Artificially Intelligent Virtual Assistant Chatbot

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ABSTRACT

In today's world where artificial intelligence (A.I) is slowly taking over, chatbots, virtual assistants (data driven and predictive conversational A.I chatbots) play a dominating role. Common examples of virtual assistant chatbots are the amazon alexa and apple's siri. They are extremely advanced, efficient, capable, sophisticated greatly helping in reducing human labour to a larger extent. A chatbot can remember all the user's input and act accordingly. It mostly uses natural language processing(NLP). Our project basically focusses in creating a artificially intelligent virtual assistant that basically responds to all human commands and executes it. It uses NLP for voice and speech recognition. We will pre-programme it accordingly.

Chatbots and virtual assistants are basically typical examples of an A.I system. They study, learn and can even copy and mimic human behaviour which makes them useful in many different fields that includes specifically education, business, retrieval of information from different sources, e-commerce etc. Frankly speaking the applications of A.I is infinite and so is for the chatbots. Several companies including many multi-national corporation use chatbots for their internal and external use. These include messaging apps like the facebook bots of companies, hike-Natasha, customer service bots that include swiggy bot, Zomato bot, voggo bot etc, the companies' internal uses like internal HR bot, internal finance tool bot etc.

Well, that's a brief about our day-to-day on use chatbots and now coming back to our project we will be programming a chatbot mostly a virtual assistant that receives our commands and acts accordingly. As we know amazon alexa is one of most popular virtual assistant voice service available on hundreds of millions of devices which basically perform anything the human commands to it via speech most of which include listening to music, creating shopping lists, getting different news updates and many more. It is also capable of setting alarms, streaming podcasts, playing audiobooks and providing weather, traffic, sports, and other real-time information. Basically, it uses automatic speech recognition, natural language processing and other forms of weak A.I to perform these tasks. Another similar virtual assistant is apple's siri.

Surely, they make stuffs lot simpler and efficient and reduces human labour. However, what if they didn't exist…or were never made. If so can we programme our very own virtual assistant chatbot that will work according to our instructions? That's basically what our project is that is to recreate a similar virtual assistant like alexa imagining that alexa didn't exist and give an overview on chatbots, their types, their importance and their future values in modernising humanity. We will use python programming which is a high-level language in creating our very own virtual assistant chatbot that will receive and operate based on our commands.

Keywords: Deep Learning, A.I, NLP, chatbot, virtual assistant, python

I. Introduction

A chatbot is a programme that communicates with you. It is a layer on top of, or gateway to, a service. It is powered by machine learning (the chatbot gets smarter the more you interact with it).Or, more commonly, it is driven using intelligent rules(i.e. if the person says this, respond with that).

The services a chatbot can deliver are diverse. Important life-saving health messages, to check the weather forecast or to purchase a new pair of shoes, and anything else in between.

The term chatbot is synonymous with text conversation but is growing quickly through voice communication… "Alexa, what time is it?" (Other voice-chatbots are available!)

The chatbot can talk to you through different channels; such as Facebook Messenger, Siri, WeChat, Telegram, SMS, Slack, Skype and many others.

Consumers spend lots of time using messaging applications (more than they spend on social media). Therefore, messaging applications are currently the most popular way companies deliver chatbot experiences to consumers.

Chatbots are used to help humans interact with technology and automate tasks. Improvements in AI, machine learning, data science, and natural language processing have enabled the proliferation of chatbots by making it easier to build conversational bots for a variety of applications that benefit companies, their customers, and their employees.

Chatbots provide a number of benefits for companies. Many companies have chatbots that act as virtual agents that can handle customer service issues and support employees. In general, improved customer service combined with a reduction in customer service costs leads to a high return on investment (ROI) for companies that use chatbots for customer service.

Customers also benefit from the use of chatbots. Chatbots provide customers access to assistance or customer service that is available on demand without restriction. When customers interact with chatbots, they can get replies to their questions anytime. They also tend to have easier sales experiences and have a more personal connection with the brands that they interact with.

