

AI Virtual Calling Assistant for Automated College Information

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Abstract--- Artificial Intelligence (AI) has made tremendous progress in the last few years and is widely integrated into our daily lives. Many Academic Institutes receive hundreds and thousands of queries regarding admissions, courses offered, fees, infrastructure and many more. Most of these are attended to manually, which leads to increase in response time, heavy workload on administrators and inefficient communication.

In this research paper, we aim to design and implement an AI Virtual Calling Assistant that will be integrated to the college information portal to enable the institutions to automate their communication channels and reach out to their students, staff, parents and other stakeholders in a more personal and effective way. The proposed system is composed of a Web interface and a conversational chatbot built using Botpress which uses speech recognition to enable users to converse with the system and get the information they need.

The integration of conversational AI and speech processing technologies has been widely explored in recent research, demonstrating significant improvements in automated communication systems [2], [3].

The assistant uses speech recognition, natural language processing and text-to-speech technologies to dynamically understand the needs of the user and respond accordingly in real-time. Its purpose is to alleviate administrative workloads, to empower students and parents to engage in the school at anytime from any location, and to provide a seamless user experience.

Introduction

Institutions receive hundreds of routine, identical questions from prospective students, parents and others on an ongoing basis. The questions relate to topics such as application procedures, who can apply, courses offered, costs, scholarships, faculty, and facilities.

Today most of these type of inquiries are generally addressed by means of telephone, email or by sitting at a common help desk. Most of the time this mechanism creates a lot of administrative hassles in general and in particular during periods when there are intakes happening. The staff has to waste a significant amount of time in giving a very similar answer for what would be a simple question. They have lesser time to attend to more number of students.

With the adoption of digital technologies in increasing numbers of institutions, there is a need to find ways to automate communication and to provide faster access to information. Artificial Intelligence, which is being explored across many departments, has revealed that conversational AI systems are an ideal and efficient means of tackling these problems.

Our research is focusing on improving communication and making the College more accessible to students and staff. One recent development, which is clearly making a real difference, is the creation and implementation of an AI Virtual Calling Assistant built into the college information portal. Using speech recognition technology, users can interact with the service using natural language and voice dialogues, receiving real time human-sounding answers.

A number of campus information inquiry activities are highly dependent on manual assistance, which results in the backward dependency on humans, frequent repetition of the same inquiry and deviation from the accuracy of information caused by human mistakes. Adopting an intelligent assistant system to realize the campus information inquiry via an intelligent chatting robot is an effective solution to ease the backward dependency on humans, decrease the frequency of repeated inquiry, improve the accuracy of campus information provided, and realize the automation and continuity of campus information service. With the smart system to service student inquiries on a 24/7 basis, the University is one step closer to becoming a smart and a fully digital campus.

Conversational agents and virtual assistants have gained considerable attention in recent years due to their ability to simulate human-like interactions and automate communication processes across multiple domains [2], [14].

I. Background and Related Work

Traditional websites generally act as a large database of static information. They have content about the programs they offer, how to apply to the College, and policies of the College. What is lacking is functionality that enables easy search and a streamlined interface for obtaining this information.

This can be a very time consuming and frustrating process. Especially if this is the person's first time on the site. Many students and parents find it much easier to call and/or e-mail the Admissions Office, which can be a real burden on the staff.

Recent breakthroughs in Artificial Intelligence (AI), Natural Language Processing (NLP) and Speech Processing have made it possible to develop highly advanced conversational chatbots. These conversational systems are capable of understanding human language and can formulate human understandable responses.

Chatbots and virtual assistants are now widely used across industries such as:

- Customer service
- E-commerce platforms
- Healthcare systems
- Educational portals

Systems that allow search and retrieval of information based on user's inquiry and may return results in either text or speech form.

Conversational AI platforms like Botpress allow for the creation of highly natural conversation flows, while maintaining business logic in an easy to manage and scalable way. An intent recognition component that understands the user's intention, a dialogue manager that chooses the next action to perform in the dialogue and access to databases and web services.

