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Intelligent Learning System Using Interactive Dialogflow and Webhooks

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Abstract: Increase in the workload and number of information needed with additional study programs to be carried out can be too burdensome on the academic staff, Computer-based systems known as Intelligent Tutoring Systems (ITSs) give students individualized education and feedback. It has been demonstrated that Intelligent Tutoring Systems are beneficial in raising student performance generally. This system made an accurate assessment of the learner's knowledge and offer pertinent feedback using artificial intelligence techniques, machine learning and natural language processing. The system was able to adjust to the learner's preferred method of learning. Rapid Application Development (RAD) was used to create the system, allowing for modifications to be made to the system as it is being developed. JavaScript was the programming language utilized for the system. A user study with a group of math learners was to assess the system. The system's success in enhancing students' knowledge and abilities, as well as their pleasure with it, was evaluated in the research. The outcomes of this study aided in the creation of ITSs for math learning that are more efficient. The system created for this research will be a useful resource for students and has the potential to raise the standard of mathematics education.

Keywords: Dialogflow, Webhooks, Intelligent Tutoring System, Feedback, Natural Language Processing

1. Introduction

The traditional approach to learning, where students sit in a classroom and listen to lectures, has proven to be less effective in many cases. This is because students have different learning styles, paces, and levels of understanding, and the traditional approach does not cater to these individual needs. As a result, researchers have been exploring the use of Intelligent Tutoring Systems (ITSs) as an alternative approach to learning. The field of education has undergone significant changes with the advent of new technologies. The Intelligent Tutoring System (ITS) is a computer-based instructional system that has gained a lot of popularity in recent years. ITS uses machine learning techniques to personalize instruction for learners based on their individual needs and abilities [1].

The education system in Nigeria is not as advanced as the education system in other countries. The educators present in the system still make use of predated textbooks and other teaching materials to teach their students. Conversational AI and natural language processing technologies have made significant strides in recent years. These developments have created new opportunities for the educational field, enabling the creation of intelligent tutoring systems that can deliver individualized and engaging learning opportunities. The adoption of this interactive tutoring system can help students learn easily at their own pace and get personalized feedback in response. Natural language processing technologies can now be used to enhance and improve learning in the Education sector [2].

The development of ITSs is critical, particularly in the era of the fourth industrial revolution, where technology is fast-evolving. The use of ITSs is not limited to a specific

domain, as they have applications in many fields, including healthcare, defense, education, and engineering [16].

1.1. Detailed Significance of Study

This study holds significant value as it explores the development and deployment of an intelligent tutoring system as a chatbot on popular messaging platforms. The system aims to improve learning outcomes by delivering personalized instruction, real-time feedback, and interactive engagement through the use of AI technologies. The system's integration with messaging platforms ensures easy access and support for students, allowing them to learn whenever and wherever they want. Additionally, the interactive features promote a stimulating learning environment, and the automation of some tasks helps teachers provide individualized instruction and track student progress. The findings of this study contribute to the advancement of intelligent tutoring systems, offering insights into the utilization of conversational AI and natural language processing technologies in education. Additionally, by demonstrating the advantages and potency of AI-driven educational tools, it has the potential to revolutionize the current educational system.

1.2. Specific Objectives of This Study

The aim of this project is to develop an intelligent tutoring system and deploy it as an interactive chatbot on popular messaging platforms using Google Dialogflow which aims to enhance the learning experience by providing personalized instruction, real-time feedback, and interactive engagement to learners, with the goal of improving educational outcomes.

Objectives:

1. Designing an intuitive conversation flow: To ensure effective communication between the chatbot and learners, create a user-friendly and well-structured conversation flow.
2. Encouraging interactive engagement: Incorporate interactive features that foster meaningful conversations, promote active learner participation, and create an engaging learning environment.
3. Integrating with messaging platforms: Set up the system to seamlessly deploy on well-liked messaging platforms so that students can easily access educational support using their preferred communication channels.
4. Testing and evaluating system performance: Conduct thorough testing and evaluation to assess the system's functionality, effectiveness, and user satisfaction, making necessary improvements based on feedback.

By achieving these goals, the project hopes to create an intelligent tutoring system that makes use of technology to deliver individualized and interactive learning experiences on messaging platforms. By providing learners with convenient and efficient educational support, the project aims to improve the educational system

2. Background Study and Related Works

A chatbot is a piece of software that converses with users (humans). It is a virtual assistant that can provide the appropriate answers to a variety of user questions. The use of chatbots in several fields has grown rapidly during the past few years. Major corporations have created various chatbots for industrial solutions and research in a variety of fields, including health care, marketing, education, and supporting systems. The Turing Test (Can machines think?) and chatbots were widely accepted during the 1950s thanks to British mathematician and logician Alan Turing, who made significant contributions to mathematics, cryptanalysis, logic, philosophy, and mathematical biology as well as the new fields of computer science [3].

