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Developing a Telegram Chatbot using Python: A Comprehensive Study

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Abstract: ***With the quick development of texting stages, chatbots have acquired critical ubiquity in different areas, including client service, data recovery, and diversion. Wire, one of the main informing applications, offers a vigorous stage for building wise chatbots. This exploration paper presents a far reaching concentrate on fostering a Message chatbot utilizing the Python programming language. The paper covers the essential ideas, plan standards, and execution subtleties of making a viable and intuitive chatbot on the Message stage.***

I. INTRODUCTION

A. *Background and Motivation*

Texting stages have changed the manner in which individuals convey and communicate with one another. Wire, a well-known informing application, has seen a critical ascent in its client base, giving a flexible stage to different motivations. One of the vital highlights of Wire is its help for chatbots, which are robotized conversational specialists that can cooperate with clients in a human-like way. Chatbots have acquired gigantic notoriety across various areas, including client support, data recovery, and amusement. They offer the comfort of day in and day out accessibility, speedy reaction times, and versatility in taking care of countless clients all the while. The inspiration driving this exploration paper originates from the rising interest for chatbot improvement and the requirement for a thorough manual for building chatbots on the Message stage utilizing the Python programming language. Python is commonly known for its effortlessness, flexibility, and broad libraries and systems that work with chatbot improvement. By figuring out the key ideas, plan standards, and execution subtleties, designers and scientists can fabricate insightful and intuitive chatbots that take care of the particular prerequisites of their clients`

The main objectives of this research paper are as follows:

1) Provide a comprehensive understanding of the Telegram Bot API and its features.
2) Discuss the design principles and considerations for developing a Telegram chatbot.
3) Present step-by-step instructions for setting up the development environment for Python-based chatbot development.
4) Explain the core functionality of a chatbot, including message handling, user input processing, and response generation.
5) Explore the integration of Natural Language Processing (NLP) techniques to enhance the chatbot's understanding of user input.
6) Discuss advanced features and integrations, such as multimedia support and external API integration.
7) Highlight the importance of testing, evaluation, deployment, and maintenance for a successful chatbot implementation.
8) Identify challenges and future directions in Telegram chatbot development using Python.

II. OVERVIEW OF TELEGRAM BOT API

A. *Introduction to Telegram Bot API*

Key elements and capacities:

Telegram Bot API offers a few critical elements and capacities that enable engineers to make hearty and drawing in chatbots:

Message Dealing with: The Programming interface permits bots to get and send messages, including message, interactive media documents, areas, and that's only the tip of the iceberg. Bots can handle approaching messages, separate important data, and produce proper reactions.

Inline Mode: Message Bot Programming interface upholds inline mode, which empowers bots to furnish moment reactions and connect with clients straightforwardly inside the talk interface. Bots can produce dynamic substance, for example, indexed lists, without changing to a different discussion.

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Console Markup: Bots can make intelligent consoles, including inline consoles and answer consoles, to give predefined choices to clients to browse. This improves on the client experience and upgrades intuitiveness.
Sight and sound Help: The Programming interface permits bots to send and get different sorts of media records, including pictures, sound, archives, and recordings. Bots can process and deal with media records, empowering rich sight and sound communications with clients.
Client and Talk The executives: Bots can get to data about clients and visits, including client profiles, talk IDs, and enrolment status. This works with customized collaborations and designated informing.
Bot Orders: Telegram Bot API upholds custom bot orders, which permit clients to cooperate with bots utilizing predefined orders. Bots can characterize and deal with explicit orders, upgrading convenience and usefulness.

