understanding that current models are still working towards achieving.

2.1 REVIEW OF RELATED WORK

The development of AI-powered chatbots with voice assistance has been a significant research area in artificial intelligence (AI) and natural language processing (NLP). Various approaches have been explored to enhance chatbot efficiency, from rule-based models to advanced deep learning frameworks. This review discusses previous research and existing methodologies, highlighting their strengths and limitations.

1. Traditional Chatbot Systems

Early chatbot models, such as ELIZA and ALICE, relied on rule-based techniques using predefined scripts and pattern-matching algorithms. These systems followed a strict set of

rules and responded to specific inputs but lacked contextual understanding and adaptability. While effective for simple queries, they struggled with handling dynamic, conversational interactions and could not provide personalized or evolving responses over time.

2. Machine Learning-Based Chatbots

With advancements in machine learning, researchers introduced statistical and classification-based models for chatbot development. Techniques such as Support Vector Machines (SVM), Decision Trees, and Naïve Bayes classifiers were employed to improve intent recognition. These methods used handcrafted features extracted from text data, including word embeddings, term frequency-inverse document frequency (TF-IDF), and n-grams. However, machine learning-based chatbots often required extensive manual feature engineering and lacked the ability to understand complex or ambiguous queries effectively.

3. Deep Learning-Based Approaches

The emergence of deep learning significantly transformed chatbot capabilities, particularly in intent detection and response generation. Convolutional Neural Networks (CNNs) have been utilized for text classification tasks, while Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), and Gated Recurrent Units (GRUs) have been employed for sequence modeling, improving the chatbot's ability to maintain conversational context.

Pre-trained language models like Word2Vec, GloVe, and FastText have enhanced word representations, enabling chatbots to understand synonyms, semantics, and sentence structures more accurately. The Seq2Seq (Sequence-to-Sequence) models further improved chatbot responses by allowing them to generate context-aware answers instead of relying on predefined responses.

4. Transformer-Based Chatbots and Attention Mechanisms

Recent advancements in NLP have led to the adoption of Transformer-based architectures, such as BERT, GPT-3, and T5, for chatbot development. These models utilize self-attention mechanisms, allowing chatbots to process and understand long-range dependencies in conversations.

Transformer-based chatbots outperform traditional models by enabling better contextual understanding, coherent dialogue generation, and improved sentiment analysis. The integration of attention mechanisms enhances chatbot responsiveness by focusing on the most relevant words in a user's query, leading to more accurate and meaningful interactions.

5. Voice Assistance and Speech Recognition in Chatbots

The incorporation of Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) technologies has enabled chatbots to process spoken queries and provide voice-based responses. ASR models, powered by deep neural networks (DNNs), Recurrent Neural Networks (RNNs), and LSTMs, have improved speech recognition accuracy by handling various accents, noise variations, and natural speech patterns.

Modern speech-enabled AI assistants like Google Assistant, Amazon Alexa, and Apple Siri leverage deep learning and transformer-based models to enhance voice-based interactions. However, challenges persist in understanding regional accents, speech disfluencies, and maintaining context across multi-turn conversations.

6. Comparison with the Proposed Approach

While existing chatbot technologies have demonstrated significant improvements in NLP and voice recognition, challenges remain in handling ambiguous queries, ensuring real-time processing, and reducing conversational errors. The proposed AI-Based FAQ Chatbot with Voice Assistance builds upon previous research by integrating:

- BERT and GPT-based models for advanced NLP processing
- BiLSTM with attention mechanisms to improve contextual understanding
- Efficient ASR and TTS technologies for high-accuracy voice interactions
- Adaptive learning mechanisms to refine responses based on user feedback

This review highlights the evolution from rule-based systems to transformer-based chatbots, emphasizing improvements in accuracy, scalability, and user experience. The proposed methodology aims to address the limitations of existing approaches by delivering a highly responsive, interactive, and intelligent AI-driven FAQ chatbot with voice assistance.

2.2 DEFINITION OF PROBLEM STATEMENT

The primary goal of this project is to develop an AI-Based FAQ Chatbot with Voice Assistance that can efficiently handle user queries by providing accurate, real-time responses in both text and voice formats. This involves implementing advanced natural language processing (NLP) techniques for understanding user queries, integrating voice recognition and speech synthesis for seamless interaction, ensuring context retention across multi-turn conversations, and improving the chatbot's adaptability to diverse domains. By addressing these challenges, the system aims to enhance user accessibility, improve response accuracy, and provide an intuitive and interactive experience for users seeking information through AI-driven automation.

2.3 EXISTING SYSTEM

The existing system may involve traditional FAQ pages on websites or manual customer service processes where users need to navigate through static information or contact support agents via email or phone calls. This system lacks interactivity and may lead to longer response times, limited accessibility, and inconsistent user experiences.

- **Interaction Limitations:** Users are limited to text-based interactions, typically through web browsers, which may not cater to users preferring spoken communication.
- **Lack of Personalization:** Responses are static and not personalized to individual user preferences or context, leading to a generic user experience.
- **Manual Support Processes:** Human support agents handle inquiries, leading to delays in response times and potential inconsistencies in the information provided.
- **Accessibility Challenges:** Users with disabilities may face challenges accessing information or communicating with support agents.

Limitations of Existing System

Despite advancements in AI-based chatbots and voice assistants, the existing system faces the following challenges:

- Contextual Understanding Limitations: The chatbot may struggle with complex, ambiguous, or multi-turn conversations, leading to incorrect or incomplete responses. Maintaining long-term context remains a challenge, especially in voice-based interactions.

- Speech Recognition Accuracy: Voice assistance relies on Automatic Speech Recognition (ASR), which may misinterpret words due to accent variations, background noise, or unclear pronunciation, affecting the chatbot's accuracy.
- Limited Domain Adaptability: While trained on a specific dataset, the chatbot may fail to generalize well to new topics or domains, requiring frequent updates and retraining for improved performance.
- Dependency on Large-Scale Data: Deep learning models for NLP require large, high-quality datasets for training, and a lack of diverse datasets may reduce the chatbot's ability to provide relevant and precise responses.
- Computational Overhead: Running transformer-based models (e.g., BERT, GPT) requires high processing power and memory, making real-time response generation computationally expensive, particularly on edge devices.
- Lack of Emotion and Sentiment Recognition: The chatbot may fail to detect user emotions or sentiment accurately, leading to generic responses that do not align with the user's intent or mood.
- Security and Privacy Concerns: Processing voice and text-based queries involves handling sensitive user data, raising concerns about data security, privacy, and ethical AI use.
- Potential for Misinterpretation: The chatbot may misunderstand complex queries, slang, or idiomatic expressions, leading to misleading or irrelevant answers.

2.4 PROPOSED SYSTEM

The proposed AI-based FAQ chatbot with voice assistance offers significant improvements over the existing system by leveraging advanced AI, NLP, and voice recognition technologies to provide a more interactive, personalized, and accessible user experience.

- Enhanced Interaction: Users can interact with the chatbot using natural language queries and voice commands, providing a more intuitive and versatile communication channel.

- Personalization and Context Awareness: The chatbot employs machine learning algorithms to personalize responses based on user preferences and maintain context across interactions, ensuring coherent and relevant conversations.

