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MegaBot: Your Financial Guide, Anytime, Anywhere

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ABSTRACT:

The advent of conversational agents and chatbots have served as a boon in providing efficient, effective and rapid customer service while meeting the various requirements of the end user. These conversational agents are revolutionizing the way in which humans interact with machines. The efficacy of these agents is further enhanced by providing them with the ability to learn from previous interactions which is facilitated by Artificial Intelligence and Machine Learning. The use of Natural Language Processing and various Machine Learning based algorithms have further strengthened the overall applicability of these agents to real-world scenarios.

One domain that is still behind in incorporating this technology is the public sector. Governmental institutions have especially been averse to adopting new technology as it accompanies its own set of risks.

The "Megabot" is a step taken in the direction of providing a conversational agent which particularly serves the public sector. Several factors that make up the fabric of a conversational agent were considered including efficient design strategies, incorporating features that enhance trust, perception, sense of security and privacy, and engagement. While most of the current chatbots serves to examine user's frequently asked questions and formulate appropriate responses for the same, the "Megabot" is built as a web application that works as an informational agent that caters to one specific need. In light of the results of various studies, it was noted that there isn't a single application that provides the public with information regarding government schemes and policies as there are multiple divisions under the government, each catering to different fields. The "Megabot" serves to bring the large number of divisions under one umbrella and then provide information regarding all of the latest schemes and policies in one single application.

Keywords: Chatbot; Government; Public Sector; Schemes; Policies; Information

1.Introduction

The advent of conversational agents and chatbots is a significant development with regard to human-computer interaction. Chatbots are machine agents with which users interact through natural language dialogue, by text or voice [5]. An intelligent system, like chatbot, is one that can hold real time conversation using the natural language processing technology [15]. With the incorporation of artificial intelligence, chatbots have become even more accurate in the provision of services, primarily due to the self-learning attribute. Artificial Intelligence (AI) is the field dedicated to creating intelligent machines capable of learning rules for processing information to derive approximate conclusions [22]. Chatbot applications can provide a variety of effective interpersonal interactions and the ability to learn through interactive methods and easy-to-use interfaces; they can even be used as a personal consultation tool [6][7]. The classification of chatbots is contingent upon their operational approach. Two main categories emerge: rule-based chatbots and machine learning-based chatbots. Furthermore, the delineation extends to the information exchange method, where chatbots are categorized into one-time Q&A chatbots and continuous conversational chatbots [16]. A large number of conversational agents and AI-based chatbots are accessible to users across the globe and some of the widely popular ones include Apple's Siri, Amazon's Alexa, Google's OKGoogle and Bard, and OpenAI'sChatGPT. While these agents cater to a variety of requirements, neither is built to cater for a specific and niche requirement. The Megabot (web application) derives inspiration from the above-mentioned agents, however, it is built to tackle that problem and cater to a very specific requirement. The primary purpose of the Megabot is to serve as an informational agent that provides all information regarding policies, schemes and loans introduced by the various departments of the Government of India.

1.1 Chatbots in the financial sector

There is growing interest in chatbots as a leading technology for digital transformation in the financial industry [21]. In order to meet the escalating expectations of customers, delivering prompt and valuable responses has become a significant requirement for service providers. Recent advancements in technology have given rise to a quicker and more streamlined solution: chatbots [17]. The use of chatbots in the financial sector has been seen to boost the efficiency of financial institutions in providing satisfactory customer experience. The use of chatbots generates a huge amount of customer data, transaction data and financial logs that can be used to support decision-making and improve the efficacy of the bot in performing repetitive tasks which can increase the speed of working and reduce cost. The social demand for and expectations from artificial intelligence in the financial sector are

high. The amount of investment in this field is larger compared to other industries such as the distribution, manufacturing, and public sectors [8]. Financial management is a critical aspect of firms, and entails the strategic planning, direction, and control of financial endeavors [19].

The first chatbot introduced in the financial sector is often attributed to "ELIZA." However, ELIZA was not specifically designed for the financial sector but rather as a general-purpose natural language processing program. ELIZA operated by using pattern-matching and simple script-based responses to simulate conversation. While ELIZA wasn't designed for financial applications, its pioneering work in natural language processing laid the groundwork for future developments in chatbots and conversational agents. One of the best examples of chatbots in the financial sector is “Erica” developed by the Bank of America for its banking app. It uses artificial intelligence and natural language processing to understand user inputs and respond appropriately to queries. Users can ask Erica questions about their accounts, transactions, and financial goals, and Erica responds with personalized insights and suggestions. It can also help users make payments, transfer money, and perform other banking tasks within the app.