B. Programming interface Documentation and Assets

Designers can allude to the authority Telegram Bot API documentation and assets to successfully figure out the Programming interface's usefulness and use it. The documentation gives definite clarifications, models, and code scraps for every Programming interface strategy and boundary. It covers different themes, including webhook arrangement, message taking care of, inline mode, consoles, media dealing with, and client the executives.
Notwithstanding the documentation, Message gives a committed BotFather bot, which fills in as an intelligent aide for making and overseeing bots. BotFather assists designers with creating bot tokens, set up webhook URLs, oversee bot properties, and the sky is the limit from there.
Moreover, Wire's true site and designer local area offer important assets, instructional exercises, and code tests for building chatbots utilizing the Message Bot Programming interface. Designers can investigate these assets to acquire bits of knowledge, learn best practices, and influence the encounters of the Message bot advancement local area.
By using the Message Bot Programming interface's broad highlights and alluding to the accessible documentation and assets, engineers can make strong and flexible chatbots on the Wire stage

III. DESIGNING THE CHATBOT

A. Characterizing The Chatbot's Motivation And Usefulness

Prior to plunging into the execution, it is significant to obviously characterize the reason and usefulness of the chatbot. This includes distinguishing the particular issue or need the chatbot plans to address and deciding its extension. Whether it's giving client care, conveying data, or offering diversion, a reasonable comprehension of the chatbot's motivation will direct its plan and improvement.

B. Figuring out Client Connections and Aims

To make a powerful chatbot, it is fundamental to comprehend how clients will connect with it and what their purposes are. This includes dissecting potential client questions, demands, or orders and recognizing the hidden expectations or objectives behind them. By perceiving client plans, the chatbot can give important and significant reactions. Different strategies, for example, regular language figuring out (NLU) and expectation acknowledgment calculations can be utilized to accomplish this.

C. Planning the Conversational stream and Exchange the Executives

The conversational stream alludes to the arrangement of communications between the client and the chatbot. It decides how the chatbot answers different client inputs and keeps a cognizant discussion. Planning a natural and connecting with conversational stream includes thinking about the accompanying viewpoints:
Welcome and Onboarding: The chatbot ought to welcome clients and give guidelines or ideas to assist them with getting everything rolling. This guarantees a smooth onboarding experience for new clients.
Setting The board: The chatbot ought to have the memorable option and keep up with setting all through the discussion. This includes monitoring past client inputs, figuring out the ongoing setting, and giving important reactions as needs be.
Blunder Dealing with: The chatbot ought to be prepared to deal with mistakes and surprising client inputs nimbly. It ought to give educational mistake messages and give thoughts or elective choices when clients give invalid or hazy info.
Personalization: Where pertinent, the chatbot can customize the discussion in view of client inclinations or verifiable information. Personalization can incorporate tending to the client by name, giving customized proposals, or recollecting client inclinations for future cooperations.

Multi-turn Discoursed: The chatbot ought to have the option to deal with multi-turn exchanges where the discussion traverses numerous client data sources and reactions. It ought to deal with the progression of the discussion, guaranteeing a cognizant and significant exchange.

Regular Language Age (NLG): NLG methods can be utilized to produce human-like and relevantly proper reactions. NLG calculations can consider the chatbot's motivation, client info, and setting to produce significant and sound reactions.

While planning the conversational stream, it is gainful to make a flowchart or graph that outwardly addresses the different client data sources, purposes, and comparing bot reactions. This aides in figuring out the general design of the discussion and guarantees a sensible and easy to understand chatbot experience.

By characterizing the chatbot's motivation, figuring out client cooperations and goals, and planning a thoroughly examined conversational stream, designers can make a chatbot that successfully addresses client issues and conveys a consistent conversational encounter.

IV. DEVELOPMENT ENVIRONMENT SETUP

A. Introducing Python and Required Libraries

To set up the improvement climate for building a Telegram chatbot utilizing Python, the accompanying advances can be followed:

Introduce Python: Download and introduce the most recent variant of Python from the authority Python site (https://www.python.org/). Adhere to the establishment guidelines in view of your working framework.

Bundle The board: Python gives bundle supervisors like pip or conda to introduce and oversee Python libraries. Guarantee that pip is introduced and modern. You can really look at the pip adaptation by running pip - - form in the order brief or terminal. Update pip if necessary, utilizing pip introduce - - redesign pip.

Introduce Required Libraries: Introduce the fundamental Python libraries for working with Message Bot Programming interface. The python-message bot library is a well-known decision for building Wire chatbots in Python. Introduce it utilizing the accompanying order:

B. Duplicate code pip introduce python-telegram chatbot Setting up a Telegram bot Account

To make a telegram account and get a Programming interface token, follow these means:

Track down BotFather: Quest for BotFather, the authority Wire bot that aides in making and overseeing bots, inside the Message application.