Eliza, the first chatbot known to exist, was created in 1966 with the goal of acting as a psychotherapist and answering inquiries from users. The fundamental pattern matching method was combined with template-based answers. However, because to the limited speaking capabilities of the chatbot, which perplexed people who were not experienced with using computers at the time, more chatbots were created in the future [4]. A chatbot named PARRY, which was created in 1972 as an improvement, took the role of ELIZA. The chatbot ALICE was developed in 1995 and won the Loebner Prize, which is a yearly Turing Test, in 2000, 2001, and 2004. It was the first computer in history to receive the honor of being the "most human computer [5].

Computer agents known as chatbots communicate by incorporating natural language to give access to users on services. Computer Systems that conmmunicate and interact with individuals using natural language processing has been in existence since the 1960s [6]. The current surge in interest in chatbots is a result of recent advances in artificial intelligence and machine learning. Chatbots have the potential to change industries like information services, education, healthcare, and customer service. Computer agents known as chatbots interact with users by leveraging natural language to provide users with access to information and services. The term "Chatbot" may be recent, but computer systems that converse with people in natural language have existed and been studied at least since the 1960s [6]. The current surge in interest in chatbots is a result of recent advances in artificial intelligence and machine learning. Chatbots have the potential to change industries like information services, education, healthcare, and customer service.

A promising breakthrough is that AI-powered chatbots can now understand and respond to emotive customer comments almost as well as human operators because to machine learning skills for sentiment recognition (Stathakarou*et al.*, 2020). Chatbots have the potentiality to boost its engagement, social network and acquisition of knowledge when its uses are maximized in the educational sector (Cordero *et al.*, 2020). Students may gain from the employment of chatbots in educational settings by having faster, more effective access to information.

Manual labor has played a significant role in all sectors of life before the advent pf this modern era of technology as chatbots are classified on the ease of user interface algorithms as well as the technologies at use. Hence, the three major categories of chatbots.

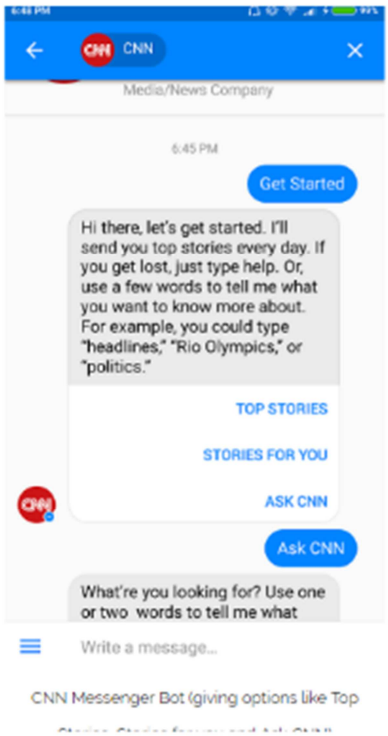

Figure 1. *Diagram representing the Menu/Button-Based Chatbots*

Menu or Button -Based Chatbots: These are the most often used and popular today, in the form of buttons with top-down menus. Their basic operations is on the tenets of decision trees to make choice among other alternatives. [7]. What the user does is to make choice(s), then look deep into the proper answer for better judgements.The performance level of the menu based chatbots are often slow.

Keyword Recognition-Based Chatbots: Here, particular terms are identified in order to get the required outcome. Its like saying 'your input determines your output'. An acceptable answer using artificial intelligence technology and some other list of personalized keywords is choosen. However, the bot breaks down when there are keyword overlaps among inquires that are related [8].

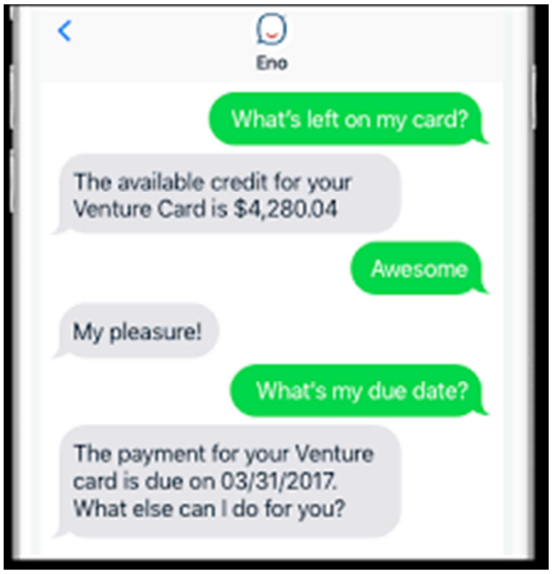

Figure 2. *Diagram representing the Keyword Recognition-Based Chatbots*

Contextual Chatbots:

The contextual chatbots are more common now, they make due with machine learning technologies like speech and voice recognition to cipher the emotion of the user. The core philosophy here is to ascertain the intent of the user and offer a smart response by giving a fair interpretation to the database's pattern. This bot learns and develops more from its experience over the time. [8].