Several studies have explored the development of conversational systems using frameworks such as Rasa and other dialogue management tools, which enable efficient intent recognition and response generation [4].

Over the past 2-3 years, conversational assistants have been being trialed in education to help aid student admissions enquiries, subject choices and student services. The benefits of these tools are multifaceted – improving user experience whilst increasing productivity and reducing staff workload.

Using recent technologies in NLP, the proposed AI Virtual Calling Assistant lets users interact using spoken words via a college information portal.

III. System Design and Methodology

Virtual Calling Assistant (VCA) - AI The Virtual Calling Assistant uses AI to become a digital voice-assistance type of support system via the college information portal. The system is meant to replicate conversations that you would have with a human Customer Service Representative while at the same time delivering the institutional information dynamically.

As compared with text-based chatbots, the proposed approach focuses on speech interaction. With speech interaction, users can talk to the speech-based assistant and receive relevant speech responses similar to a telephone conversation.

This skill's system consists of several modules such as Speech recognition, Speech synthesis, Intent Handler, Data Access, and more that work together to capture and process user input and respond to it as expected.

The system leverages Natural Language Understanding techniques to classify user intent and extract relevant information, which is a fundamental concept in spoken language understanding systems [12].

A. Call Activation and User Interaction

The College Portal Chatbots project was based on enhancing the user experience for university students and staff who seek clarification on various matters. In this respect, a technical solution was proposed aiming to improve the way students can get answers to their

questions. Thus, communication was initiated when a user logged in to the college website and activated the calling assistant feature which is normally icon shaped or in a virtual assistant button format.

By clicking on this icon, the web browser has to request access to the microphone of the device.

Once you give permission, we will make a voice call to allow you to communicate directly with our assistants. No more typing! Our interface works the way you would talk to a human support representative.

B. Voice Capture and Speech Recognition

Once the voice session is started, the system will capture every audio word sent by the device microphone. The audio is then sent to a Speech-to-Text module which converts the audio sent to text.

Speech recognition technology relies on audio samples as the initial input for the process of transcription. Audio samples may contain ambient noise and undesired sections, all of which can affect the overall quality of speech recognition. Audio samples therefore need to undergo some pre-processing activities such as noise reduction and audio segmentation. Ambient noise is always present in all forms of speech interaction regardless of the environment, and is often inherently included in speech samples that are to be transcribed and so needs to be reduced or filtered out to achieve the most accurate speech recognition results. Similarly, samples containing speech need to be broken up into sections of speech and silence so that the speech recognition application may exclude the non speech samples from processing.

The text output of every speech conversion received is analyzed in order to know the meaning of each speech utterance and therefore, be able to respond appropriately to the queries or requests made by the users.

Modern speech recognition systems utilize deep neural networks to improve transcription accuracy and handle variations in speech patterns, accents, and environmental noise [17].

C. Natural Language Understanding and Intent Detection

After the speech is converted to text, the Natural Language Processing (NLP) module determines the intent of the user. This is known as syntax analysis and involves examining the words, phrases and sentences in the text to understand the language.

It looks at the context of the search terms and words to

try and determine the category of the search. Such as admissions, programs, fees, faculty or buildings & facilities.

Understanding the intent of the user is key to ensuring that the assistant gets the right information.

D. Knowledge Base Processing

After understanding the users intention the system will search the Institutional Knowledge Base which contains structured data about the academic and administrative information. The knowledge base is the main repository of information that the assistant uses to answer the user's questions.

This intention is then searched by the Retrieval component in the database to get all relevant information for which the users may be interested like Admission requirements, Courses offered, Fee structure of college, Information about Departments and various facilities available on each campus.

Modular KB structure enables the easy maintenance of all types of data by an Administrator. An Administrator can update, delete or add new data at any stage.

E. Response Generation and Text-to-Speech Conversion

After extracting all relevant information from knowledge base, it's time to turn it into a natural and human sounding dialogue, which is conveyed back to the user via speech. This dialogue is the output of our Text-to-Speech engine that enables the audio to sound human and more natural.