We've probably interacted with a chatbot whether we know it or not. For example, we're at our computer researching a product, and a window pops up on our screen asking if we need help. Or perhaps we're on our way to a concert and we use our smartphone to request a ride via chat. Or we might have used voice commands to order a coffee from our neighbourhood cafe and received a response telling us when our order will be ready and what it will cost. These are all examples of scenarios in which we could be encountering a chatbot.

Where is the evolution of chatbots headed? Chatbots, like other AI tools, will be used to further enhance human capabilities and free humans to be more creative and innovative, spending more of their time on strategic rather than tactical activities.

In the near future, when AI is combined with the development of 5G technology, businesses, employees, and consumers are likely to enjoy enhanced chatbot features such as faster recommendations and predictions, and easy access to high-definition video conferencing from within a conversation. These and other possibilities are in the investigative stages and will evolve quickly as internet connectivity, AI, NLP, and ML advance. Eventually, every person can have a fully functional personal assistant right in their pocket, making our world a more efficient and connected place to live and work.

Therefore, with improved outcomes, chatbots with better representation learning capabilities have been demonstrating its relevance in this area. Using deep neural architectures and natural language processing modules we analyse how chatbots functions and how can we programme our very own chatbots that responds to our commands efficiently.

There are different types of chatbots based on their functionality, purpose, and design. Here are some common types of chatbots:

Rule-Based Chatbots: Rule-based chatbots operate using a predefined set of rules and responses. They are programmed to recognize specific keywords or patterns in user input and provide corresponding predefined answers. Rule-based chatbots are relatively simple and limited in their capabilities, as they can only respond to queries, they have been explicitly programmed to handle.

AI-Powered Chatbots: AI-powered chatbots, also known as intelligent chatbots, utilize artificial intelligence and machine learning techniques to understand and respond to user queries. They can handle a wider range of natural language inputs and learn from user interactions to improve their responses over time. AI-powered chatbots are more flexible and adaptive compared to rule-based chatbots.

Virtual Assistant Chatbots: Virtual assistant chatbots are designed to emulate human-like conversation and provide personalized assistance to users. They can perform tasks such as answering questions, providing recommendations, making reservations, and executing various tasks through integration with external services or APIs. Virtual assistant chatbots often have advanced natural language understanding and can handle complex interactions.

Transactional Chatbots: Transactional chatbots are specifically designed to facilitate transactions and complete actions on behalf of users. They can handle tasks like placing orders, making payments, tracking shipments, and providing customer support for specific products or services. Transactional chatbots often integrate with e-commerce platforms or payment gateways to facilitate seamless transactions.

Social Media Chatbots: social media chatbots operate on platforms like Facebook Messenger, WhatsApp, or Twitter. They can engage with users, answer questions, provide information, and perform actions within the social media ecosystem. Social media chatbots are commonly used by businesses for customer support, lead generation, and marketing purposes.

Hybrid Chatbots: Hybrid chatbots combine the capabilities of rule-based systems and AI-powered systems. They use rule-based logic for simpler and more predictable queries, and AI techniques for handling more complex or ambiguous queries. Hybrid chatbots aim to strike a balance between flexibility and control.

The type of chatbot used depends on the specific requirements and goals of the application or business. Some chatbots may also incorporate elements from multiple types to offer a more comprehensive conversational experience.

Deep Learning

Deep learning is a powerful technique that is commonly used in the development of chatbots. Deep learning is a subfield of machine learning that focuses on training artificial neural networks with multiple layers to recognize patterns and make predictions or decisions.

In the context of chatbots, deep learning is employed to enhance the natural language understanding (NLU) and natural language generation (NLG) capabilities. Here's how deep learning is utilized in different aspects of chatbot development:

➢ Natural Language Understanding (NLU): Deep learning models, such as recurrent neural networks (RNNs) or more advanced models like long short-term memory (LSTM) or transformer models, are trained on large amounts of text data to understand and interpret user inputs. NLU models help extract the intent of a user's message, identify key entities, and determine the context of the conversation.