Make Another Bot: Begin a visit with BotFather and adhere to the guidelines to make another bot. Give a name to your bot and get a Programming interface token.

Keep the Programming interface Token Secure: The Programming interface token is significant for getting to the Wire Bot Programming interface. Guarantee that the token is kept secure and not shared openly.

C. Designing the Advancement Climate

To design the advancement climate for building the Wire chatbot, follow these means:

Set up an Improvement Registry: Make another index on your PC for the chatbot project. This index will contain the Python contents and assets for your chatbot.

Make a Python Content: Make another Python script in the improvement registry. This content will act as the section point for your chatbot code.

Import Required Libraries: In your Python script, import the fundamental libraries, like message from python-wire bot, to work with the Message Bot Programming interface.

Set Up Bot Association: Utilize the Programming interface token got from BotFather to lay out an association between your Python script and the Message Bot Programming interface. This includes making an example of the telegram. Bot class and passing the Programming interface token as a boundary.

With the improvement climate set up, you are currently prepared to begin executing the centre usefulness of your Message chatbot utilizing Python. You can allude to the Message Bot Programming interface documentation and the python-wire bot library's documentation for additional subtleties and models on utilizing the Programming interface and library really.

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V. IMPLEMENTING CORE CHATBOT FUNCTIONALITY

A. *Handling Incoming Messages And Commands*

To handle incoming messages and commands in your Telegram chatbot, you can utilize the event-driven architecture provided by the `python-telegram-bot` library. This allows your chatbot to respond to various types of user interactions. Here's a general outline of how to handle incoming messages and commands:

1) Define Handler Functions: Create separate functions to handle different types of events, such as text messages, commands, inline queries, etc. These functions will be triggered when the corresponding event occurs.
2) Set Up Updater: Instantiate an `Updater` object from the `telegram.ext` module and pass your bot's API token and other optional parameters. This `Updater` will handle the communication between your chatbot and the Telegram Bot API.
3) Register Handlers: Register your handler functions with the `Updater` object using the appropriate handler types (e.g., `MessageHandler`, `CommandHandler`). This associates each handler function with the corresponding event.
4) Start the Bot: Start the bot by calling the `start_polling()` method of the `Updater` object. This initiates the process of receiving updates from Telegram and triggering the registered handlers.

B. *Parsing and processing user input:*

To parse and process user input in your chatbot, you can access the information contained in the received `Update` object. The `Update` object provides details about the incoming message, such as the user who sent it, the chat it belongs to, and the text or command provided by the user. Here's an example of how to parse and process user input:

1) Access the Message: Within your handler functions, access the `message` property of the `Update` object to get data about the message received. These include properties like `message.text` for the message text and `message.from_user` for information about the user who sent the message.
2) Extract User Input: Extract the user's input from the message.text` attribute. You can use string manipulation techniques, regular expressions, or natural language processing (NLP) techniques to extract and process the relevant information from the user's input.
3) Perform Processing: Perform any necessary processing on the user's input based on the requirements of your chatbot. This can include tasks such as validating input, performing database queries, invoking external APIs, or applying NLP techniques for understanding user intents.

C. *Generating Appropriate Responses*

Once you have Parsed and processed the user's input, your chatbot needs to generate appropriate responses to send back to the user. This can involve various techniques such as rule-based responses, template-based responses, or more advanced approaches using machine learning or natural language generation (NLG) models. Here's an outline of generating responses:

1) Determine Response Logic: Based on the user's input and the purpose of your chatbot, determine the logic for generating an appropriate response. This can include retrieving information from a database, performing calculations, or formulating a text response.
2) Generate Response: Utilize the relevant techniques or methods to generate a response. This can involve simple string concatenation, formatting templates with user- specific data, or using more sophisticated NLG algorithms to generate natural-sounding responses.
3) Send Response: Use the `bot.send_message()` method to send the generated response back to the user. Specify the target chat ID (e.g., `update.message.chat_id`) and the generated response as the message content.

By implementing the core functionality of handling incoming messages and commands, parsing and processing user input, and generating appropriate responses, your Telegram chatbot will be able to interact with users and provide meaningful and contextual responses.