It streams speech through the device's speakers.

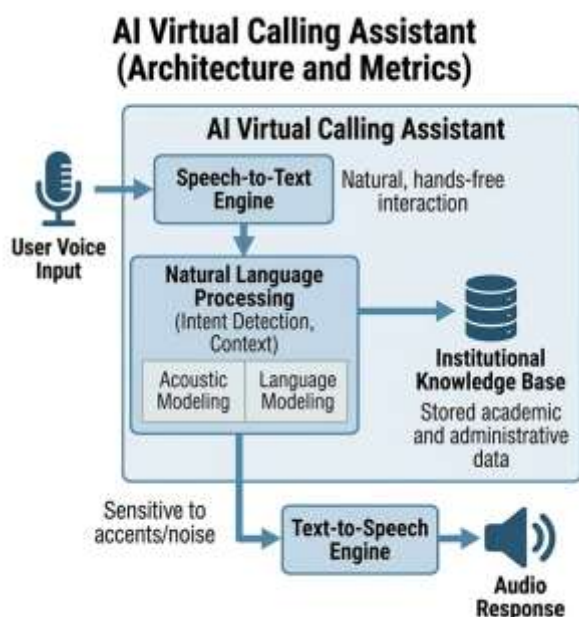
This step completes the communication cycle and it enables the user to hear the answer or information he requested.

F. Continuous Conversation Management

The system allows free conversation: you can ask more than one question during a single session. The assistant always keeps track of the conversation, so that it understands the relation between the questions you ask. The Session management module makes sure that the communication session is closed in a proper manner, when the conversation is finished. This greatly improves the user experience of the system.

BLOCK DIAGRAM OF AI VIRTUAL CALLING ASSISTANT

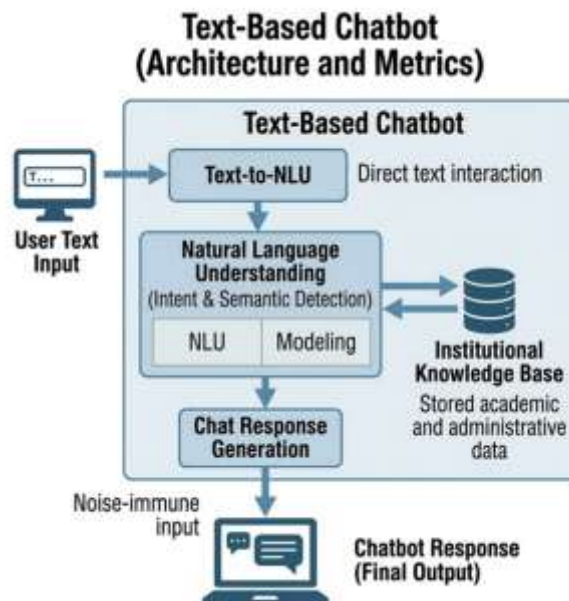
This block diagram shows how the Website User Interface communicates with the Call Assistant. It shows in detail how the Voice Input from the user is processed into a Sound which can be heard through the loudspeakers. It starts with the Website UI requesting the Call Assistant of the Website, followed by a Voice Capture through the Microphone of the website, using the Speech recognition technology to transform the Voice captured from the Microphone into a meaningful Text that is given as Input to the NLP – Natural Language Processing, which in turn identifies the intent or requirements of the User using the output for search and bringing in the required information from the database of the College and Institution. Finally the output obtained is given to the Text-to-Speech engine, which further processes the output into sound and transforms the Sound into output speech that is further transmitted to the Loudspeaker through the Speaker for transmission of the voice output to the User.