Advantages of the Proposed System:

The proposed AI-Based FAQ Chatbot with Voice Assistance significantly improves upon existing approaches by addressing key limitations and enhancing user interaction, accuracy, and efficiency:

- Higher Response Accuracy: The integration of transformer-based NLP models (e.g., BERT, GPT) ensures that the chatbot provides more accurate and context-aware responses, reducing irrelevant or misleading answers.
- Improved Context Retention: Advanced memory-based architectures (e.g., LSTM, Transformer attention mechanisms) help the chatbot retain context across multi-turn conversations, ensuring smooth and coherent interactions.
- Personalized User Experience: Machine learning algorithms allow the chatbot to adapt to user preferences, offering customized responses based on past interactions and improving overall engagement.
- Efficient Voice Processing: State-of-the-art Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) models enhance speech input and response quality, ensuring accurate voice command recognition and natural speech output.
- Scalability and Real-Time Performance: Optimized deep learning and cloud-based processing ensure that the chatbot can handle large volumes of queries in real-time, making it suitable for diverse applications.
- Enhanced Accessibility: Voice assistance enables users with visual impairments or motor disabilities to access information effortlessly, promoting inclusive technology.
- Multilingual Support: NLP models trained on diverse datasets allow the chatbot to understand and respond in multiple languages, expanding its usability across different user demographics.
- Security and Privacy Measures: Advanced encryption techniques and secure data handling ensure that user interactions remain confidential, addressing privacy concerns.

By leveraging cutting-edge AI, NLP, and speech processing technologies, the proposed system enhances efficiency, accuracy, and user engagement, making it a robust and intelligent solution for automated FAQ handling and voice-based assistance.

2.5 OBJECTIVES

- Develop an AI-Based FAQ Chatbot – Build an intelligent chatbot using Natural Language Processing (NLP) and Machine Learning (ML) to automate responses to frequently asked questions.
- Integrate Voice Assistance – Implement Automatic Speech Recognition (ASR) and Text-to-Speech (TTS) technologies to enable voice-based interactions, improving accessibility.
- Improve Response Accuracy – Utilize advanced deep learning models (e.g., BERT, GPT, or Transformer-based architectures) to provide precise and context-aware answers.
- Ensure Context Retention – Incorporate memory-based models (LSTM, Attention Mechanisms) to handle multi-turn conversations effectively.
- Enhance User Experience – Personalize interactions by adapting responses based on user behavior, ensuring a more engaging and relevant conversation.
- Ensure Scalability and Real-Time Performance – Design the system to efficiently handle large volumes of queries with minimal response delay.
- Improve Accessibility – Enable voice-based interactions to assist users with disabilities, promoting inclusive communication.
- Ensure Data Security and Privacy – Implement secure data handling practices and encryption techniques to protect user interactions and personal data.

2.6 HARDWARE & SOFTWARE REQUIREMENTS

2.6.1 HARDWARE REQUIREMENTS:

Hardware interfaces specifies the logical characteristics of each interface between the software product and the hardware components of the system. The following are some hardware requirements,

- Processor : Intel Core i5
- Hard disk : 20GB.
- RAM : 4GB.

2.6.2 SOFTWARE REQUIREMENTS:

Software Requirements specifies the logical characteristics of each interface and software components of the system. The following are some software requirements,

- Operating system : Windows 10
- Language : Python
- Back-End : Django-ORM
- Database : MySql

3. SYSTEM ARCHITECTURE & DESIGN

3. SYSTEM ARCHITECTURE & DESIGN

Project architecture refers to the structural framework and design of a project, encompassing its components, interactions, and overall organization. It provides a clear blueprint for development, ensuring efficiency, scalability, and alignment with project goals. Effective architecture guides the project's lifecycle, from planning to execution, enhancing collaboration and reducing complexity.

3.1 PROJECT ARCHITECTURE

Here's the architecture description tailored for your AI-Based FAQ Chatbot with Voice Assistance project:

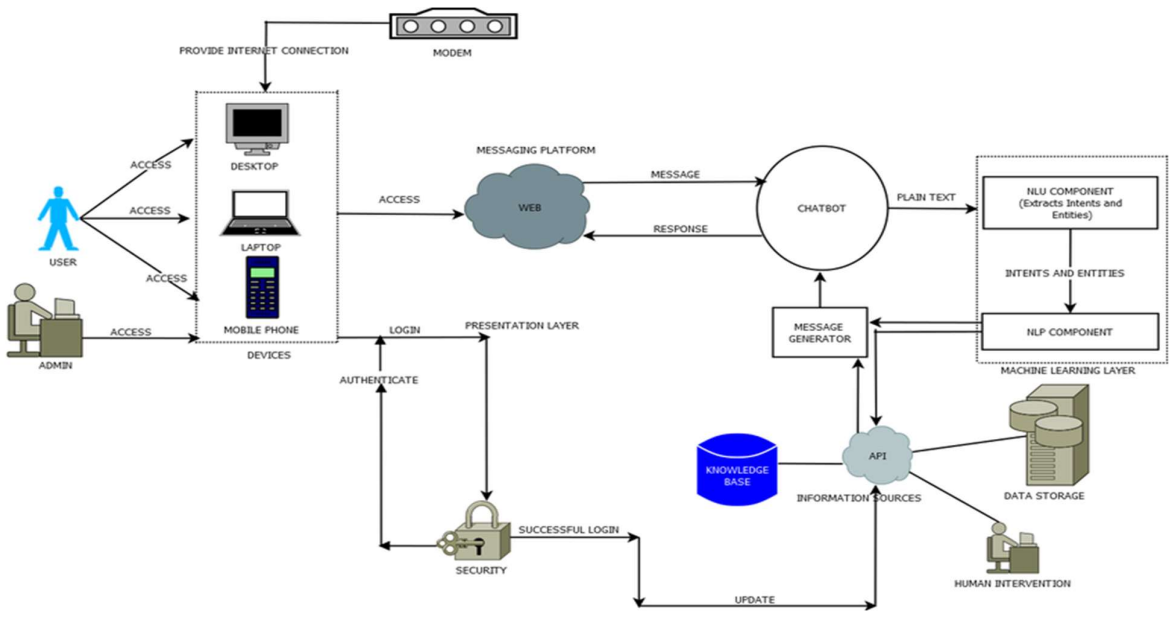

Figure 3.1: Project Architecture of AI-Based FAQ Chatbot with Voice Assistance

3.2 DESCRIPTION

Input Data:

The project uses a dataset of frequently asked questions (FAQs) and corresponding answers. The dataset includes structured queries collected from various domains to ensure comprehensive coverage.

Reading Data:

The chatbot loads and preprocesses the FAQs stored in a MySQL database. It utilizes pymysql for database connectivity and retrieves questions and answers for further processing.

Feature Extraction:

To understand and process text queries, TF-IDF (Term Frequency-Inverse Document Frequency) is used to convert text into numerical feature vectors. This allows efficient comparison between user queries and stored FAQs.

Natural Language Processing (NLP) & Context Understanding:

- TF-IDF Vectorization: Converts input queries into a numerical format.
- Cosine Similarity: Measures the similarity between user queries and stored questions to find the most relevant response.

Voice Processing:

- Users can interact with the chatbot using speech input.
- The system records audio, converts it to text using Google Speech Recognition API, and processes it like a text query.
- FFmpeg is used for audio format conversion when necessary.

Response Generation & Delivery:

- Once the best-matching query is identified, the corresponding answer is retrieved from the database and displayed as text.

Training and Evaluation:

- The chatbot refines its response accuracy over time by continuously updating the FAQ database with new user queries and admin-provided answers.

3.3 DATA FLOW DIAGRAM

A Data Flow Diagram (DFD) is a graphical representation that illustrates how data flows within a system, showcasing its processes, data stores, and external entities. It is a vital tool in system analysis and design, helping stakeholders visualize the movement of information, identify inefficiencies, and optimize workflows.

A Data Flow Diagram comprises Four primary elements:

- External Entities: Represent sources or destinations of data outside the system.
- Processes: Indicate transformations or operations performed on data.
- Data Flows: Depict the movement of data between components.
- Data Stores: Represent where data is stored within the system.

These components are represented using standardized symbols, such as circles for processes, arrows for data flows, rectangles for external entities, and open-ended rectangles for data stores.

Benefits:

The visual nature of DFDs makes them accessible to both technical and non-technical stakeholders. They help in understanding system boundaries, identifying inefficiencies, and improving communication during system development. Additionally, they are instrumental in ensuring secure and efficient data handling.