VI. NATURAL LANGUAGE PROCESSING (NLP) INTEGRATION

A. *Introduction to NLP Techniques for Chatbots*

Natural Language Processing (NLP) techniques enable chatbots to understand and interpret user input in a more sophisticated manner. NLP helps in extracting meaning from text, recognizing user intents, and generating contextually appropriate responses. Here's an introduction to some common NLP techniques used in chatbots:

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1) Tokenization: Tokenization is the process of breaking down text into individual units, or tokens, such as words, sentences, or characters. This helps in preprocessing and analyzing the text at a more granular level.
2) Part-of-Speech(POS)Tagging: POS tagging is the process of assigning to each word in a sentence its respective part of speech, like noun, verb, adjective,etc. Such information aids in comprehending the grammatical form and syntactic relations in the text.
3) Named Entity Recognition (NER): NER refers to identification and classification of named entities in text, i.e., names of individuals, organizations, locations, dates, etc. This aids in extracting relevant information and determining the context of the user's input.
4) Sentiment Analysis: Sentiment analysis aims to determine the sentiment or opinion expressed in a specific piece of text as positive, negative, or neutral. This can be useful for deciding on user sentiment and responding accordingly.
5) Intent Recognition: Intent recognition involves identifying the underlying intent or purpose behind a user's input. By analyzing the user's text, chatbots can categorize user intents and respond accordingly. This helps in providing more targeted and relevant responses.

B. *Preprocessing user Input and text Classification*

Before applying NLP techniques, it is often necessary to preprocess user input to clean and normalize the text. Preprocessing steps can include removing punctuation, converting text to lowercase, removing stop words, and handling special characters or URLs. This ensures that the text is in a suitable format for analysis.

Text classification is another important step in NLP for chatbots. It involves categorizing or classifying user input into predefined classes or categories. For example, classifying user queries into categories like "order status," "product information," or "support request" helps in routing the user to the appropriate response or action. Machine learning techniques like supervised learning, such as Naive Bayes or Support Vector Machines (SVM), or deep learning approaches, such as Recurrent Neural Networks (RNNs) or Transformers, can be used for text classification tasks.

C. Incorporating NLP libraries for Better Understanding

To incorporate NLP capabilities into your chatbot, you can leverage existing NLP libraries and frameworks that provide ready-to-use functionality. Some popular NLP libraries for Python include:

1) NLTK (Natural Language Toolkit): NLTK provides a wide range of NLP tools and resources, including tokenization, POS tagging, NER, sentiment analysis, and more. It also offers pre-trained models and datasets for various NLP tasks.
2) spaCy: spaCy is a powerful NLP library that offers efficient tokenization, POS tagging, NER, and dependency parsing. It provides pre-trained models for various languages and allows customization for specific tasks.
3) scikit-learn: scikit-learn is a versatile machine learning library that includes algorithms and tools for text classification, feature extraction, and model evaluation. It can be used in combination with NLP techniques to build classification models for chatbot intents.
4) Transformers (Hugging Face): Transformers is a popular library by Hugging Face that provides state-of- the-art models and pre-trained language models like BERT, GPT, and RoBERTa. These models can be fine- tuned for specific NLP tasks, including intent recognition and sentiment analysis.

By incorporating NLP libraries and techniques, you can enhance your chatbot's understanding of user input, improve the accuracy of intent recognition, and generate more contextually relevant responses. Experimenting with different NLP approaches and fine-tuning models can help tailor the chatbot's understanding and responsiveness to specific user needs.

VII. ADVANCE FEATURE AND INTEGRATIONS

A. High level Elements and Reconciliations

Executing sight and sound help (pictures, sound, and so forth.):

To add mixed media backing to your Wire chatbot, you can use the capacities given by the Telegram chatbot API. The 'TELEBOT' library offers techniques for sending and getting different sorts of media records, including pictures, sound, archives, and recordings. This is an outline of the way to carry out interactive media support:

1) Sending Media: Utilize the 'bot.send_photo()', 'bot.send_audio()', 'bot.send_document()', or other applicable techniques to send media records to clients. Give the document way or URL, alongside discretionary boundaries like inscriptions or record sizes, contingent upon the media type.