BLOCK DIAGRAM OF TEXT-BASED CHATBOT MODULE (BRIEF)

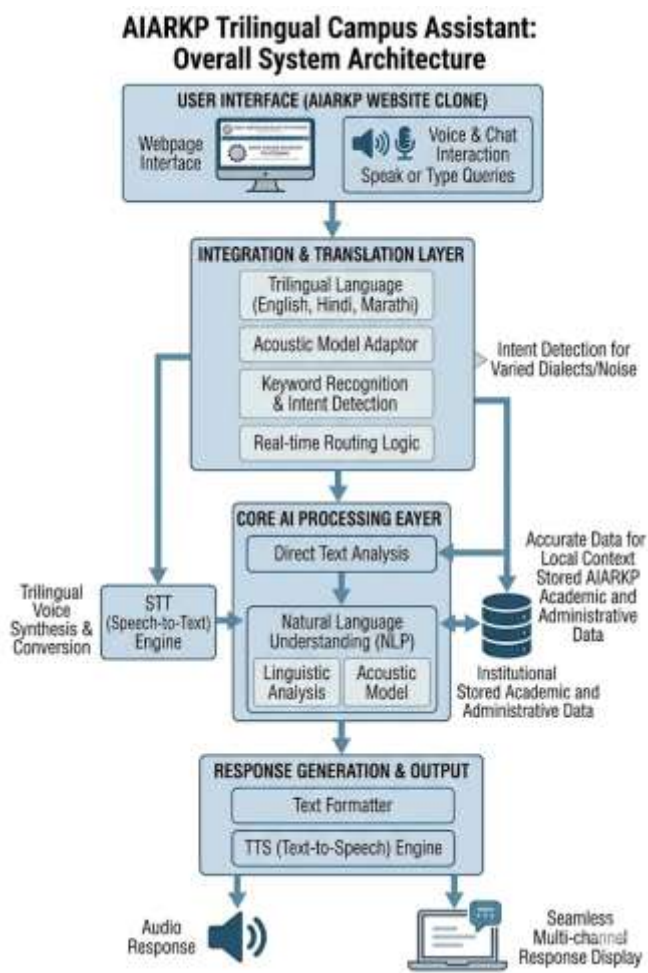
A Text-based Chatbot Layer can be added on top of the Voice Based Portal using text-based chatbots. In this architecture, users can ask their questions via a chat based interface and intended result is captured by a NLP Algorithm and the required data is fetched from the Database, just like in Voice based version and the output is displayed as text to the user. This allows the users to continue their communication via Text when

they want to avoid speaking via Voice.



BLOCK DIAGRAM OF OVERALL INTEGRATION

An integrated system combines both voice-based and text-based interaction within the college information portal to enhance user flexibility. Users can either speak or type their queries, and in both cases, the input is processed using Natural Language Processing to identify user intent. The system then retrieves relevant information from the knowledge base and generates an appropriate response. The output is delivered as speech for voice interaction and as text for chat-based interaction. This unified approach ensures consistent performance while allowing users to switch between communication modes based on their preference.



IV. RESULTS AND DISCUSSION

This evaluation aimed at verifying the functionality of the AI Virtual Calling Assistant and at analyzing the potentiality of real-time voice communication for spreading institutional information. The parameters under analysis were the accuracy of responses, the swiftness of interaction, ease of use, reliability and overall performance. This evaluation aimed at verifying how far the system can manage to reproduce the human assisted communication scenario, while being always reliable in terms of providing institutional information. The experimental testing was done by querying the assistant with a diverse set of questions about admission, courses, fees, faculty and other campus related information.

A wide range of query types were generated for testing to see how the system handled varying query formulations and query complexities.

Based on the experimental tests, the test result shows that the proposed assistant can handle a large number of input questions and provide a large number of output answers in a short time. The system is composed of speech recognition, natural language processing and

knowledge retrieval modules. It has been implemented as a real time intelligent conversational assistant.

The observed performance of the system aligns with existing research indicating that conversational AI systems can significantly enhance user interaction efficiency and reduce response time [14].

A. Response Accuracy

The system achieved high degree of accuracy in understanding the input given by the user and produced an optimal output. The speech recognition portion was able to convert speech into corresponding text efficiently within a typical environment. The Natural Language Processing portion can convert the input text into corresponding keywords and is then able to match these keywords to the intents listed within the knowledge base.