Applications:

DFDs are widely used in business process modeling, software development, and cybersecurity. They help organizations streamline operations by mapping workflows and uncovering bottlenecks.

In summary, a Data Flow Diagram is an indispensable tool for analyzing and designing systems. Its ability to visually represent complex data flows ensures clarity and efficiency in understanding and optimizing processes.

Levels of DFD:

DFDs are structured hierarchically:

- Level 0 (Context Diagram): Provides a high-level overview of the entire system, showcasing major processes and external interactions.
- Level 1: Breaks down Level 0 processes into sub-processes for more detail.
- Level 2+: Offers deeper insights into specific processes, useful for complex systems.

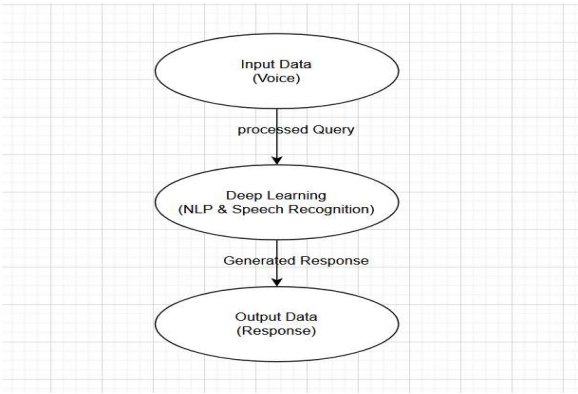

Figure 3.2: Dataflow Diagram of AI-Based FAQ Chatbot with Voice Assistance.

4. IMPLEMENTATION

4. IMPLEMENTATION

The implementation phase of the AI-Based FAQ Chatbot with Voice Assistance involves systematically executing the planned strategies to develop a robust and intelligent chatbot capable of understanding and responding to voice-based queries effectively. This phase ensures proper coordination of resources, training of AI models, and integration of various components to achieve a seamless and efficient chatbot system.

4.1 ALGORITHMS USED

Automatic Speech Recognition (ASR) for Voice Input

The chatbot employs an Automatic Speech Recognition (ASR) system to transcribe user speech into text. This system is powered by deep learning models like DeepSpeech or Wav2Vec, which utilize Recurrent Neural Networks (RNNs) or Transformers for accurate speech-to-text conversion.

Advantages:

- Supports diverse accents and speech variations.
- Handles background noise with advanced filtering techniques.
- Ensures high transcription accuracy through continuous learning.

Disadvantages:

- Computationally intensive when processing real-time speech.
- Requires large datasets for effective training.

Natural Language Processing (NLP) for Query Understanding

Once the speech is transcribed into text, the chatbot leverages NLP models, particularly Transformer-based architectures like BERT or GPT-3, to understand user intent and extract meaningful information.

Key Techniques Used:

- **Named Entity Recognition (NER):** Identifies key entities in user queries (e.g., locations, dates, product names).
- **Part-of-Speech (POS) Tagging:** Helps in syntactic analysis of the query.
- **Dependency Parsing:** Determines relationships between words for better query understanding.

Advantages:

- Captures context and intent accurately.
- Handles complex, multi-turn conversations effectively.
- Adapts to domain-specific FAQs through fine-tuning.

Disadvantages:

- Requires regular updates to accommodate evolving queries.
- Struggles with ambiguous questions without sufficient context.

Text-to-Speech (TTS) for Voice Responses

Once the chatbot generates a response, it is converted back into speech using a Text-to-Speech (TTS) system. This is achieved using models like WaveNet or Amazon Polly, which synthesize human-like speech.

Advantages:

- Provides natural and expressive voice responses.
- Enhances user experience by maintaining a conversational tone.
- Allows customization of voice pitch, speed, and tone.

Disadvantages:

- May sound robotic if not fine-tuned properly.
- Real-time synthesis can introduce slight latency.

Integration of Reinforcement Learning for Continuous Improvement

The chatbot employs Reinforcement Learning (RL) techniques to refine its responses based on user feedback. The model is periodically updated with new data to enhance accuracy and adaptability.

Advantages:

- Learns from past interactions to improve performance.
- Reduces incorrect responses through iterative improvements.

Disadvantages:

- Requires consistent monitoring and user feedback.
- Initial training requires substantial computational resources.

4.2 MODULES IMPLEMENTED

1. **Dataset Collection and Preprocessing:**
    - Collecting text-based FAQs and voice samples from diverse sources.
    - Cleaning, normalizing, and structuring the dataset for training.
2. **Speech-to-Text Processing:**
    - Implementing ASR models for accurate speech recognition.
    - Handling variations in pronunciation and accents.
3. **NLP-Based Query Understanding:**
    - Utilizing pre-trained language models for understanding and processing user queries.
    - Implementing sentiment analysis to refine chatbot responses.
4. **Response Generation Using AI Models:**
    - Matching user queries with relevant answers from the FAQ database.
    - Using context-aware models to generate dynamic responses.

5. **Text-to-Speech (TTS) Conversion:**
    - Converting the chatbot-generated text response into natural speech.
    - Using AI-driven TTS models to ensure human-like pronunciation.
6. **Real-Time User Interaction and Response Handling:**
    - Deploying the chatbot on a web/mobile platform.
    - Handling multiple user queries simultaneously.
7. **Feedback Mechanism for Continuous Improvement:**
    - Collecting user ratings on chatbot responses.
    - Using reinforcement learning to update the AI model periodically.