Similar assistants have been developed by both private and public sector banks in India. They cater to the requirements of the user but are limited to accessing the facilities and services of the particular bank. The available assistants and chatbots focus on individual institutions or organizations. While the private sector uses virtual assistants and remains up-to-date with the latest technology, the same does not apply to governmental institutions. Artificial intelligence (AI) exerts a substantial impact on digital financial inclusion, particularly in domains concerning the identification, measurement, and management of risks. The issue of information asymmetry, provides customer support and assistance through chatbots, and plays a pivotal role in fraud detection and cybersecurity is also to be addressed [18].

There is a desperate need to incorporate technology into governance to enhance the reach of governmental policies, schemes and loans to the grass-root level, to the intended recipients. A lot of benefits of AI applications in the public sector are broadly reported, namely cost savings, alleviation of public servants' workload, increase of productivity, creation of new employment opportunities, solution of resource allocation problems, public service delivery and improvement of citizens' satisfaction (through personalisation and 24/7 availability) [9], [10].

1.2 Chatbots to enhance governance

A rising number of AI applications in government are related to chatbots or conversational agents. Recent literature review suggests that chatbots are predominantly deployed on social media (especially Twitter) by government agencies, political parties and politicians, to serve mainly political purposes. They are used as a new way of political communication [11].

The purpose of the Megabot is to move away from the general trend of using chatbots for political purposes and serve as a tool for information and knowledge gain, a means to spread awareness of the government policies, schemes and loans that have been put in place for the benefit of the people.

An important variable to factor in while developing a chatbot that serves the public sector is the trust factor in a machine. Public trust is defined as the public's confidence in a machine, based on the perceived probability of its performing the work expected of it and displaying favourable behaviour [12]. Considering the trust factor, incorporating design strategies that make the end-user experience comfortable, and serving as an informational agent to the general public (covering all bases of the general population and ensuring no particular group is left out from being able to access the salient features of the web application) is the driving force behind the development of the Megabot.

2.Literature Review

a. **Title**: Understanding the user experience of customer service chatbots: An experimental study of chatbot interaction design
Author: Isabel Kathleen FornellHaugeland, AsbjørnFølstad (2022)
BriefDescription: The study’s primary focus is to understand the relationship between user experience of chatbots and overall customer satisfaction. The survey was conducted on a sample of 35 people with the primary goal of investigating chatbot interaction design features. The survey was led on two design fronts namely: a. Topic-led conversation b.Free text interaction. The study measures scores for three variables - perceived anthropomorphism, hedonic quality and pragmatic quality.

b. **Title**: Virtual Customer Assistants in finance: From state of the art and practices to design guidelines
Author: Andrea Iovine, FedelucioNarducci (2023)
BriefDescription: The study reviews the importance of VCAs in the financial and banking domain and provides recommendation of a set of tools that can be used to design and develop a VCA in the financial domain that guarantees a high-quality user experience. The study organizes VCAs into three broad categories namely: a. Informational b. Transactional c. Advisory. It covers all the wide range of topics from conversational agent architecture, natural language interpreter, text-to-speech synthesizer, rule-based systems, generative systems, discriminative systems, end-to-end conversational systems.

c. **Title**: Text-Based Chatbot in Financial Sector: A Systematic Literature Review
Author: Hana DemmaWube, SintayehuZekariasEsubalew, FiresewFayisoWeldesellase and Taye GirmaDebelee (2023)
BriefDescription: The study presents a comprehensive literature review of a multitude of articles focused on text-based chatbots in the financial sector. It focuses on user experience of chatbots in terms of the following factors: perception, expectation, trust, engagement, security and privacy. It also identifies potential pitfalls that developers could face in the development of chatbots and arrives at potential strategies to avoid the same.

d. **Title**: Toward a Chatbot for Financial Sustainability
Author: Sewoong Hwang and Jonghyuk Kim (2021)
BriefDescription: The primary goal of this study is to establish the effectiveness of AI in the financial sector. The study examines the

relationship between the use of chatbots and effect on banking revenue through customer age classification. The paper studies the direct effect of implementation of a chatbot in increasing financial soundness and suggesting policy alternatives to the customers. Additionally, banking data was thoroughly studied to increase the real life applicability and prove that efficient customer service can be provided through a chatbot system. The paper also mentions how resistance to technology across different age groups can be reduced to make this service available to all customers.