➢ Natural Language Generation (NLG): Deep learning techniques are employed to generate human-like responses. NLG models use data-driven approaches to generate coherent and contextually relevant responses based on the input received. These models can leverage recurrent neural networks, generative adversarial networks (GANs), or transformer models to generate high-quality text responses.

➢ Dialog Management: Deep learning can be applied to manage the flow of conversation and maintain context. Reinforcement learning techniques, combined with deep neural networks, can be used to train chatbots to select appropriate responses based on the current conversation state, user feedback, and predefined reward signals.

➢ Sentiment Analysis and Emotion Recognition: Deep learning models can be trained to analyse user sentiments and emotions expressed in their messages. This helps the chatbot to understand the user's emotional state and respond accordingly, providing a more empathetic and personalized experience.

It's important to note that deep learning is just one aspect of building a chatbot, and the overall architecture typically involves several other components, such as data preprocessing, feature extraction, and integration with the conversational interface.

By leveraging deep learning techniques, chatbots can become more accurate, context-aware, and capable of delivering engaging and human-like interactions. As the field of deep learning advances and more sophisticated models are developed, chatbots are expected to become even more intelligent and capable of understanding and responding to user inputs with greater accuracy and nuance.

Next we proceed to create our very own virtual assistant and our very own chatbot and name it dua.

Building and designing our very own virtual assistant

We have created a Python script that uses speech recognition and text-to-speech synthesis to perform various tasks, including playing songs on YouTube, providing the current time, looking up information on Wikipedia, telling jokes, and more. The script responds to voice commands and interacts with the user accordingly.

Here's a brief summary of the key components and functionalities of our script:

1. We import necessary libraries, including **speech_recognition**, **pyttsx3**, **pywhatkit**, **datetime**, **wikipedia**, and **pyjokes**.

2. We initialise the text-to-speech engine and sets the voice to a specific one.

3. We define a **talk** function to convert text to speech and a **take_command** function to listen for voice commands using a microphone.

4. Within the **run_dua** function, it listens for voice commands and responds accordingly based on the recognized command. Some of the supported commands include playing songs, providing the current time, looking up information about a person on Wikipedia, telling jokes, and more.

5. The script runs in an infinite loop, continuously listening for new voice commands and responding to them.

Overall, this script is a simple voice-controlled assistant that can perform various tasks. We can continue to expand and improve its functionality by adding more commands and capabilities as needed.

Next we create our very own chatbot using python, however before going to that we first look at the models used in chatbot development.

There are various models used in chatbot development, ranging from rule-based systems to machine learning-based approaches. Here are some commonly used models:

Rule-based Models: These models use predefined rules and patterns to generate responses. They rely on handcrafted rules and patterns to match user inputs and provide corresponding predefined responses. Rule-based models are relatively simple but lack the ability to learn from data.

Retrieval-based Models: Retrieval-based models select responses from a predefined set of responses based on the similarity between user inputs and predefined queries or patterns. They often use techniques like TF-IDF (Term Frequency-Inverse Document Frequency) or word embeddings to find the most suitable response.

Examples of retrieval-based models include keyword matching, nearest neighbour search, and cosine similarity-based approaches.

Generative Models: Generative models, particularly sequence-to-sequence models, are widely used in chatbot development. These models, often based on recurrent neural networks (RNNs) or transformer models, learn to generate responses based on input sequences. They are trained on large datasets and can generate contextually relevant responses. Popular models include the Seq2Seq model with LSTM or GRU cells, as well as transformer models like GPT (Generative Pre-trained Transformer) and its variants.

Hybrid Models: Hybrid models combine rule-based, retrieval-based, and generative approaches to leverage their respective strengths. They may use rule-based or retrieval-based systems for specific patterns or predefined queries, and generative models for generating more diverse and contextually relevant responses.