As part of testing, the system was asked a number of questions about admissions, courses and fees and understood most of the queries. Although the knowledge base was highly structured, the system was able to produce helpful and relevant replies which were always in line with official information as provided by the institution. Consistency and accuracy of information is crucial in an educational setting, where it forms the basis of many student decisions.

Small errors in recognition can sometimes occur as a result of changing intonation, or due to differences in speaking tempo, but in the majority of cases the system could correctly identify the intended language in the search query and return a useful response.

B. Response Time and Interaction Speed

We felt that one of the major factors when evaluating any conversational platform was the speed of the response and AI Virtual Calling Assistant proved itself to be very efficient in terms of processing time. Our AI was generally responding within seconds of us uttering a question.

Every component of the pipeline that we demonstrated - speech recognition, natural language understanding, knowledge base retrieval, and speech synthesis - can work together within a second.

So the assistant was able to keep up a conversation roughly in real time.

Compared to the manual inquiry system in which the users have to keep calling and/or emailing the

administrative staff for an answer, our chatbot assistant cut the time and as a result improved the user experience with a high capacity to handle large numbers of conversations.

C. System Usability and User Experience

User usability was assessed in terms of how easy it was to be able to interact with the virtual assistant and obtain the information required. The user was able to communicate very simply with the virtual assistant using spoken voice instead of having to type on a device or peruse lots of menus.

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One of the new features at SearchDex.com allowed first time visitors to quickly find whatever information they needed on a site. According to SearchEngineWatch, first time visitors were often lost without the knowledge of how the site was structured. In some cases they would have to navigate several pages in an attempt to find a piece of information. This new feature made it so that visitors could simply search using speech and get all of the answers they were looking for right away.

The output of the Text-to-Speech engine yielded responses that sounded like having a real human operator for conversation dialogue. The natural humanization of the communication makes the user experience both more engaging and more friendly.

D. System Reliability and Stability

Reliability of the system is an important factor when it comes to high availability of autonomous services. In testing, the AI Virtual Calling Assistant performed well across numerous iterations of interaction with no apparent crashes or outages.

The system modular design is considered as a factor enhancing its reliability because every system element works in isolation.

When occasional minor delays in processing occurred, the system was able to maintain its overall process and function to continue to provide responses.

The web-based release of the assistant also ensured that it would work with any modern browser and device, and that the overall performance would be good regardless of whether one was using a smartphone, tablet or a full computer.

E. Impact on Administrative Efficiency

The main goal behind the AI Virtual Calling Assistant was to ease the workload on staff. The evaluation showed that the system can efficiently handle routine and administrative inquiries related to admissions, programmes and the university.

The repetitive nature of the questions was an ideal candidate for automation. The assistant freed up staff from the drudgery and allowed them to deal with more meaningful work. Additionally, the faculty had significantly less interaction with institutional support services, such as Student Administrative Services, Admissions, and Registrar's Services. During peak periods for admissions, such as during open houses, the volume of questions to the services could be overwhelming.

F. Discussion

According to the overall test results, the AI Virtual Calling Assistant really does improve the communication ability of a college information portal. Through the means of speech recognition, natural language processing and text-to-speech, the Virtual Calling Assistant can turn the College information into a conversational dialogue, and release the real time information for the college.

This system helps bridge the gap between the static websites of yore and modern, smart dynamic applications. Using speech as a conduit for users to communicate with websites makes interacting with websites more approachable and for the purposes of search query input or obtaining specific information eases user experience.

In addition to all the above features, the implementation shows the applicability of conversational AI for educational applications. With improved speech recognition and natural language understanding, the system will be more applicable and forms a foundation for a fully automated smart campus communication system.

VI. LIMITATIONS

Although the innovative features of the AI Virtual Calling Assistant proved to be effective, as were the design choices that were undertaken to enable a full featured Voice User Interface (VUI) and fully autonomous application in a contact centre environment, there were a number of situations that

arose during the building and testing of the application that showed where the application was lacking.