2) Getting Media: Set up suitable overseer capabilities to deal with approaching media records. Utilize the 'Message Handler' or 'Call back Query Handler' to catch messages containing media and interaction them as per your chatbot's prerequisites.
3) Handling Media: While getting media records, you can perform further handling depending on the situation. This can incorporate investigating picture content utilizing PC vision calculations, extricating sound data, or approving the configuration and size of the media documents.

B. Coordinating outer APIs for Information Recovery

Coordinating outer APIs permits your chatbot to recover information or perform activities from outside administrations. This can be helpful for getting to continuous data, recovering information from a data set, or coordinating with outsider administrations. Here is a general layout of how to coordinate outer APIs:

1) Pick a Programming interface: Distinguish the outer Programming interface that gives the information or usefulness you want. Consider factors, for example, validation prerequisites, rate limits, and accessible endpoints.
2) Introduce and Import Libraries: Introduce any essential Python libraries for making HTTP demands and associating with the Programming interface. Normal libraries incorporate 'demands' or concentrated libraries well defined for the Programming interface you're coordinating.
3) Make Programming interface Solicitations: Utilize the library's techniques to make HTTP solicitations to the Programming interface endpoints. Give any necessary boundaries, headers, or confirmation tokens.
4) Process Programming interface Reactions: Handle the Programming interface reactions and concentrate the applicable information or play out any important handling. This can include parsing JSON or XML reactions, changing the information, or taking care of blunders effortlessly.
5) Incorporate with Chatbot Rationale: Coordinate the Programming interface calls and reactions inside your chatbot's rationale. Utilize the recovered information to create reactions, give data to clients, or trigger explicit activities in view of the Programming interface results.

C. Adding Usefulness For Client Verification And Approval

In the event that your chatbot requires client validation and approval, you can execute this usefulness to guarantee secure access and customized cooperations. Here is a general way to deal with add client validation and approval:

1) Client Enrollment: Execute a client enlistment cycle to permit clients to make represents your chatbot. This can include gathering important client subtleties and putting away them safely in a data set.
2) Client Login: Make a login system to confirm clients in light of their certifications. This can incorporate checking usernames and passwords, executing multifaceted confirmation, or coordinating with outer verification suppliers.
3) Meeting The executives: Conduct meeting the board to maintain the pace of client meetings and follow verified clients through their interactions with the chatbot. This might involve using meeting tokens or treats to identify and approve clients.
4) Access Control: Define access control rules to limit certain functionalities or information in accordance with client jobs or approvals. This ensures that clients can access the highlights or information they are authorized to use.
5) Approval Checks: Execute actually looks at inside your chatbot's rationale to approve client approval prior to playing out specific activities or giving delicate data. This can include really looking at client jobs, consents, or other applicable characteristics.

By executing sight and sound help, incorporating outer APIs for information recovery, and adding usefulness for client confirmation and approval, you can upgrade the capacities of your Message chatbot and give seriously captivating and customized encounters for clients.

VIII. EVALUATION

Quantitative metrics such as response time, accuracy, and user engagement were used to appraise the performance of the Telegram chatbot. For instance, to measure response time, the average time taken by the chatbot to respond to queries of a user was done. Accuracy was tested by comparing what the chatbot responded with what they were supposed to. User engagement metrics tracked numbers of interactions and session durations. User feedback insights were obtained through surveys and interviews. In order to determine general sentiment, user satisfaction ratings were measured in terms of reactions. Feedback on conversational flow revealed the consistency within the bot's responses. Identification of preferred features helped in understanding users' reception and their expectations for augmentation functions.

Usability testing entailed different situations that mimic real world interactions. Performance measures comprised completion rates and error occurrences among others. For instance, usability included analyzing user navigation patterns through examination how users approached the interface of a chatbot. Usability testing outcomes encompassed task success rates, error rates, as well as insights into human adaptability towards using a chatbot interface and input commands. To put it all together in terms of evaluation; quantitative metrics synthesized response times, accuracies and user engagement at a glance. Integrated user feedback gave a fine-tuned view.