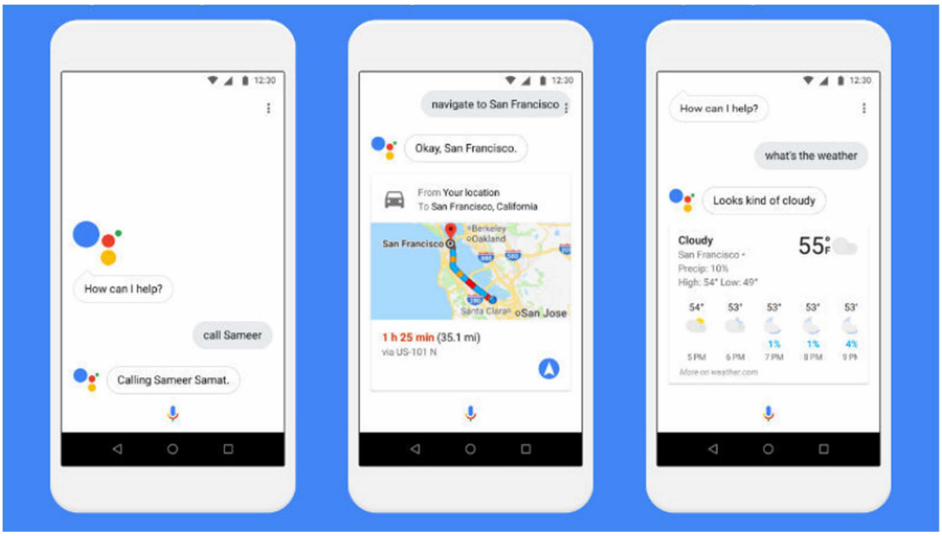

Figure 3. *Diagram representing the Contextual Chatbots.*

A meal delivery service is a clear example of one of the bot as the database is used to keep the history of prior order, the preferences of pay by the users and also the address for delivery.

Chatbot Architecture

The structure of the chatbot is its backbone. Your Chatbot's architecture will rely on a number of variables, including its use-case, domain, and kind. But the fundamental structure of the discourse stays the same. There are four components to it.

1. The knowledge base
2. The back-end
3. The front-end
4. The corpus of data used for training.

The users are always communicated with on the front end as the context and intent are understood through Natural langauge Understanding. The knowledge base supported at the back end is determined by the Natural Language Understanding and generated using the domain corpus. Inputs are received in the form of text or speech [9]. The dialog management system receives the input while determining the relevant answers in order to instruct on the necessary action.

A chatbot which stimulates effective interaction using natural language processing was developed with its deployment on the telegram messaging App through Telegram API obtained on Botfather. This provided an easy access to information that one would have had the difficulty to access through the handbooks or confrontations with humans. The work tested for accuracy and its likeliness responded to queries effectively and on time [10].

A multi-headed deep neural network (MH-DNN) model for addressing the logical and fuzzy errors caused by retrieval chatbot models [11] was proposed. This model cuts down on the error raised from the information loss. The experiments extensively trained the model on a large Ubuntu dialog corpus. The recall evaluation scores showed that the MH-DNN approach slightly outperformed selected state-of-the-art retrieval-based chatbot approaches. The results obtained from the MHDNN augmentation approach were pretty impressive.

The inclusion of chatbots in commerce with the help of the machine learning technique providing learning from historical data to make real time predictions was surveyed by Kushwaha et al, [12].

As businesses try so hard to increase their reach across the globes, Chatbots as anew information and services gives the enablement and bridges the gap between customers/clients and entrepreneurs throuh Apps such as WhatsApp, Instagram, Facebook etc. This when compared to the traditional way of chatting is more efficient and effective as chatbots are sofware free from fatigue and weariness which the human body can suffer from [13].

The use of chatbots in customer services is highly recommendable as well as in the transport sector where passengers can purchase tickets, find out timetables and also be provided with real-time and relevant information about their journeys. These information includes travel prefetences, usage patterns, location and geography based etc.