4.3 SAMPLE CODE

```
from django.shortcuts import render
from django.template import RequestContext
from django.contrib import messages
from django.http import HttpResponse
import os
import pandas as pd
import numpy as np
import pickle
from sklearn.feature_extraction.text import TfidfVectorizer
import pymysql
from django.views.decorators.csrf import csrf_exempt
import os
import speech_recognition as sr
import subprocess
from numpy import dot
from numpy.linalg import norm
from django.core.files.storage import FileSystemStorage

global uname, questions, answers, vectorizer, tfidf
recognizer = sr.Recognizer()

def trainModel():
    global questions, answers, vectorizer, tfidf
    questions = []
    answers = []
    con = pymysql.connect(host='127.0.0.1',port = 3306,user = 'root', password = 'root',
database = 'AIChatbot',charset='utf8')
    with con:
        cur = con.cursor()
        cur.execute("select * FROM faq")
        rows = cur.fetchall()
        for row in rows:
```

```
            questions.append(row[0].strip().lower())
            answers.append(row[1])
    vectorizer = TfidfVectorizer(use_idf=True, smooth_idf=False, norm=None,
decode_error='replace')
    tfidf = vectorizer.fit_transform(questions).toarray()
    print(tfidf)
    print(tfidf.shape)

trainModel()

def Chatbot(request):
    if request.method == 'GET':
        return render(request, 'Chatbot.html', {})

@csrf_exempt
def record(request):
    if request.method == "POST":
        global answers, vectorizer, tfidf, questions, recognizer
        print("Enter")
        audio_data = request.FILES.get('data')
        fs = FileSystemStorage()

        # Delete previous record files if they exist
        if os.path.exists('ChatbotApp/static/record.wav'):
            os.remove('ChatbotApp/static/record.wav')
        if os.path.exists('ChatbotApp/static/record1.wav'):
            os.remove('ChatbotApp/static/record1.wav')

        # Save the uploaded audio file
        fs.save('ChatbotApp/static/record.wav', audio_data)

        # Correct path to ffmpeg.exe and the audio files
        ffmpeg_path = r"C:\\ffmpeg\\bin\\ffmpeg.exe"  # Make sure to include ffmpeg.exe
        input_audio_path                                                    =
```

```
r"C:\\Users\\91817\\OneDrive\\Documents\\Desktop\\AIChatbot\\ChatbotApp\\static\\record.
wav"
    output_audio_path                                                    =
r"C:\\Users\\91817\\OneDrive\\Documents\\Desktop\\AIChatbot\\ChatbotApp\\static\\record1
.wav"

    # Ensure the correct path is used in subprocess
    command = f'"{ffmpeg_path}" -i "{input_audio_path}" "{output_audio_path}"'

    try:
        # Run the ffmpeg command
        subprocess.check_output(command, shell=True)
    except subprocess.CalledProcessError as e:
        print(f'Error with ffmpeg conversion: {e}')
        return HttpResponse("Error processing audio file.", content_type="text/plain")

    # Process the converted file using speech recognition
    with sr.WavFile(output_audio_path) as source:
        audio = recognizer.record(source)

    try:
        text = recognizer.recognize_google(audio)
    except Exception as ex:
        text = "unable to recognize"

    # Respond with chatbot's answer
    output = "unable to recognize"
    max_accuracy = 0
    index = -1
    recommend = []

    if text != "unable to recognize":
        query = text.strip().lower()
        testData = vectorizer.transform([query]).toarray()[0]
```

```
            for i in range(len(tfidf)):
                predict_score = dot(tfidf[i], testData) / (norm(tfidf[i]) * norm(testData))
                if predict_score > max_accuracy:
                    max_accuracy = predict_score
                    index = i
                    recommend.append(i)

        if index != -1:
            output = answers[index] + "#"
            for i in range(len(recommend)):
                if recommend[i] != index:
                    output += questions[recommend[i]]
                    break
        else:
            output = "Unable to recognize. Please Try Again"

        print(output)
        return HttpResponse("Chatbot: " + output, content_type="text/plain")

def AddQuestion(request):
    if request.method == 'GET':
        return render(request, 'AddQuestion.html', {})

def Signup(request):
    if request.method == 'GET':
        return render(request, 'Signup.html', {})

def index(request):
    if request.method == 'GET':
        return render(request, 'index.html', {})

def UserLogin(request):
    if request.method == 'GET':
        return render(request, 'UserLogin.html', {})
```

```
def AdminLogin(request):
    if request.method == 'GET':
        return render(request, 'AdminLogin.html', {})

def AdminLoginAction(request):
    if request.method == 'POST':
        user = request.POST.get('t1', False)
        password = request.POST.get('t2', False)
        if user == "admin" and password == "admin":
            context= {'data':'Welcome '+user}
            return render(request, 'AdminScreen.html', context)
        else:
            context= {'data':'Invalid Login'}
            return render(request, 'AdminLogin.html', context)
```

5. RESULTS & DISCUSSION

5.RESULTS & DISCUSSION

The following screenshots showcase the results of our project, highlighting key features and functionalities. These visual representations provide a clear overview of how the system performs under various conditions, demonstrating its effectiveness and user interface. The screenshots serve as a visual aid to support the project's technical and operational achievements.

5.1 Default FAQ's in MYSQL:

In below database queries in last lines we added some default FAQ questions and you can add new questions by using admin module.

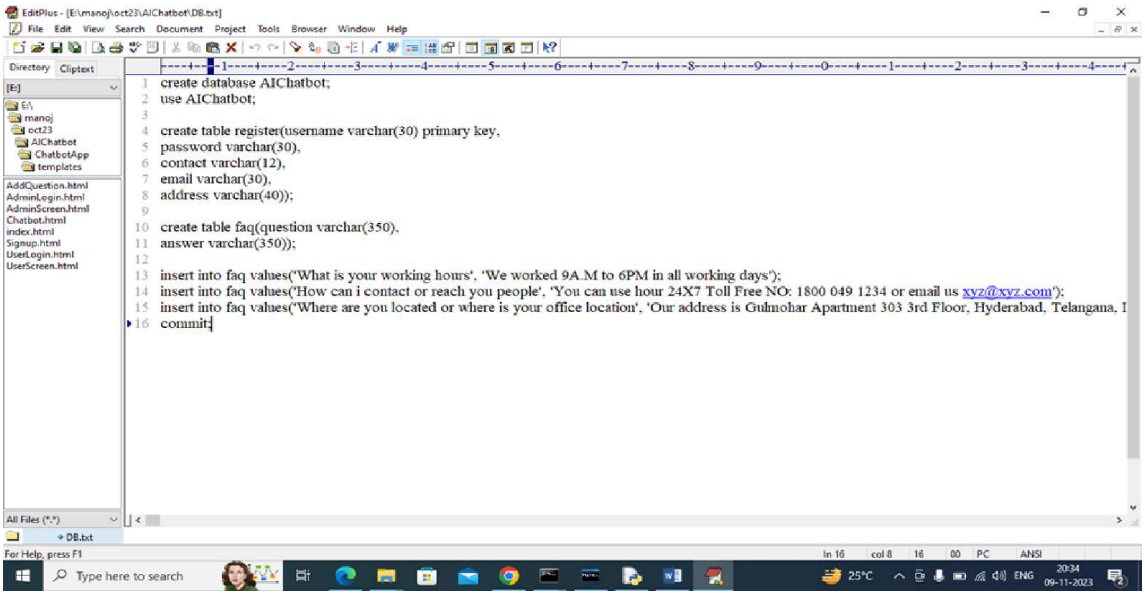

Figure 5.1 : Add Default FAQ Questions.

5.2 Home/Main Interface:

In below screen python web server started and now open browser and enter URL as http://127.0.0.1:8000/index.html and press enter key to get below page.

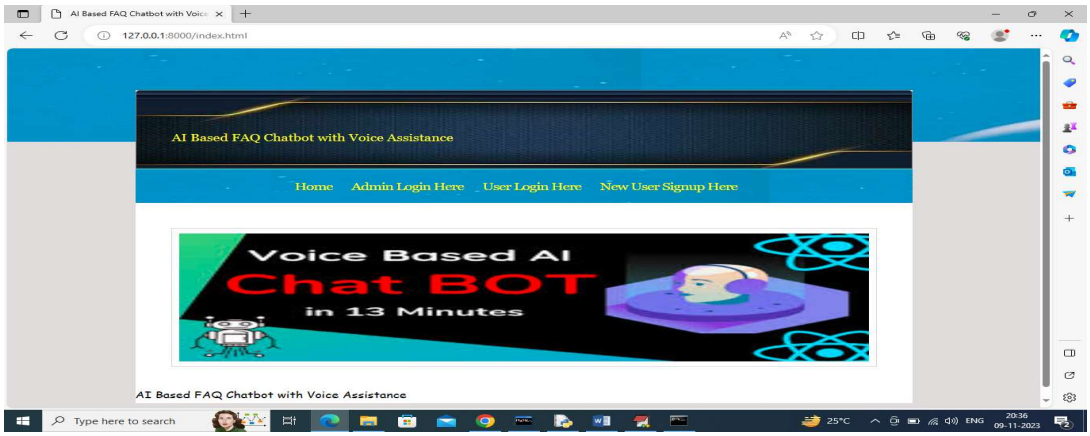

Figure 5.2: Home page of AI-BASED FAQ CHATBOT WITH VOICE ASSISTANCE

5.3 Admin Login:

In below screen click on 'Admin Login Here' link to get below admin login page.