e. **Title**: Transforming the communication between citizens and government through AI-guided chatbots
Author: AggelikiAndroutsopoulou, Nikos Karacapilidis, EuripidisLoukis, Yannis Charalabidis (2019)
BriefDescription: Motivated by the success stories recounted by private sector entities, government agencies have initiated the integration of diverse Artificial Intelligence (AI) technologies across various domains such as health, taxation, and education. Nonetheless, there is a pressing need for extensive research to fully harness the potential of AI within the public sector and effectively apply diverse AI technologies to tackle significant problems and address essential needs. This paper contributes to this objective by introducing a novel approach and outlining the architecture of an Information and Communication Technology (ICT) platform designed to facilitate the advanced utilization of a specific AI technology—chatbots—within the public sector. The primary focus is on enhancing communication between the government and citizens to address a pivotal issue.

2.1 Objectives

a. **Drawback** - Lack of flexibility in interacting with the conversational agent [1][2]
Objective - To enhance Megabot's capabilities, we aim to integrate both topic-led interaction and free-text interaction, offering users greater flexibility in their interactions. The Megabot needs to account for the requirements of the user in terms of the user experience and ensure it is providing the best experience to the user through optimum design strategies. It has to provide text-based interaction as well as button-based interaction to improve the perceived anthropomorphism.

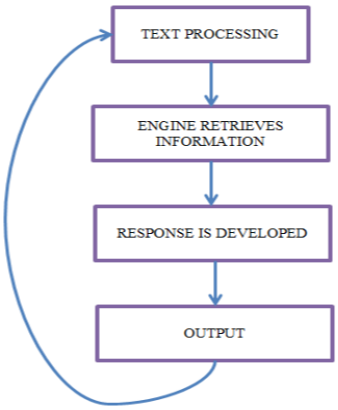
b. **Drawback** - Current chatbots are built for a niche audience [1]
Objective - Ensure that the Megabot cater to all categories of end-users and doesn't cater to one particular age group, race, sex, or religion. The chatbot has to provide its services to anyone who requires information without enquiring or needing information about the background of the end user. Incorporate features that make it accessible for all different age groups and for people of different strata of the society irrespective of their backgrounds.

c. **Drawback** - Current chatbots rely primarily on written form of interaction [3]
Objective - The Megabot should have the capability to provide multiple forms of input to the end user. Apart from the usual written or text-based form of interaction, the bot should allow the user to ask their queries verbally. Thus, the bot should be developed in a manner that it has speech-to-text feature in-built so that multiple forms of interaction with the conversational agent is ensured.

d. **Drawback** - Most chatbots don't have a system in place to record feedback [4]
Objective - The Megabot has to have the feature to capture the user feedback. This provides for better transparency and also ensures that the bot meets the demands of the user. Hence, the bot must incorporate the feedback option wherein the user can express his contentment or dissatisfaction with the application and subsequent steps and measure to reform the issues can be undertaken.

3.Proposed Methodology

The creation of Megabot followed a detailed and organized plan, involving the use of various software and frameworks. The process was divided into four main steps: Text processing, information retrieval, response formulation, and output generation.
To bring this plan to life, several languages, tools, and frameworks were employed, including Python, Flask, HTML, CSS, Bootstrap, jQuery, JavaScript, OpenAI, and the SpeechSynthesis API. In simpler terms, the development of Megabot was carefully structured, breaking down the tasks into specific stages and utilizing a range of programming languages and tools to achieve its functionality.