They include travel, product, service and content preferences, usage patterns, demographic and location-based data. Chat botsRanking and sentence similarity calculation are done using n-gram, TF-IDF and cosine similarity, and from the given input sentence, the score obtained for each sentence and more similar sentences are obtained for the given query. The query posed to the bot which isn't comprehended or not present in the database is further processed by the third party, expert system.

With literatures of the harzardous nature of in the sea container terminals. Analysing the technological solutions at the port showed the lack of empirical application of chatbot. [15] underlines the importance of innovative technologies to curb dangers. The chatbot for training and assisting operators in the inspection of containers was deployed defining five models while presenting a taxonomy for the feature definition. A real study showed the introduction of the Popeye chatbot with contents such as spoken language understanding, image processing app and voice services to handle the harzardous nature of the examination of containers and freights [15].

3. The Intelligent Learning System Using Interactive Dialogflow and Webhooks

This serves as the standard interface when initiating the chat. Every user encounters this interface upon clicking the link to the chatbot. Once the user clicks the start button located at the top of the screen, the chatbot promptly responds.

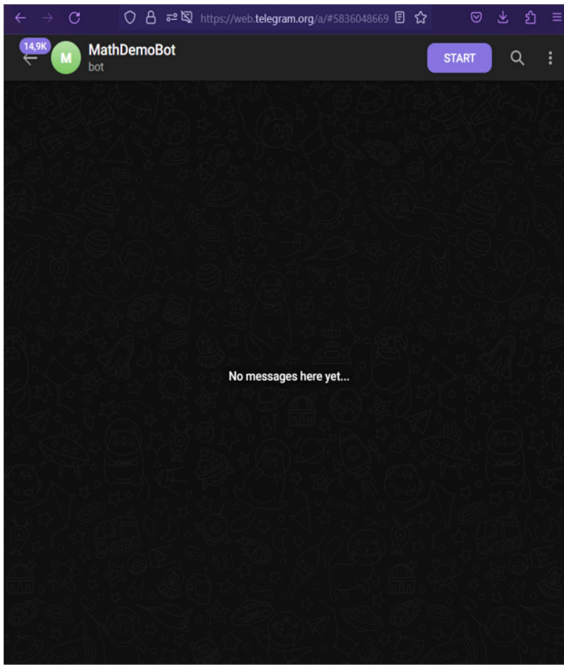

Figure 4. *Telegram Screenshot of the MathDemoBot: Start chat.*

Upon clicking the start button located at the top of the screen to initiate the chat, users are warmly greeted by a welcome message that provides them with comprehensive details about the chatbot's capabilities and instructions on how to interact with it effectively. The welcome message serves as an introduction, acquainting users with the chatbot's functionalities and setting the tone for a pleasant and informative interaction.

Once the welcome message is displayed, the chatbot enters an anticipatory state, eagerly awaiting the user's response to kickstart its operation. It stands ready to engage in dynamic and responsive conversations, offering personalized assistance, answering queries, and providing relevant information based on the user's input. The chatbot's readiness to engage with users in a conversational manner fosters a friendly and approachable atmosphere, encouraging users to explore its capabilities and benefit from the valuable assistance it provides.