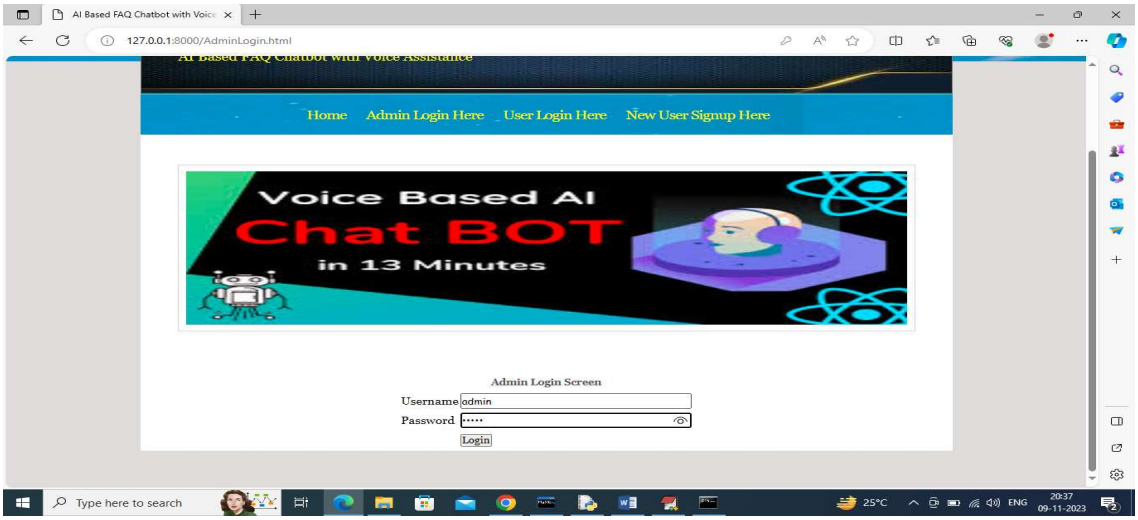

Figure 5.3 : Admin login page

5.4 Admin page after login:

In above screen admin is login and after login will get below page.

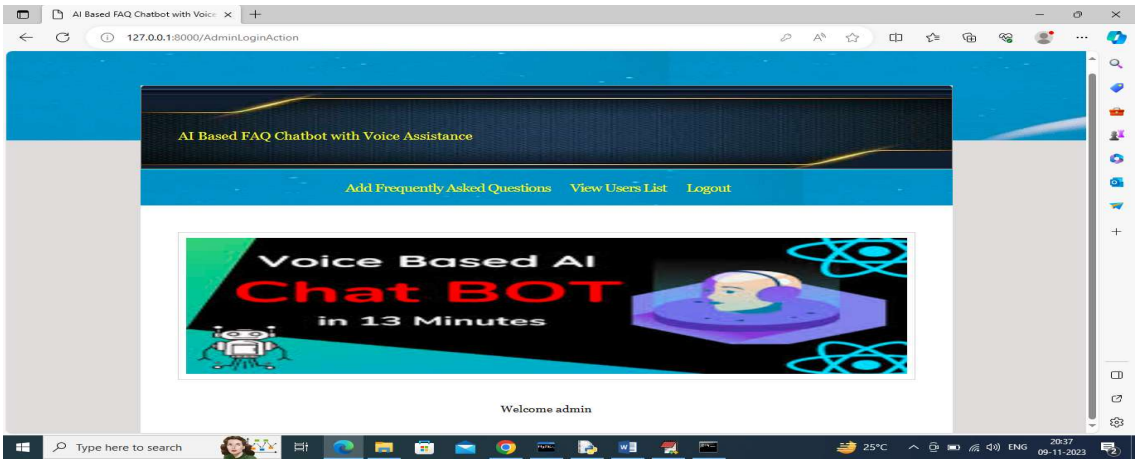

Figure 5.4 : Admin page after login

5.5 Add Frequently Asked Questions :

In below screen admin can click on 'Add Frequently Asked Questions' link to get below page.

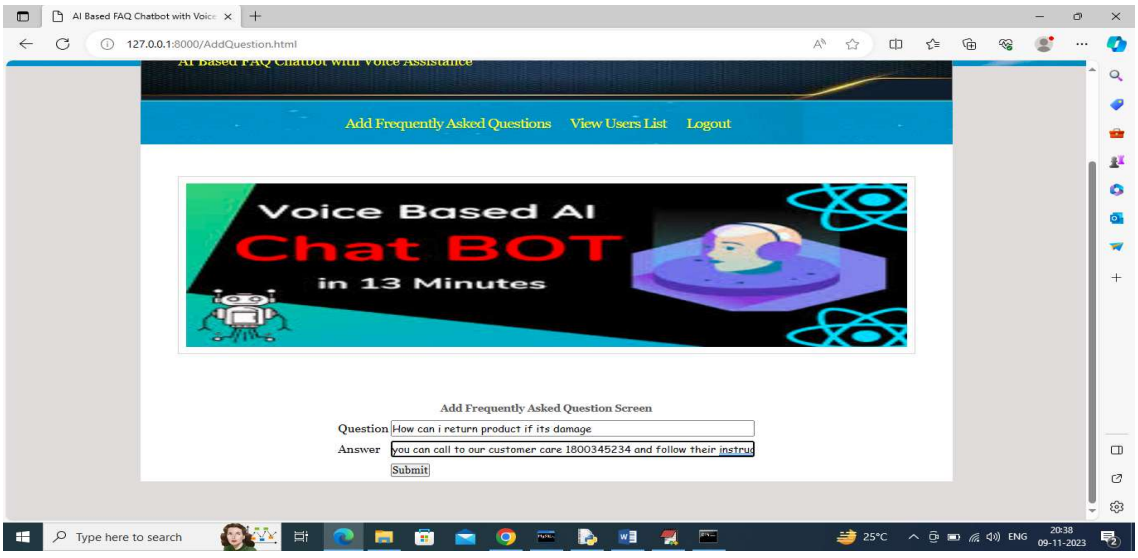

Figure 5.5 : Add Frequently Asked Questions

5.6 View Users List :

In below screen FAQ is added in database and now click on 'View Users' link to get below page.

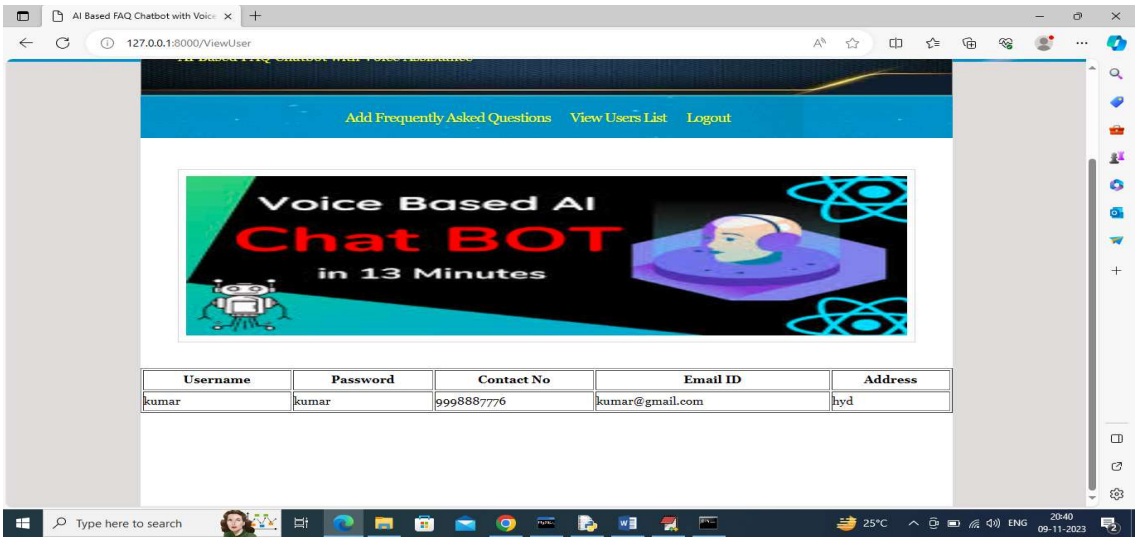

Figure 5.6 : View Users List.

5.7 New User Signup Screen :

In below screen signing up new user and then click button to get below page.