A reflection of the technology underlying some of the functionality, the limitations showed the effect of Speech Recognition and NLP technology, the data needed to train these systems, and other environmental and system related variables.

In order to improve the upcoming releases and to ensure the system's stability, it is important to know the limitations of the current beta release.

Despite recent advancements, NLP systems still face challenges in handling ambiguous queries and complex conversational structures, particularly when relying on rule-based or intent-driven approaches [3].

A. Speech Recognition Sensitivity

The performance of the Calling Assistant is highly dependent on the Speech-to-Text (STT) engine accuracy. There are a variety of factors that can impact speech recognition accuracy, such as: - Accent and pronunciation - Speaking pace - Background noise Improper microphone alignment, or a noisy ambient environment can also cause the speech recognition model to misinterpret the user's command. While various techniques can be employed to help clean up the audio such as noise reduction and audio feature preprocessing, it is extremely difficult to eliminate all forms of ambient background noise.

B. Limited Natural Language Understanding

We found some limitations in the system that we explain in the following. Natural Language Processing One of the limitations in this system is the Natural Language Processing part. The current implementation is heavily based on pre-defined intents and on the keyword mapping for structured information about the university. This approach works very well for the frequently asked basic information about the university. However, it is not very effective for more open-ended and natural language inquiry that users may have. Users cannot ask questions that are not directly related to the pre-defined intents. For example, they cannot ask an indirect question that is related to one of the intents.

The output generated by the system will not always match the user's intent, especially for open-ended and unconventional inquiries that do not match the pre-

defined patterns.

C. Knowledge Base Dependency

The AI Virtual Calling Assistant is highly dependent on the institution's Knowledge Base to obtain the answers to the questions it is asked. Therefore, the reliability, precision and utility of the Virtual Calling Assistant will depend on the accuracy, comprehensiveness and structure of the institutional knowledge base. The knowledge base is the heart of the information that is required for the system to provide adequate service.

If the Knowledge Base contains outdated, missing, duplicate or poorly formatted information, the Assistant may produce only partially correct or even incorrect answers. The quality of user experience can also be negatively affected due to the absence of certain entries. In such cases, the Assistant produces fallback answers, which may not suffice to satisfy the user's request.

Another challenge was dealing with dirty or unstructured data. If the data wasn't properly normalized and indexed, the database wouldn't be able to query it efficiently, and the return values would either be wrong or slow to come back. But dealing with dirty data was an important one. Our system had to deal with very dynamic data, lots of institutions are educational, and the information on their websites concerning admission, timetables, and administrative rules, changes frequently. Therefore, dealing with dirty data in real time was key.

We must deal with the challenges described above by regularly updating and verifying the knowledge base. To ensure the accuracy and reliability of the assistant, we must regularly maintain the data, keep it in a structured format and carry out the necessary classification and organization of the information. In addition, we must provide the function of synchronization of data with the infrastructure of the institution, so that the knowledge base is always updated.

The overall performance of the AI Virtual Calling Assistant is highly dependent on the quality of the knowledge base, making KB a very important element for providing accurate, consistent and reliable institutional information to students, staff and parents.

D. Internet and Browser Dependency

This Virtual Assistant works on the web as a part of our College Portal and so works on the principle of internet connectivity and browser compatibility. Sometimes the speech processing as well as the output is a bit delayed if the internet speed is not good. Also, if your browser security settings and or your Microphone settings do not allow access to audio of your voice then too this Virtual Assistant may not function to your satisfaction.

E. Processing Latency During Continuous Interaction

Although the assistant will generally respond almost in real time, there may be a little delay when exchanging many messages. The processing of each request involves several stages: speech recognition, language processing, database search and speech generation. Because these operations have to be carried out in sequence, the response time can increase when exchanging many messages within a single conversation.