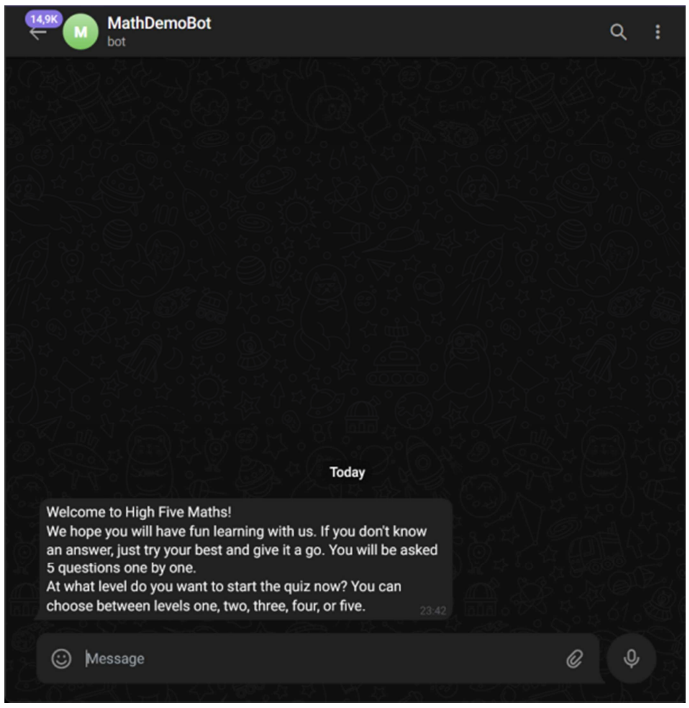

Figure 5. *Telegram Screenshot of the MathDemoBot: Welcome message.*

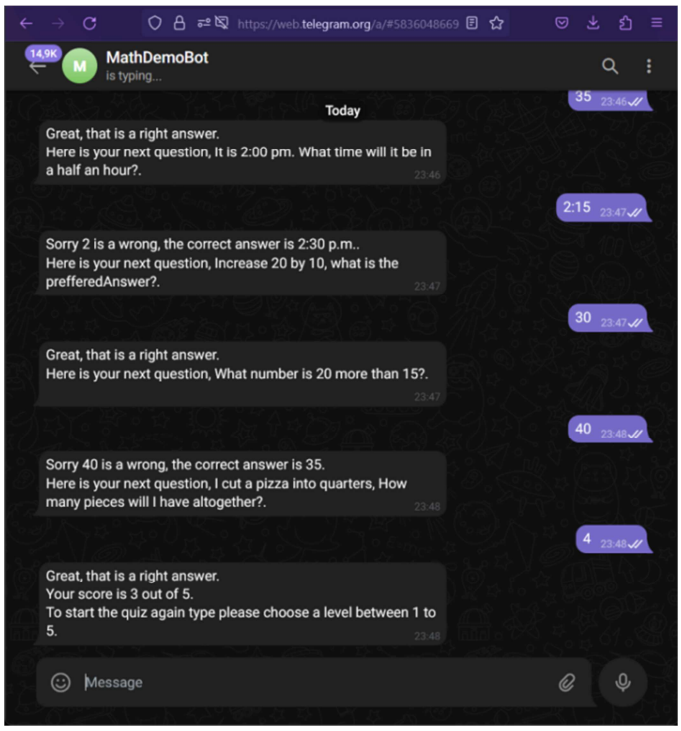

Figure 6. *Telegram Screenshot of the MathDemoBot: Active chat.*

In this immersive segment of the interaction, a comprehensive exchange takes place between the user and the chatbot. The chatbot takes on the role of an evaluator, grading the user's responses based on a set of predefined criteria. This assessment allows the chatbot to tailor its responses and assistance according to the user's demonstrated understanding and proficiency.

As the session draws to a close, the user is presented with two distinct options to proceed. They are given the flexibility to either restart the interaction from the beginning or gracefully exit the chat, enabling them to continue the conversation at a more convenient time. This thoughtful provision ensures that users have the autonomy to revisit and engage with the chatbot as per their convenience and preferences, fostering a user-centric and accommodating experience.

By incorporating this well-structured interaction segment, the chatbot establishes a dynamic and responsive learning environment. It promotes active user participation, offers targeted feedback for improvement, and empowers users to control the pace of their learning journey, ultimately enhancing the overall effectiveness and user satisfaction with the chatbot system.