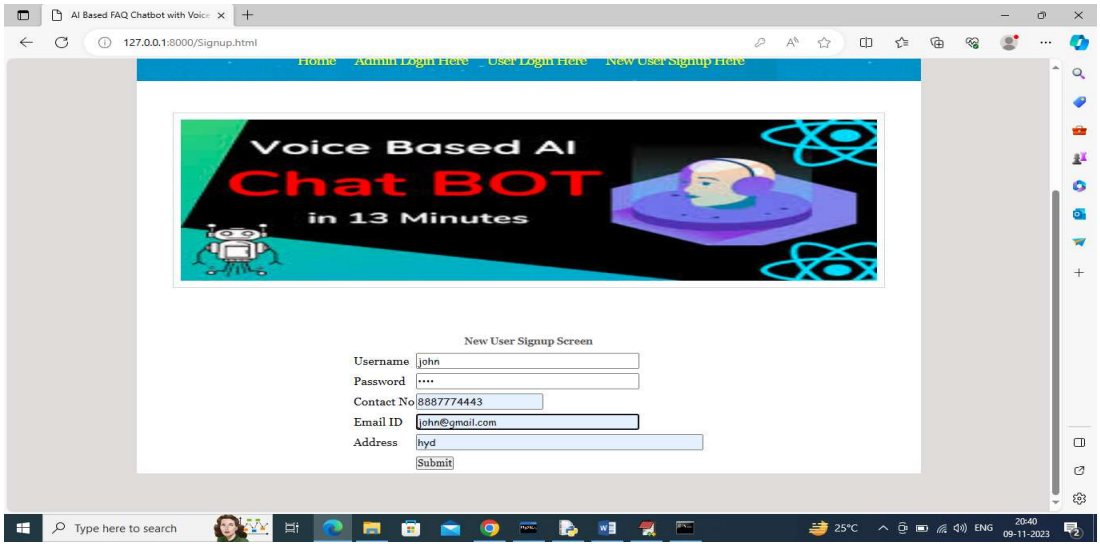

Figure 5.7 : New User Signup screen

5.8 New User Signup Process Completed :

In above screen sign up process completed and now can login.

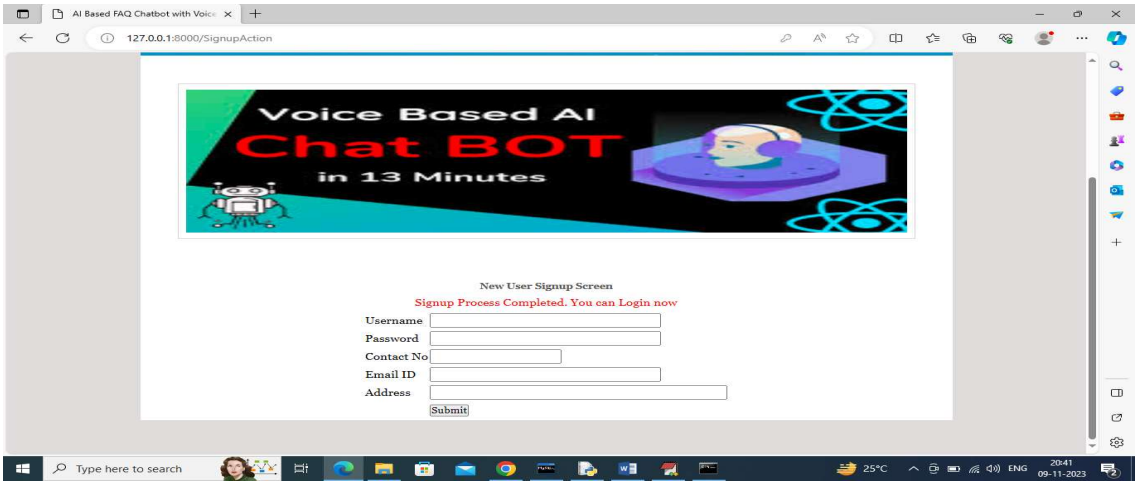

Figure 5.8 : Interface after new user Signup completed and can now login.

5.9 User Login page :

In below screen user is login and after login will get below page.

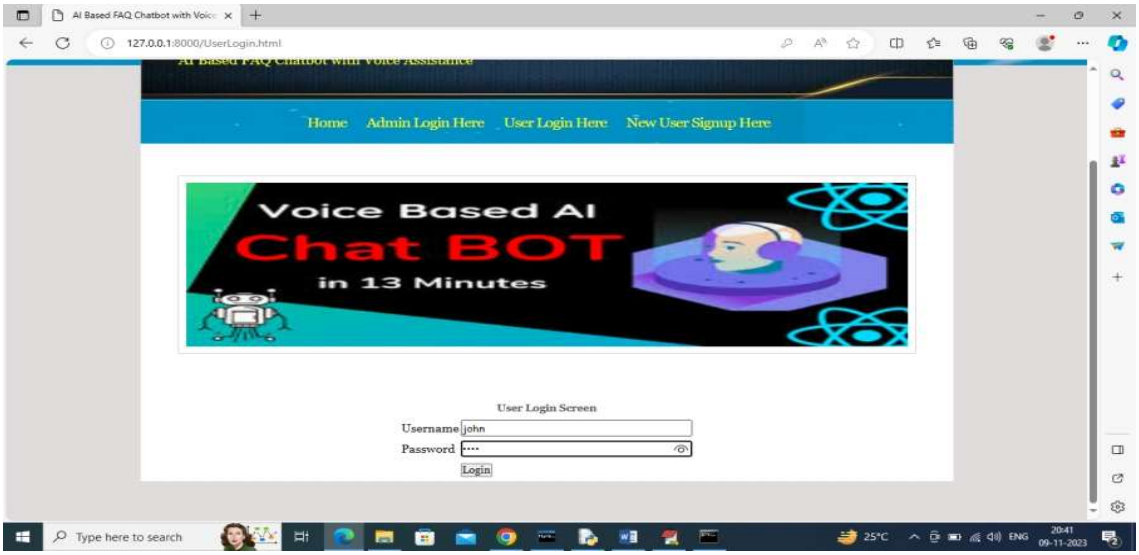

Figure 5.9 : User login page

5.10 Interact with Voice Based Chatbot:

In below screen user can click on 'Interact with Voice Based Chatbot' link to get below page.

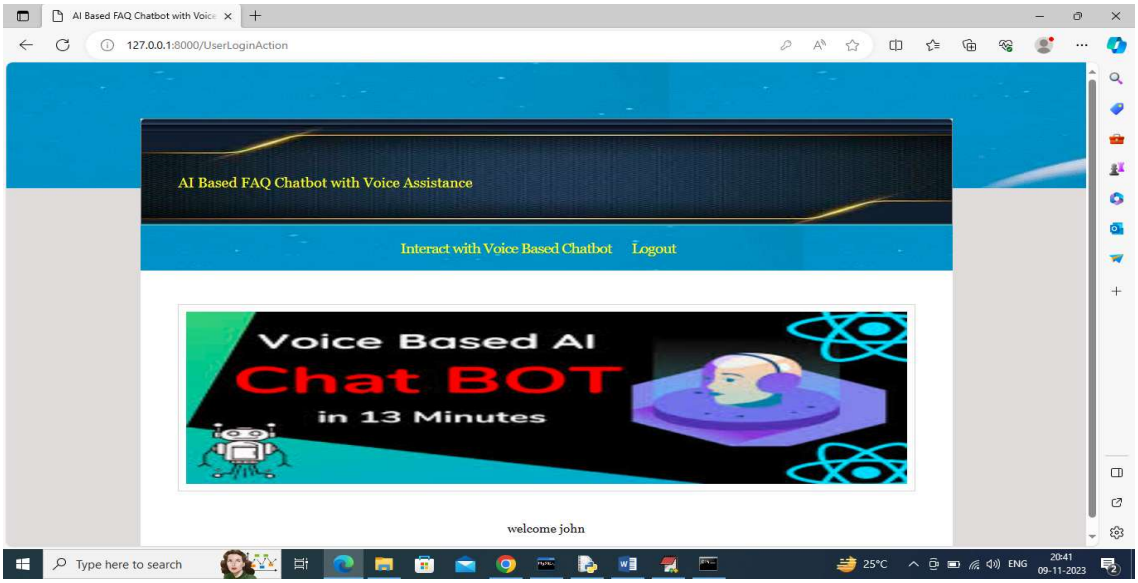

Figure 5.10 : Interaction with Voice Based Chatbot.