IX. CHALLENGES AND LIMITATION

The development of the Telegram chatbot resulted to a number of issues. Issues include but not limited to the complexity of integrating the bot with the Telegram API's and coming up with a good conversational flow.

The major challenge that was faced in developing this chatbot was how to make it consistent by maintaining coherence in its replies. Constraints on functionality of the chatbot were experienced during its development and testing phases. A good example is that use of some features of telegram platform which restricted what functionalities could be executed. Additionally, scaling down of the chat bot was constrained by lack of computing resources such as servers.

A number of possible solutions were suggested to deal with these challenges. For technical difficulties, we contacted with further assistance from Telegram API documentation and developer community who shared their experience and provided us with best practices. User testing and feedback iterations helped address conceptual challenges; thus, improving conversational design so as to enhance user understanding. Platform limits resulted in innovative alternatives and considering other features that might have added value to our chatbot given certain boundaries.

Yet we took care to recognize the restrictions that were integral in the process of Telegram hatbot development and sought to develop mechanisms for their escape. Iterative problem-solving strategy implemented here sought to enhance the performance of chatbot in accordance with given specifications.

X. COMPARATIVE ANALYSIS

In assessing the strengths and weaknesses of our Telegram chatbot over other existing solutions, various aspects were taken into account. A significant strength is the user interface of the bot which is very intuitive, making it easy for users to interact. Our chatbot also exhibited impressive understanding and response of diverse user queries, hence contributing to its effectiveness.

Areas that needed to be worked upon were identified through comparing it with other similar existing solutions. Although certain elements worked well in our chatbot, some features could have been added or even a wider range of functions put in place. In particular, better natural language processing skills and more commands provided by users had to be improved from this point on

Our Telegram chatbot remains relevant and competitive in the current landscape. It has user interface design strengths and accuracy, making this a plausible choice for those people who want efficient and reliable conversations. This continuous commitment to updates and enhancements makes the chatbot competitive in a dynamic landscape by addressing user needs and keeping pace with emerging trends in chatbot technology. The comparative analysis was also used as an important yardstick to improve and innovate it so as to remain relevant and competitive in the constantly changing world of Telegram chatbots.

XI. FUTURE WORK

The future presents several areas where the Telegram chatbot can be developed and researched further. One area for future work is expanding the functionality of the chatbot in terms of advanced natural language processing capabilities that would enable it to understand users' queries more subtly. Moreover, looking at how machine learning algorithms can be integrated could help to improve adaptability and learning ability from user interactions over time.

Some suggested improvements were made to increase how much users take part in the chats as well as their satisfaction. This is inclusive of amending the way the bot interacts with its users basing on their contextual relevance. In addition, incorporation of multimedia content such images and videos would also improve user experience on Telegram platform.

Voice recognition and synthesis technologies seem promising as far as integration of emerging technologies is concerned. For instance, this could enable users to command the chatbot using voice thus increasing its accessibility and usability. The possibility of integrating AI-driven sentiment analysis could personalize interactions even more allowing the chatbot to reply from a sympathetic perspective empathetic towards the emotional level of the user.

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XII. CONCLUSION

In summary, these research findings have given the most critical information and contributions towards Telegram chatbot development and assessment. The chatbot performed optimally in terms of being interactive, highly precise and with a user interface that is simple to use. Feedback from users and usability testing guided iterative enhancements leading to improved user experience.

SIts potential usefulness to users as a means of offering them a seamless and efficient conversation experience is the measure of the relevancy of this chatbot in the context of Telegram and other available run-of-the-mill chatbots. The intuitive nature of the chatbot and the accurate responses make it easy for customers to engage, thus making it an essential tool for the whole Telegram ecosystem.

In view of future research investigations as well as industry applications, there is lot to look forward to. These include improvement areas like advanced natural language processing, integration with emerging technologies among others which can still be further developed through innovation. Furthermore, since it is responsive to users changing needs due to the ever- changing landscape of chatbots, this implies that it can have numerous applications across different industries.

In summary, for all future development plans for Telegram's chatbot, there should be improvements on natural language processing capabilities, conversational design and consideration of new technologies such as machine learning, voice recognition and sentiment analysis. These innovations are aimed at making it remain innovative in the era of rapidly changing trends in chatbots' world where it will not become irrelevant any time soon.