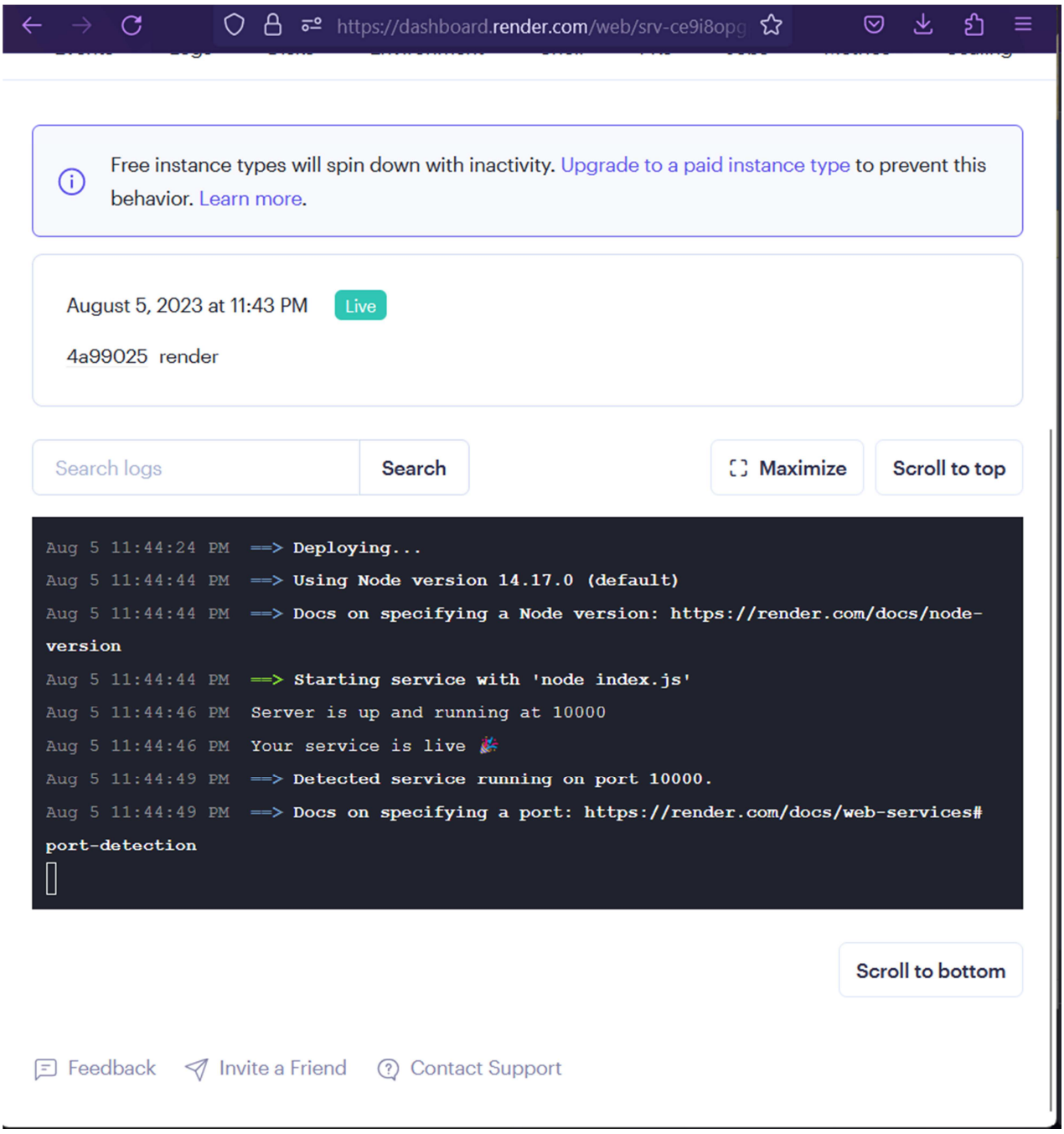

Figure 7. *Backend Bot deployment.*

The operational backend of the chatbot finds its home on render.com, ensuring the chatbot's availability and responsiveness, the backend must remain actively running on render.com. This continuous activity is the key to keeping the chatbot fully functional and ready to engage with users at any time.

By leveraging render.com's reliable hosting services, the chatbot's backend can seamlessly manage user interactions, process requests, and deliver timely responses. The platform's robust infrastructure and performance optimizations ensure that the chatbot operates smoothly, regardless of fluctuations in user traffic or demands.

With the backend consistently active on render.com, the chatbot remains an ever-ready assistant, consistently available to assist users, provide valuable insights, and offer a seamless learning experience. This stable and dependable setup allows users to confidently engage with the chatbot, knowing that its backend is always up and running, delivering a consistent and satisfying user experience.