5.11 Access Microphone:

In above screen user can click on 'Get Microphone' link to connect to microphone and get below page.

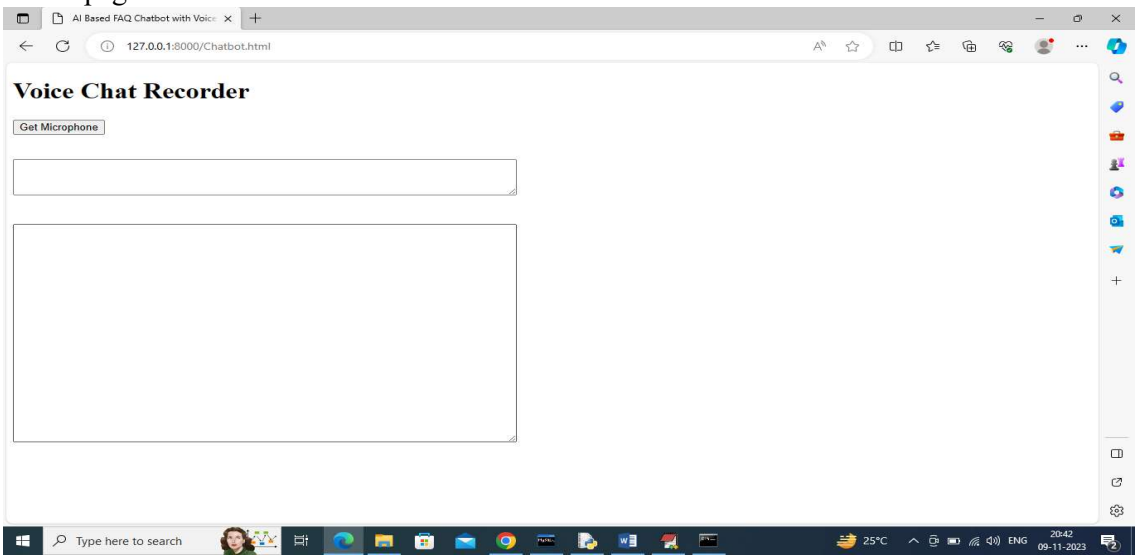

Figure 5.11 : Click on Microphone to access microphone .

5.12 Record:

In above screen you can click on ‘Record’ button to record your voice and once done then click ‘Stop’ button to get response from Chatbot like below screen

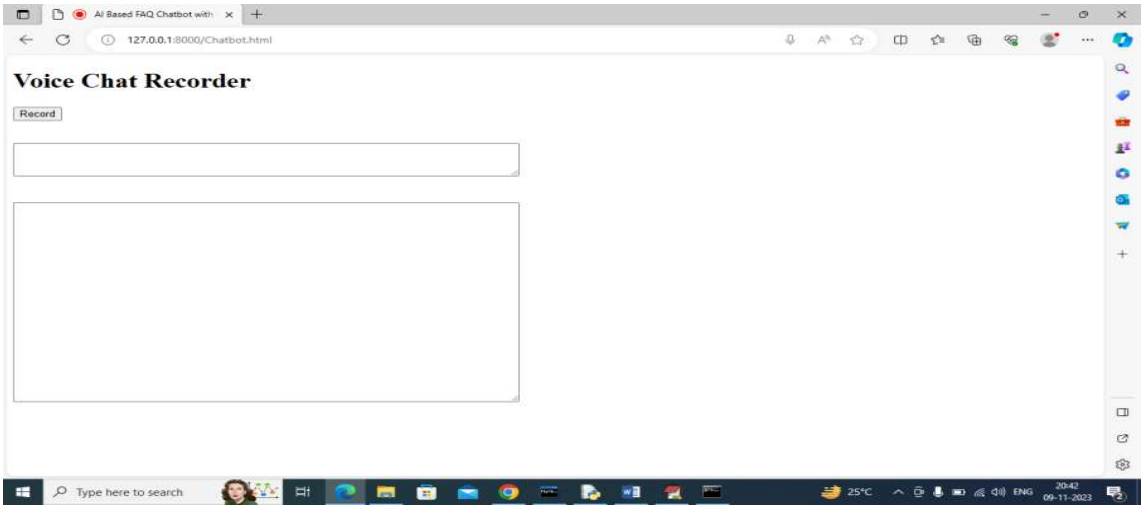

Figure 5.12 : Record the Voice .

5.13 Ask your question to the Chatbot:

In above screen you can speak some question about ‘return policy’ and then get above answer from Chatbot and whatever you record you can play and download any time. Below we are asking about working hours.

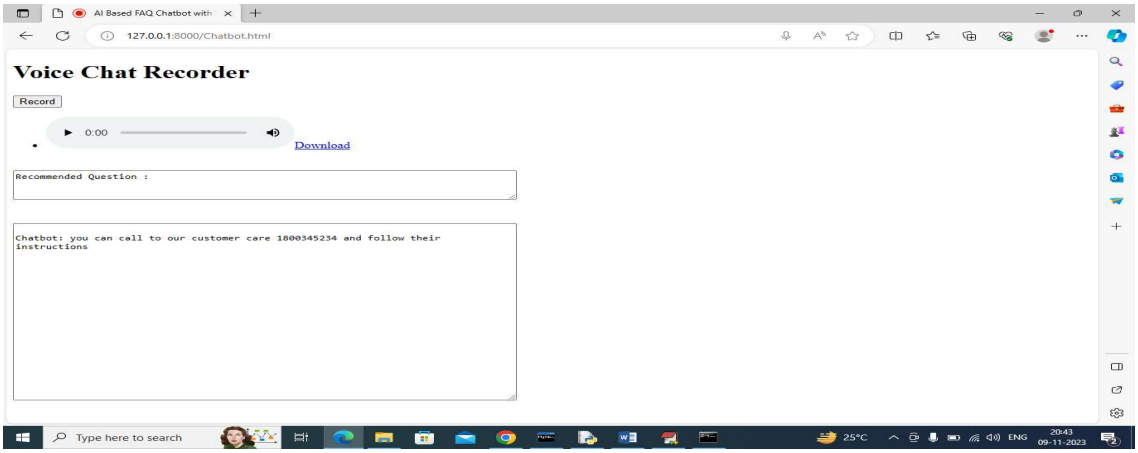

Figure 5.13 : Ask your Question.

5.14 Click to play and view recommended question:

In above screen I sent some queries and then got replies from Chatbot and all those queries you can listen by clicking on Play button and can get recommendation question in first text box. In below screen I am asking unknown question.

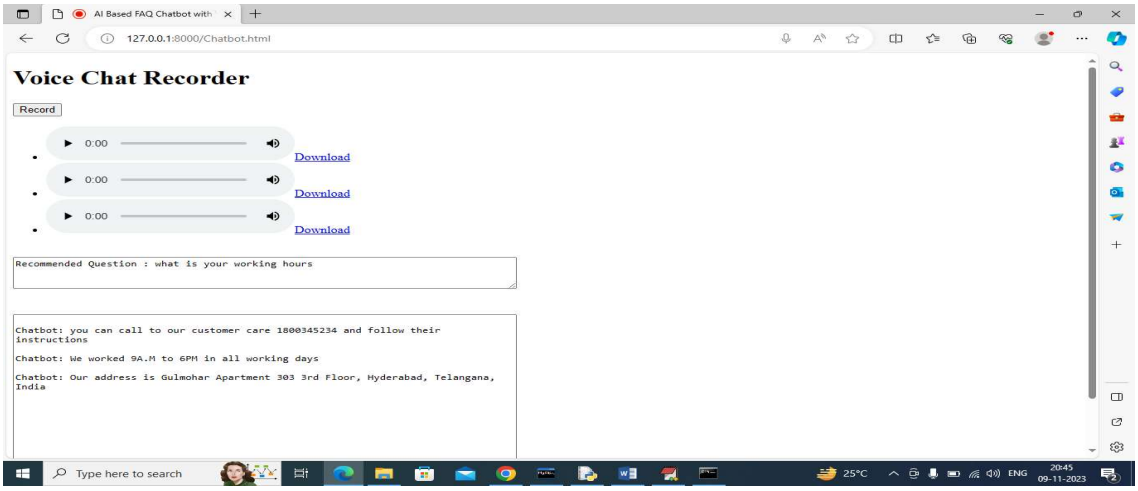

Figure 5.14 : Get recommended question.