Reinforcement Learning Models: Reinforcement learning (RL) can be used to train chatbot models. In this approach, the chatbot interacts with users and learns from their feedback to optimize its responses. The model receives rewards or penalties based on the quality of its responses and uses this feedback to improve over time.

Transfer Learning: Transfer learning involves leveraging pre-trained models on large-scale language tasks and fine-tuning them for chatbot-specific tasks. This approach allows chatbot developers to benefit from models that have been trained on extensive datasets and have learned general language patterns. For example, models like GPT-3 or BERT (Bidirectional Encoder Representations from Transformers) can be fine-tuned for chatbot applications.

It's important to note that the choice of model depends on factors such as the complexity of the chatbot task, available data, and computational resources. Additionally, chatbot development often involves a combination of these models, as different models may be suitable for different aspects of the chatbot's functionality.

Next we create our own chatbot dua using deep neural networks and trained it accordingly to respond to our commands and respond accordingly.

Building and designing our very own chatbot
The code we did is a simple chatbot script using TensorFlow and Keras for natural language processing. It loads a pre-trained model, a tokenizer, and a label encoder to understand and respond to user inputs based on predefined intents stored in a JSON file called "intents.json." The chatbot generates responses based on the most probable intent predicted by the model.
Here's a breakdown of the script:
➤ The code imports necessary libraries and modules, such as json, numpy, TensorFlow (keras), sklearn's LabelEncoder, colorama for colorful console output, random, and pickle.
➤ It reads the contents of "intents.json" into the variable data, which contains predefined intents along with corresponding responses.
➤ The chat() function is defined, which serves as the main loop for the conversation with the chatbot.
➤ Inside the chat() function:
• The pre-trained model, tokenizer, and label encoder are loaded from their respective files.
• The max_len parameter is set to 20, representing the maximum length of input sequences used by the model.
➤ The script enters a continuous loop to read user inputs and respond accordingly until the user types "quit."
➤ When a user inputs a message, it gets processed through the loaded model and the tokenizer. The model predicts the most probable intent for the given input.
➤ The corresponding tag is then used to find the appropriate response from the data loaded from "intents.json."
➤ The chatbot generates a response based on the selected intent and displays it to the user.
➤ The conversation continues until the user types "quit," and the loop breaks, ending the script.

To use this chatbot, we would need the following files in the same directory as the script:
➤ "intents.json": A JSON file containing predefined intents and responses for the chatbot.
➤ "chat_model": The pre-trained TensorFlow/Keras model for intent prediction.
➤ "tokenizer.pickle": A pickle file containing the tokenizer used for processing text inputs.
➤ "label_encoder.pickle": A pickle file containing the label encoder used to map intent tags to their corresponding labels.

We make sure these files are present and properly formatted before running the script. We can start the conversation by executing the script and typing our messages to interact with the chatbot and that's it, our chatbot is ready. Next we see some future works of these chatbots and virtual assistants in our daily life and in general in our society.

Future work of virtual assistant and chatbot

The future work of chatbots and virtual assistants is promising, as ongoing research and advancements in artificial intelligence and natural language processing continue to shape their capabilities. Here are some key areas of future work for chatbots and virtual assistants:

➢ Multimodal Interaction: Integrating chatbots and virtual assistants with multiple modalities such as voice, text, images, and gestures will enable more natural and intuitive interactions. This will make them more accessible and user-friendly across different devices and platforms.

➢ Emotional Intelligence: Developing chatbots and virtual assistants with emotional intelligence, the ability to recognize and respond to users' emotions, will lead to more empathetic and personalized interactions.

➢ Context-Awareness: Enhancing context awareness will enable chatbots and virtual assistants to maintain continuity in conversations and better understand user intent across multiple interactions and sessions.