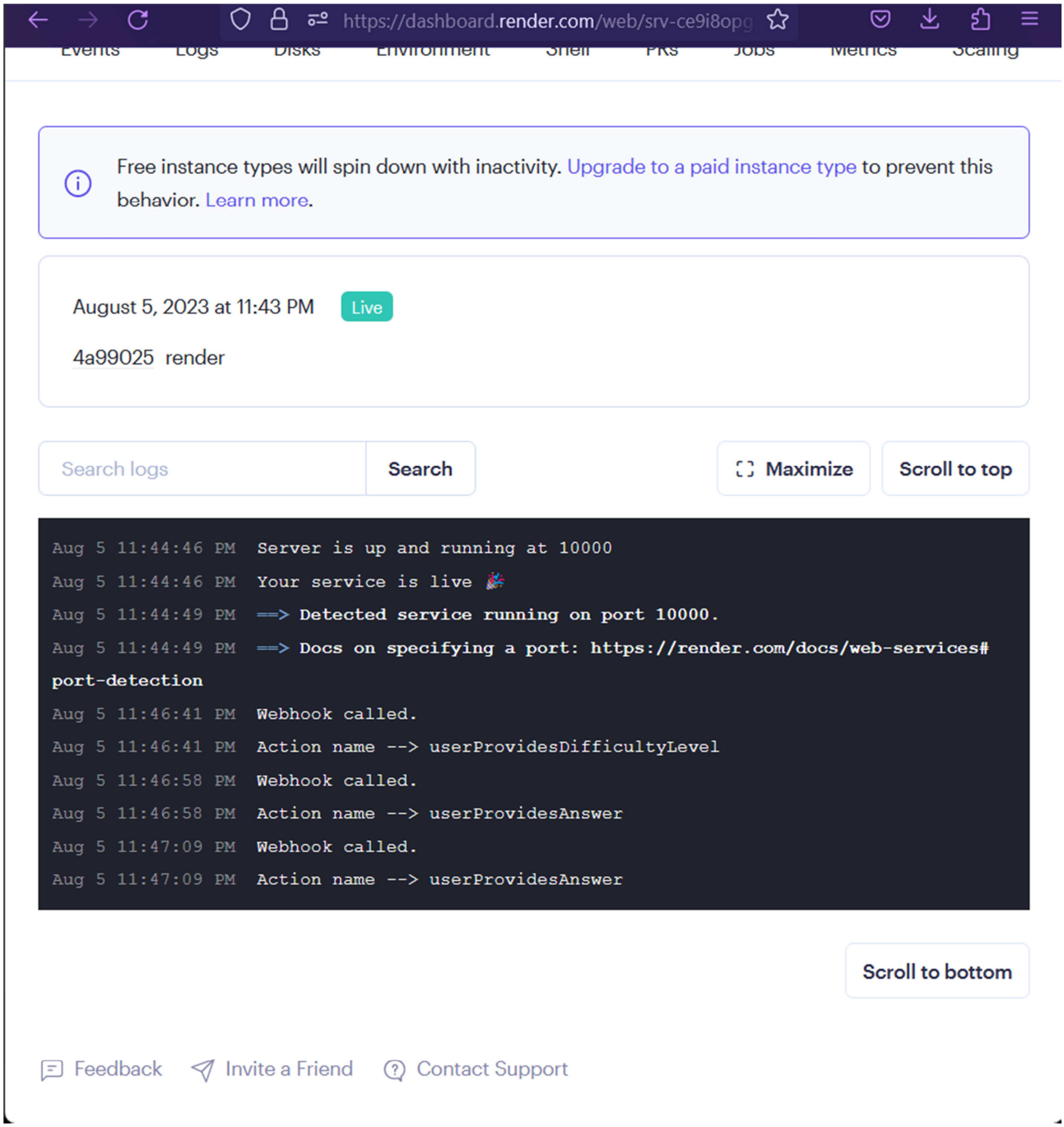

Figure 8. *The Backend of an Active chat.*

As the conversation unfolds, the crucial task of managing the exchange of information between the chatbot and the user

is skilfully handled by Webhook.

In this dynamic process, Webhook acts as a bridge, facilitating seamless communication between the chatbot and the user. When the user inputs a query or message, Webhook swiftly captures and transfers the request to the chatbot, initiating the chatbot's response generation process. Subsequently, when the chatbot formulates its response, Webhook adeptly captures and relays it back to the user, ensuring a smooth and continuous conversational flow.

Designing an Intuitive Conversation Flow

When a user initiates a conversation with the chatbot on the Telegram platform, the chatbot promptly responds by presenting the user with a selection of difficulty levels to choose from. The chatbot then awaits the user's response, patiently anticipating the user's preferred difficulty level. Once the user makes their choice, the chatbot proceeds to pose the first question in the selected difficulty level.

As the user provides an answer to the initial question, the chatbot attentively processes the response. If it happens to be the last question in the chosen difficulty level, the chatbot proceeds to showcase the results of the entire interaction, offering valuable feedback or relevant information based on the user's performance. However, if there are more questions remaining in the difficulty level, the chatbot seamlessly proceeds to present the next question, fostering a continuous and engaging learning experience.