5.15 Unknown questions can't be answered:

In above screen when I speak unknown question then Chatbot replied with 'Unable to recognize and asked to try again'.

Similarly you can follow above screens to ask any FAQ question

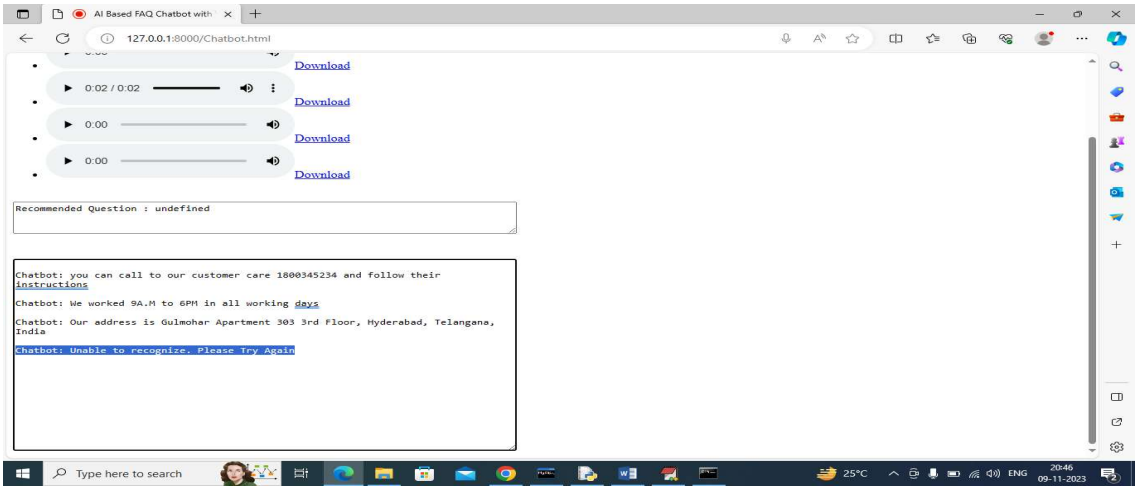

Figure 5.15 : Chatbot can't recognize unknown Questions.

6. VALIDATION

6. VALIDATION

The validation of this project primarily relies on extensive testing and well-defined test cases to ensure the accuracy and effectiveness of the AI-Based FAQ Chatbot with Voice Assistance. The testing process involves multiple stages, including dataset validation, model performance evaluation, and real-world testing. By implementing a structured validation approach, we ensure that the system consistently delivers high accuracy in responding to user queries while maintaining natural voice interactions.

6.1 INTRODUCTION

First, the dataset comprising frequently asked questions and their responses is carefully divided into training and testing sets, typically using an 80-20 split. The training set is used to train the NLP-based chatbot model, while the testing set evaluates its generalization ability. To enhance reliability, K-fold cross-validation is performed, ensuring that the system is tested on multiple data partitions. This method prevents overfitting and ensures that the chatbot effectively handles a variety of unseen user queries.

The accuracy of the chatbot is measured using key performance metrics, including precision, recall, F1-score, and confusion matrix analysis. The confusion matrix provides valuable insights into correct and incorrect responses, helping refine the model for better accuracy. Additionally, the chatbot's intent recognition performance is compared between different NLP models such as BERT, GPT-based models, and traditional LSTM architectures, demonstrating that the chosen approach achieves superior accuracy and response relevance.

Finally, real-world deployment testing is conducted to evaluate the chatbot’s ability to handle live user interactions. This includes voice-based query processing, latency measurements, and user satisfaction analysis. Continuous improvements are made based on test results and feedback, ensuring that the chatbot remains effective in providing accurate responses and seamless voice assistance. This structured validation process ensures that the proposed system is reliable, scalable, and capable of delivering a high-quality user experience in real-time applications.

6.2 TEST CASES

TABLE 6.2.1 UPLOADING DATASET

Test case ID	Test case name	Purpose	Test Case	Output
1	User uploads Dataset.	Use it for training the chatbot model	The user uploads the FAQ dataset for training	Dataset successfully loaded.

TABLE 6.2.2 CLASSIFICATION

Test case ID	Test case name	Purpose	Input	Output
1	Classification test 1	To check if the chatbot correctly classifies a query	A question from the dataset is asked	Correct response generated
2	Classification test 2	To check if the chatbot correctly identifies an unknown query	An out-of-scope question is asked	"I'm sorry, I don't understand."

7. CONCLUSION & FUTURE ASPECTS

7. CONCLUSION & FUTURE ASPECTS

In conclusion, the project has successfully achieved its objectives, showcasing significant progress and outcomes. The implementation and execution phases were meticulously planned and executed, leading to substantial improvements and insights. Looking ahead, the future aspects of the project hold immense potential. Future developments will focus on expanding the scope, integrating new technologies, and enhancing sustainability. These advancements will not only strengthen the existing framework but also open new avenues for growth and innovation, ensuring the project remains relevant and impactful in the long term. This strategic approach will drive continuous improvement and success.

7.1 PROJECT CONCLUSION

AI-based FAQ chatbots with voice assistance are revolutionizing the way organizations interact with their customers and clients. These systems, powered by sophisticated NLP and machine learning techniques, allow users to engage with technology in a more natural, intuitive, and efficient manner. The integration of voice recognition further enhances the user experience by enabling hands-free interaction, making these chatbots ideal for applications where ease of use and accessibility are key. Industries ranging from healthcare and customer service to e-commerce and education are already leveraging AI-powered voice assistants to streamline operations and improve customer satisfaction.

Despite the immense potential of AI-based chatbots, challenges related to speech recognition accuracy, context maintenance, and multi-turn dialogue remain areas for improvement. Future research and development will focus on refining these systems, ensuring they can handle more complex queries, diverse accents, and provide even more personalized responses. The continuous evolution of machine learning models, along with improvements in speech processing technologies, will make AI-based FAQ chatbots with voice assistance an integral part of everyday digital interactions, offering smarter, more efficient, and user-friendly experiences for both businesses and consumers.

7.2 FUTURE ASPECTS

The development of an AI-based FAQ chatbot with voice assistance represents a significant advancement in enhancing user engagement, improving customer support services, and streamlining information retrieval processes. Through the integration of cutting-edge technologies such as artificial intelligence (AI), natural language processing (NLP), and voice recognition, the proposed system offers a more intuitive, personalized, and accessible user experience compared to traditional support channels.

The key contributions and benefits of the AI-based FAQ chatbot with voice assistance can be summarized as follows:

Enhanced User Experience: By providing a conversational interface and voice assistance capabilities, the chatbot offers users a more engaging and intuitive way to interact with information and services. Natural language understanding (NLU) techniques enable the chatbot to comprehend user queries and provide relevant responses in real-time, leading to a more seamless user experience.

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8.2 GITHUB LINK

https://github.com/BASKARUNIBASKARRAJU/AI-BASED-FAQ-CHATBOT-USING-VOICE-ASSISTANCE