➢ Hyper-Personalization: Utilizing advanced profiling and machine learning techniques, future chatbots and virtual assistants can tailor responses and recommendations based on individual preferences, behaviour, and past interactions.

➢ Cross-Domain Capabilities: Enabling chatbots and virtual assistants to handle a wider range of tasks across different domains will make them more versatile and useful for users.

➢ Explainable AI: Improving the explainability of chatbots and virtual assistants will help build user trust and confidence in the technology. Users should be able to understand why certain responses or actions were taken by the AI.

➢ Continuous Learning: Implementing mechanisms for continuous learning will allow chatbots and virtual assistants to stay up-to-date with new information, trends, and user preferences.

➢ Collaboration with Humans: Enhancing collaboration between chatbots/virtual assistants and human agents will improve customer support and overall user experience. Hybrid systems that seamlessly switch between automated and human support will be valuable.

➢ Integration with IoT and Smart Home Devices: Integrating chatbots and virtual assistants with Internet of Things (IoT) devices and smart home technology will enable users to control and manage their smart environments more efficiently.

➢ Natural Language Generation (NLG): Improving NLG capabilities will allow chatbots and virtual assistants to generate more human-like and coherent responses, leading to more engaging interactions.

➢ Security and Privacy: Addressing security and privacy concerns associated with chatbots and virtual assistants will be critical to safeguard user data and ensure user trust in these technologies.

➢ Universal Accessibility: Ensuring that chatbots and virtual assistants are accessible to users with disabilities and diverse linguistic backgrounds will be an important consideration for future development.

➢ Multilingual Support: Expanding language support to include a broader range of languages will make chatbots and virtual assistants more globally accessible.

➢ Ecosystem Integration: Integrating chatbots and virtual assistants into various applications, platforms, and services will lead to a more connected and seamless user experience.

As AI technologies continue to advance, chatbots and virtual assistants will play an increasingly significant role in various industries and daily life. The future work in this field will focus on making them more intelligent, adaptable, and user-centric, with an emphasis on delivering value and convenience to users across different contexts.

II. Conclusion

In conclusion, virtual assistants and chatbots have emerged as transformative technologies in the field of artificial intelligence and natural language processing. Over the years, they have made significant strides in their capabilities and applications, revolutionizing the way we interact with computers and technology.

Virtual assistants, like Siri, Google Assistant, and Alexa, have become an integral part of our daily lives, providing us with a hands-free and convenient way to access information, perform tasks, control smart devices, and more. They have evolved to understand and respond to natural language queries, making them accessible to a broader range of users.

Chatbots, on the other hand, have found applications across various industries, including customer support, e-commerce, healthcare, and education. They offer instant and personalized responses, helping businesses improve customer engagement and streamline interactions.

The strengths of virtual assistants and chatbots lie in their ability to provide quick responses, scalability, and 24/7 availability, which are challenging to achieve with human-only support. Moreover, they can process vast amounts of data and learn from user interactions, continually improving their performance.

However, there are still challenges to overcome. Current virtual assistants and chatbots can sometimes struggle with understanding complex queries, maintaining context in extended conversations, and providing nuanced responses. There are also concerns about privacy, security, and potential biases in AI systems that need to be addressed to ensure ethical and responsible deployment.

Looking ahead, the future of virtual assistants and chatbots appears promising. Advancements in natural language understanding, multimodal interfaces, emotional intelligence, and explainable AI will drive their development further. They will become more context-aware, adaptable, and capable of providing hyper-personalized experiences.

Furthermore, as virtual assistants and chatbots integrate with other technologies like IoT devices and smart home systems, they will become central hubs for managing our interconnected environments seamlessly.

Ultimately, the success of virtual assistants and chatbots will depend on their ability to strike a balance between automation and human touch, providing efficient and empathetic interactions while respecting user privacy and maintaining ethical standards. As the field of AI continues to progress, these technologies will undoubtedly play an essential role in shaping the future of human-computer interaction and transforming various aspects of our lives.

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