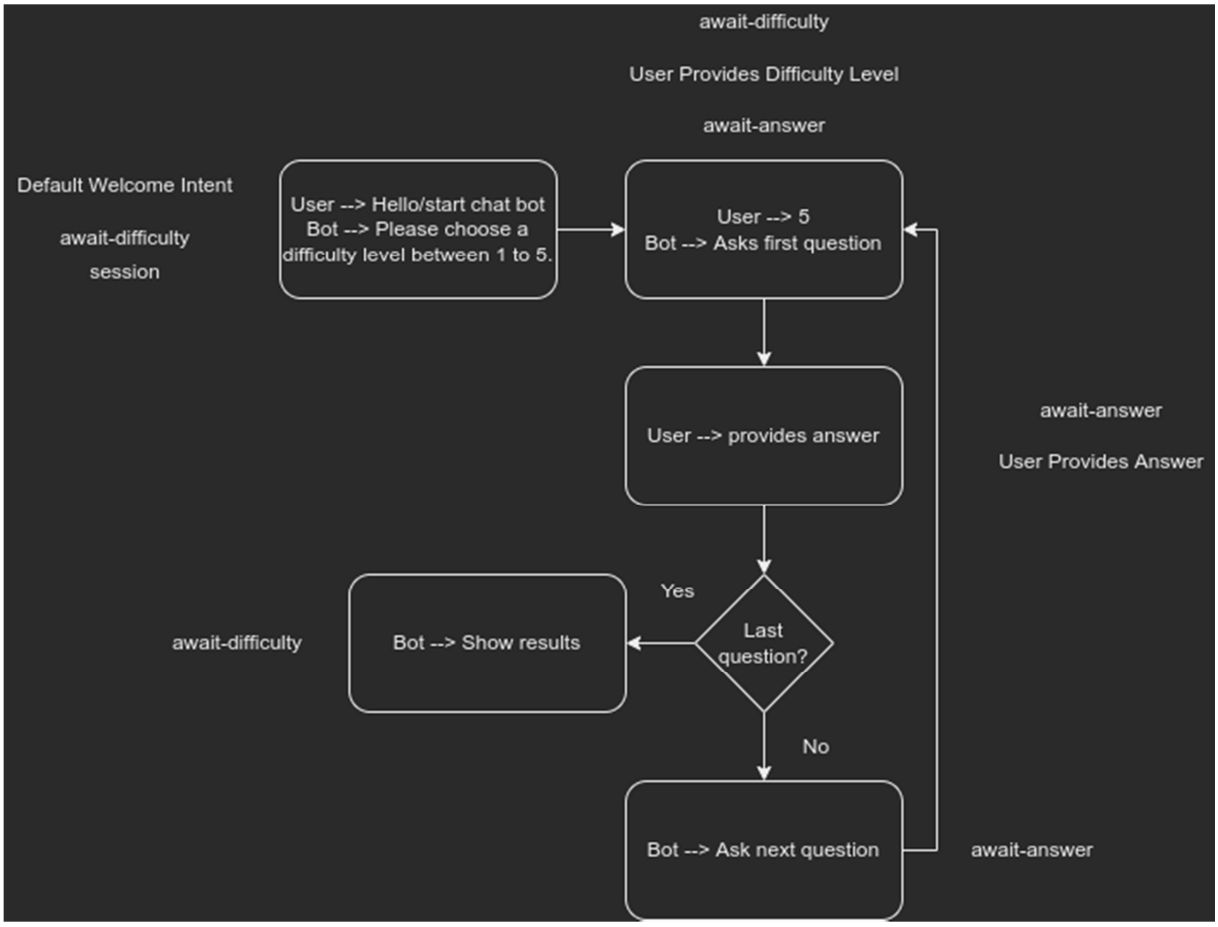

Figure 9. *Flowchart Diagram of the conversation Flow.*

This iterative process continues until the user has answered the last question within the selected difficulty level. Once all questions have been addressed, the chatbot concludes the interaction by displaying a comprehensive summary of the proceedings, encapsulating the user's performance and achievements throughout the interaction.

By following this carefully designed conversational flow, the chatbot system optimizes user engagement, encourages active participation, and provides users with a rewarding and personalized learning journey. This structured approach ensures that users receive a well-paced and interactive experience, enhancing the effectiveness of the chatbot as an intelligent and informative educational tool on the Telegram platform.

4. Conclusion

The Intelligent Tutoring System (ITS) emerges as the central hallmark, a culmination of meticulous design and implementation efforts. Its intuitive conversation flow has been meticulously constructed to facilitate seamless interactions, creating an environment conducive to meaningful and engaging exchanges. Moreover, the robust integration of advanced natural language processing

techniques, facilitated by Google Dialogflow, has endowed the system with the ability to comprehend and respond to user queries with remarkable accuracy and relevance. Equally noteworthy is the incorporation of webhooks, a critical underpinning that has enabled the system to transcend its inherent capabilities, offering access to external data sources and fostering a more enriched learning experience. Within this segment, the journey undertaken throughout the project finds its profound conclusion, brimming with insights and reflections. The comprehensive analysis of the ITS's development and deployment underscores the significance of achieving its intended objectives. The ITS's role in empowering learners with personalized instruction, interactive engagement, and a dynamic learning environment emerges as a tangible achievement, in alignment with the project's overarching goals. Yet, the narrative doesn't shy away from acknowledging the limitations encountered along the way, which have provided a vital lens for understanding the project's boundaries and potential. The concluding remarks encapsulate the researcher's introspective examination of the project's trajectory, weaving together the achievements and constraints to create a holistic understanding of the project's impact and implications. By leveraging the foundational achievements of the ITS, there's a tangible springboard for future development.

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Conflicts of Interest

The authors declare no conflicts of interest.

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