F. Limited Emotional and Contextual Awareness

The AI Virtual Calling Assistant does not have emotional intelligence or the ability to understand the context of the conversation at a human level. It is based solely on the text and decision trees and does not have the emotional intelligence, empathy or ability to understand context in the same way a human would. This means that the Assistant will not be able to pick up on the emotional cues in the language or tone used, which means that it will not be able to detect if the user is becoming frustrated or if they are requiring a deeper or more empathetic response, and it will only be able to respond to the most superficial of queries.

Discussion of Limitations

Even though the limitations may impact some functionalities of the Virtual Calling Assistant for AI, they do not impact the core functionality of being able to service routine institutional enquiries quickly and efficiently. It is believed that most of these limitations are due to current limitations in technology, rather than being a function of the overall design of the system. In the future, when speech recognition technology and natural language understanding improve, as well as with the inclusion of more advanced algorithms for learning and adapting, some of the current limitations

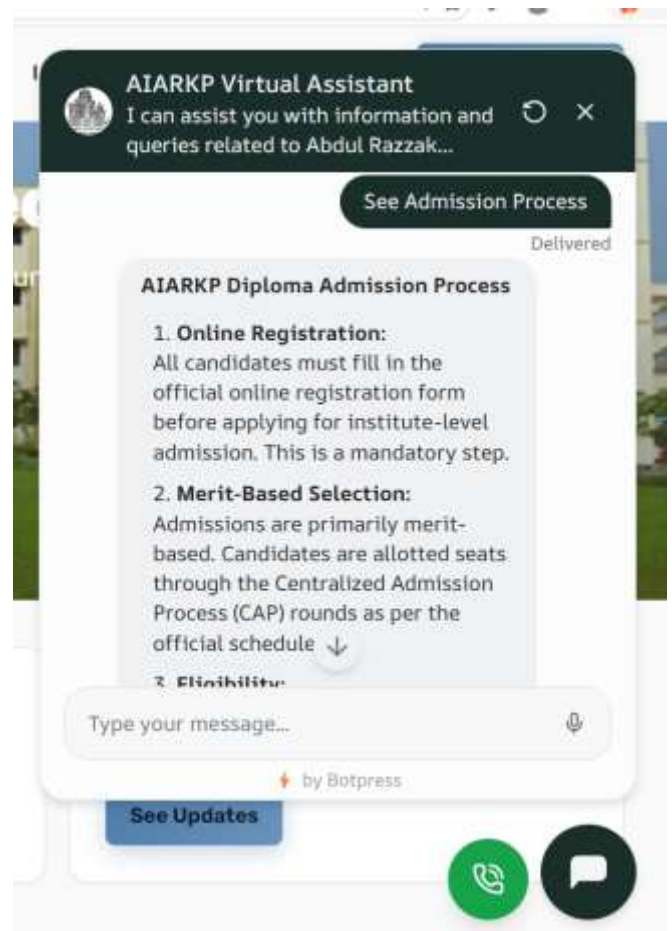
of the system will be addressed, allowing for improved functionality and higher levels of accuracy and smartness in the Virtual Calling Assistant for AI.

VII. IMPLEMENTATION & RESULTS

Website:



Chatbot:



Calling Interface:



Call Activated:



VIII. FUTURE SCOPE

The proposed AI Virtual Calling Assistant has demonstrated tremendous potential for automating institutional communication. A plethora of features that can be enhanced, and many opportunities to extend the proposed functionalities. As smart, and more user interactive systems are needed by all sectors of our societies, the proposed system can be evolved to a much wiser, more agile, scalable, and highly applicable system, by capitalizing the recent breakthroughs and advancements in the AI research area. Therefore, the proposed system can be transformed to a highly intelligent, and fully-fledged communication system, through which, a vast number of institutional services can be delivered effectively.

One of the most important future development areas for this project will be deep learning-based NLP. The current functionality of the plugin relies heavily on hard-coded intents and keywords, which are insufficient for dealing with the free-form, sometimes ambiguous and particularly in conversational speech not always directly phrased language users apply when interacting with an AI. Advanced deep learning-based language understanding models can help improve context

recognition and make the plugin more compatible with human speech, allowing it to better deal with ambiguous and indirect input and result in more human-friendly and context-specific dialogue output.