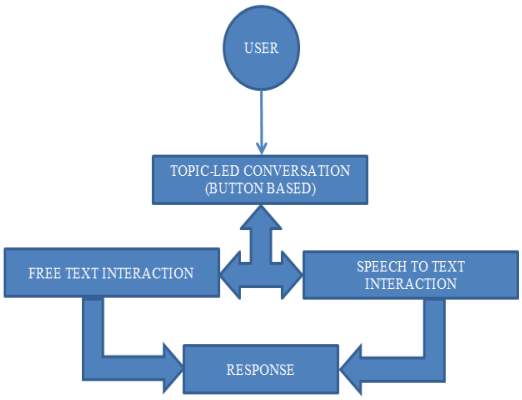
3.1 Methodology Requirements

i. Python and Flask: Employed for backend development, Python with Flask provides a robust and efficient framework, ensuring the seamless functioning of Megabot.
ii. HTML, CSS, Bootstrap, and jQuery: These front-end technologies collectively shape Megabot's user interface, enhancing its visual appeal and user experience through structured HTML, styled with CSS and Bootstrap, and dynamic features with jQuery.
iii. JavaScript: Crucial for client-side interactivity, JavaScript enriches Megabot's user engagement, enabling dynamic content and responsive behavior on the front end.
iv. External APIs Overview
The implementation of Megabot incorporates External APIs to enhance functionality.
   a. OpenAI API: Leveraging OpenAI's advanced capabilities, Megabot accesses cutting-edge natural language processing, enhancing its ability to understand and respond intelligently to user queries.
   b. SpeechSynthesis API: Megabot's text-to-speech feature is powered by the SpeechSynthesis API, enabling it to convert written content into spoken words, enhancing accessibility and user interaction.

4.Design and Implementation

4.1 System Design

The Megabot boasts a diverse range of features, necessitating a reliable and secure architecture to efficiently handle user requests. Building such a chatbot involves careful consideration of key factors:
1. User Interface (UI): Craft an intuitive and user-friendly interface to facilitate seamless interactions, ensuring users findthe experience both accessible and enjoyable.
2. Chatbot Engine: Implement a robust chatbot engine that comprehends user queries intelligently, providing accurate and relevant responses.
3. Activity Logging: Maintain detailed activity logs to track user interactions, enabling the enhancement of future experiences based on historical data.
4. API Integration: Integrate APIs for smooth connectivity with external systems and data sources, ensuring Megabot can leverage diverse information seamlessly.
5. Frameworks: Utilize sturdy frameworks to streamline development processes and guarantee scalability as Megabot evolves.
6. Feedback Mechanism: Incorporate a feedback mechanism for gathering user insights, allowing continuous improvements to the chatbot's performance based on user suggestions.
7. ML Model Training and Maintenance: Employ machine learning for ongoing model training and maintenance, ensuring Megabot stays current and adapts to evolving user needs effectively.