To summarize, the research didn't only provide insights on the Telegram chatbot's strengths and improvements but also placed it as a relevant and influential player in the larger sphere of chatbot technology. The findings have practical implications for future research, indicating directions for further growth and application in different industries that are interested in effective and user-friendly conversational interfaces.

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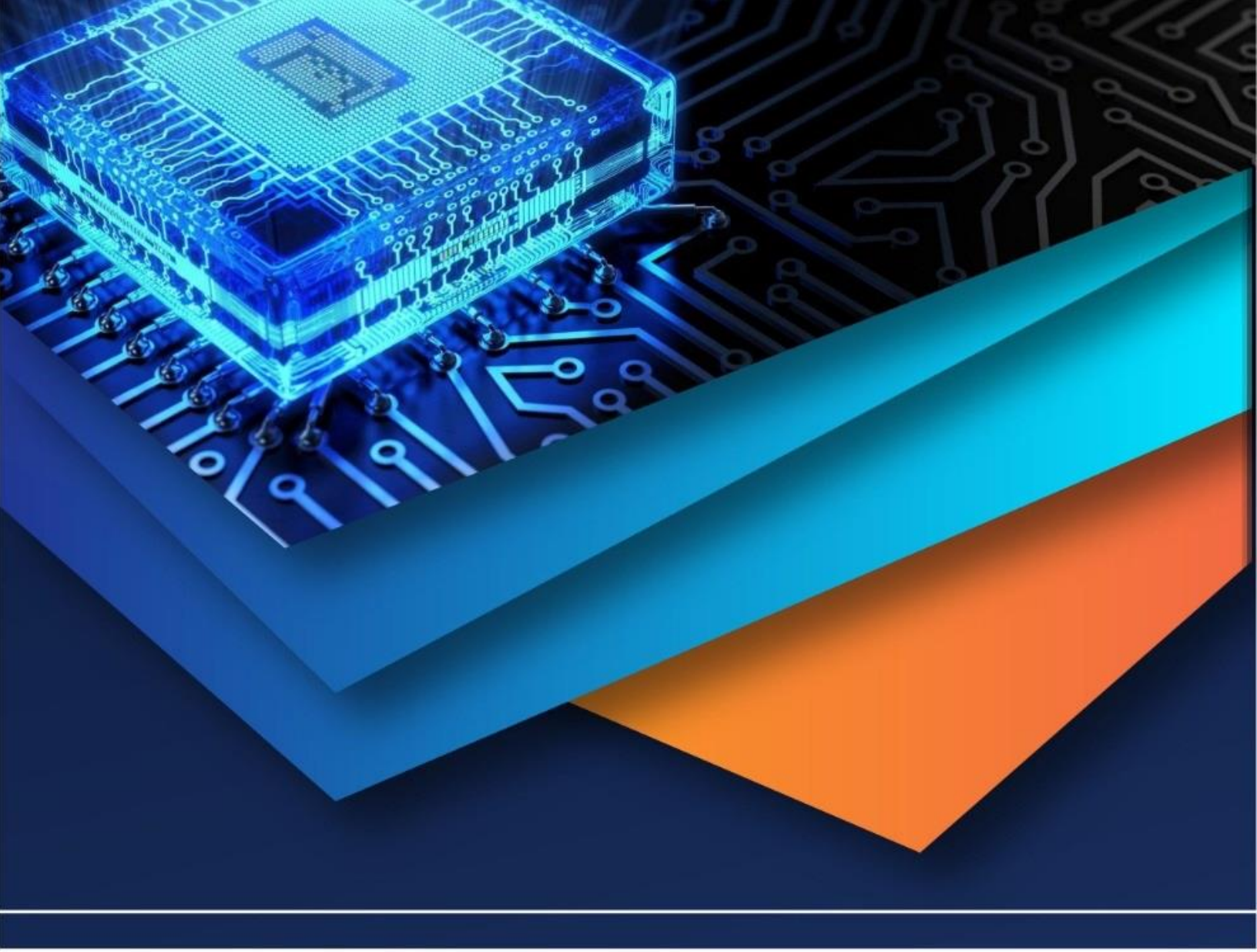

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