Multilingual Support is another major feature that is being added. Currently, the Chatbot works only in a single language. This may not be enough for institutions which have students with multi lingual backgrounds. By making the Chatbot Multilingual, it will be possible to work with multiple regional and international languages and thus enable the Chatbot to communicate better with users across different languages. By enabling Multilingual Support, the Chatbot will become more inclusive in terms of communicating with users who would like to interact in a language of their choice.

The system can be further enriched with the integration of institutional systems such as online application portals, student information systems and examination databases. With an integration to these systems, the assistant can keep students updated with the progress of their applications, admissions etc. along with the class timings, results of exams, attendance etc. This real time data connectivity makes the assistant from a simple knowledge tool to an intelligent academic support tool capable of delivering highly personalized services to students.

Also future releases will incorporate Voice Personalization & Adaptive Learning Features. The system will learn user behavior based on how the user interacted with the product in the past and on the search history, so it can better understand the intent behind the user input and provide accordingly. Machine learning will also be used to continuously improve user experience with analysis of user input and search behavior.

Another area for future work will be to improve the accuracy and robustness of the speech recognition component. Currently, the speech recognition works very well under typical conditions, but there are many conditions where it may not work well, such as in the presence of background noise, with non-standard speaking styles or dialects, etc. The ability to incorporate more advanced speech processing techniques and better noise reduction algorithms will all contribute to higher recognition accuracy and more robust speech-to-text functionality.

Future improvements can incorporate transformer-based models and attention mechanisms to enhance

contextual understanding and response accuracy [20].

The system can also be developed to integrate with mobile apps and devices such as mobile phones, tablets, and voice assistants (e.g. Siri, Google). This makes the use of the AI Virtual Calling Assistant more accessible to users, at any time, anywhere. By integrating various devices and systems, the system can be expanded to become a more scalable platform that can benefit a larger user base.

Emotional Intelligence & Sentiment Analysis is an area that is receiving increasing amount of focus and one of the key areas of development for Voice Assistants. Emotional intelligence involves a set of skills that involve understanding human emotions, being able to empathize and interact with individuals on a deeply personal level. Some of the key elements include tone recognition, intent behind language, sentiment behind statements and more. Voice assistants can greatly benefit from adding emotional intelligence in the way they interact and assess users. For instance, having the ability to gauge a user's sentiment behind their language can guide more empathetic and appropriate responses which can not only boost engagement but also significantly improve the quality of conversation a user has with a Voice Assistant.

In the near future, more functions will be added such as system security, verification and authentication etc. to enable students, teachers and administration to securely access important data in the institutional network. This might include user authentication, role based access control and encryption of user data to name a few.

The future of the AI Virtual Calling Assistant is in making this system a highly intelligent, adaptive, secure and scalable communication system that can be used to provide a multitude of academic and administrative services. With rapid development of Artificial Intelligence, machine learning and speech technologies, it is highly expected that this system will form one of the building blocks of a smart campus environment and in turn make communication between institutions and users intelligent and highly effective.

VIII. CONCLUSION

This research presents a Virtual Calling Assistant provided by an AI, which can serve as a useful tool for replacing some of the communications made within academic institutions. It combines speech recognition, natural language processing and text-to-speech technologies in an academic college web portal in order

to allow students to obtain information about the college via voice conversation.

The system has been implemented to handle frequent queries that are concerned with Admissions, Courses, Fees and Facilities of the University Campuses. The system responds to these queries very efficiently and gives the exact human response that the user is looking for in no time. It also has the advantage of reducing the manpower in the administrative department and also in facilitating the user in the best possible way.

Despite some present constraints, the system provides a solid basis for future improvements and work, including the adoption of more sophisticated machine learning algorithms, support for multilingual input, and increased connections to the college's enterprise-level data stores.

The AI Virtual Calling Assistant is another instance of innovative works in the domain of Smart Campus technologies. It is an evolving development that shall likely form the cornerstone of the future Intelligent Communication Systems.

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