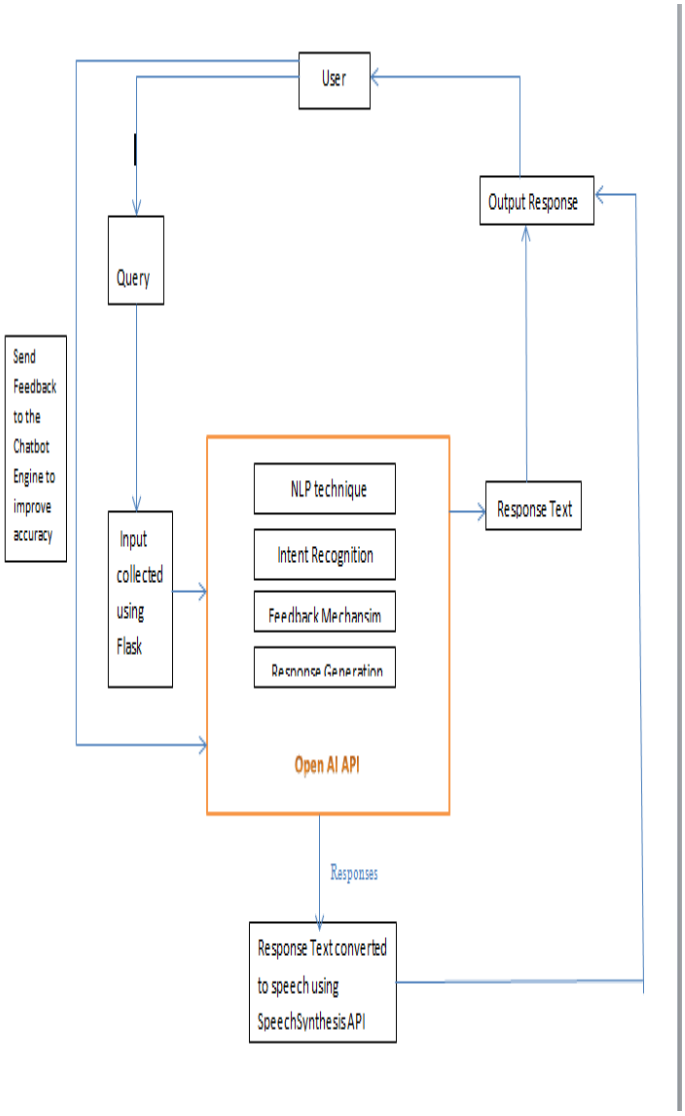


4.2 Implementation

The Megabot is a synergy of Flask, OpenAI, and SpeechSynthesis. OpenAI serves as the chatbot engine, SpeechSynthesis adds features like speech-to-text, and Flask underpins the web application.
Requirement Gathering: Megabot's initiation involves meticulous requirement gathering, understanding user needs by analysing existing systems, and laying a solid foundation for an effective and user-centric chatbot system.
Planning: The planning phase focuses on development timelines, overcoming drawbacks, and aligning with user requirements. It addresses the time required for each development step and ensures compatibility with user expectations.
Design: Using HTML, CSS, Bootstrap, jQuery, and JavaScript, Megabot's design phase creates an intuitive user interface. Iterative prototyping and user feedback refine the design, enhancing the overall user experience.

Development: Megabot's development phase utilizes Flask and Python to write the chatbot logic. Integration of OpenAI API for NLP andSpeechSynthesis for voice interactions solidifies the chatbot's functionality.

Testing: In the testing phase, Megabot undergoes rigorous evaluation to ensure alignment with specifications. NLP model accuracy, security measures, and overall user experience are meticulously examined, ensuring a reliable and responsive chatbot. This phase instills confidence in Megabot's capabilities.



5.Results

The Megabot strives to achieve the objectives that were described in this paper and this web application successfully navigates the gaps that were discovered in earlier studies. The features incorporated in the Megabot meet the major requirements of the users which other chatbots failed to do so in one aspect or the other. The following factors are considered:

1.Provide the user with easy and efficient user interface

The Megabot successfully achieves this as it has an easy design interface. The user interface was built with regard to the discoveries made in previous studies and ensures that the end user experience is in line with the required qualities of being pragmatic and retaining a sense of anthropomorphism. The bot also combines multiple ideologies of design such as topic-led and free-text interaction which provides the user with the desired flexibility.

2.Improved access to information

By combining the information from all the different institutions into one application, the Megabot achieves the task of improving access to information. The design features and the robust engine, further make the process of information retrieval easy, quick and accurate.

3.Caters to a broad audience

The Megabot ensures that the web application is available for use to anyone who requires information regarding government schemes and policies.

4. Feedback mechanism

The Megabot successfully incorporates a feedback mechanism which was a feature uavailable in most chatbots. This helps the developers improve the overall user experience by taking into consideration the feedback of the end user.

6.Conclusion

In conclusion, the development and implementation of the Megabot represent a significant stride towards addressing the limitations observed in traditional chatbots and conversational agents. By strategically aligning with the objectives outlined in this study, the Megabot has successfully overcome several drawbacks associated with existing conversational agents.

The Megabot's commitment to enhancing user flexibility distinguishes it in the realm of conversational agents. With the incorporation of both topic-led and free-text interactions, the Megabot ensures a user-friendly experience, addressing the common issue of inflexibility observed in other agents. This approach contributes to the perceived anthropomorphism, fostering a more natural and intuitive interaction between the user and the application.

Furthermore, the Megabot stands out in its dedication to inclusivity. By catering to a diverse audience without discrimination based on age, race, sex, or religion, it upholds the principle of equal accessibility for all. The Megabot's design emphasizes accessibility, ensuring that individuals from different strata of society can seamlessly access valuable information on government schemes and policies.

The outcomes of this project extend beyond individual user interactions. By consolidating information from various government institutions into a single, easily accessible application, the Megabot improves information accessibility for users while simultaneously contributing to enhanced financial literacy. This holistic approach aligns with the broader goal of empowering citizens with the knowledge needed to make informed decisions regarding government policies and schemes.

Moreover, the Megabot's success in cultivating increased user trust distinguishes it from its counterparts. By functioning solely as an informational agent and avoiding transactional or advisory roles, the Megabot eliminates concerns related to data security and financial advice. The incorporation of a user feedback mechanism further demonstrates a commitment to transparency and continuous improvement, fostering a sense of trust and reliability among users.

From a governance perspective, the Megabot emerges as a valuable tool for efficient information dissemination. By directly integrating with government websites and providing real-time updates on policies and schemes, it streamlines the process of reaching the intended recipients at the grassroots level. This not only facilitates smart governance but also contributes to time and resource efficiency, benefiting both end-users and government agencies.

In summary, the Megabot represents a pioneering effort to revolutionize the landscape of conversational agents, specifically tailored for the public sector. Its achievements in user experience, inclusivity, trust-building, and governance efficiency position it as a model for future developments in the integration of AI and chatbot technology for public service delivery.

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