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UrbanAssist: An Interactive Virtual Assistant for Smart Urbanism

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Abstract: ***Virtual Assistant or Chatbot is a computer program built purposefully to simulate a natural conversational flow with human users over the internet through an app having chat interfaces. This paper showcases the practical implementation of Virtual Assistant or Chatbots along with the help of active participation from citizens' and users in urban planning that would later provide assistance to policymakers. The Virtual Assistant provides automated responses to the queries made by the users and creates a natural conversation flow along with the understanding of common phrasing of sentences. The chat system is implemented using a combination of Artificial Intelligence, Deep Learning, Natural Language Processing and Big Data techniques. The Data gathered from conversation is then used to provide deep insights to the policymakers of the institution or organization for decision making. This Chatbot allows users to report complaints, give feedback and ask general questions about their city and can also become a guide for tourism purposes. This chatbot can be a mobile or web application which provides guided assistance to the users of their cities.***

Keywords: Chatbot, Virtual Assistant, Artificial Intelligence, Big Data, Natural Language Processing, Deep Learning, Machine Learning.

I. INTRODUCTION

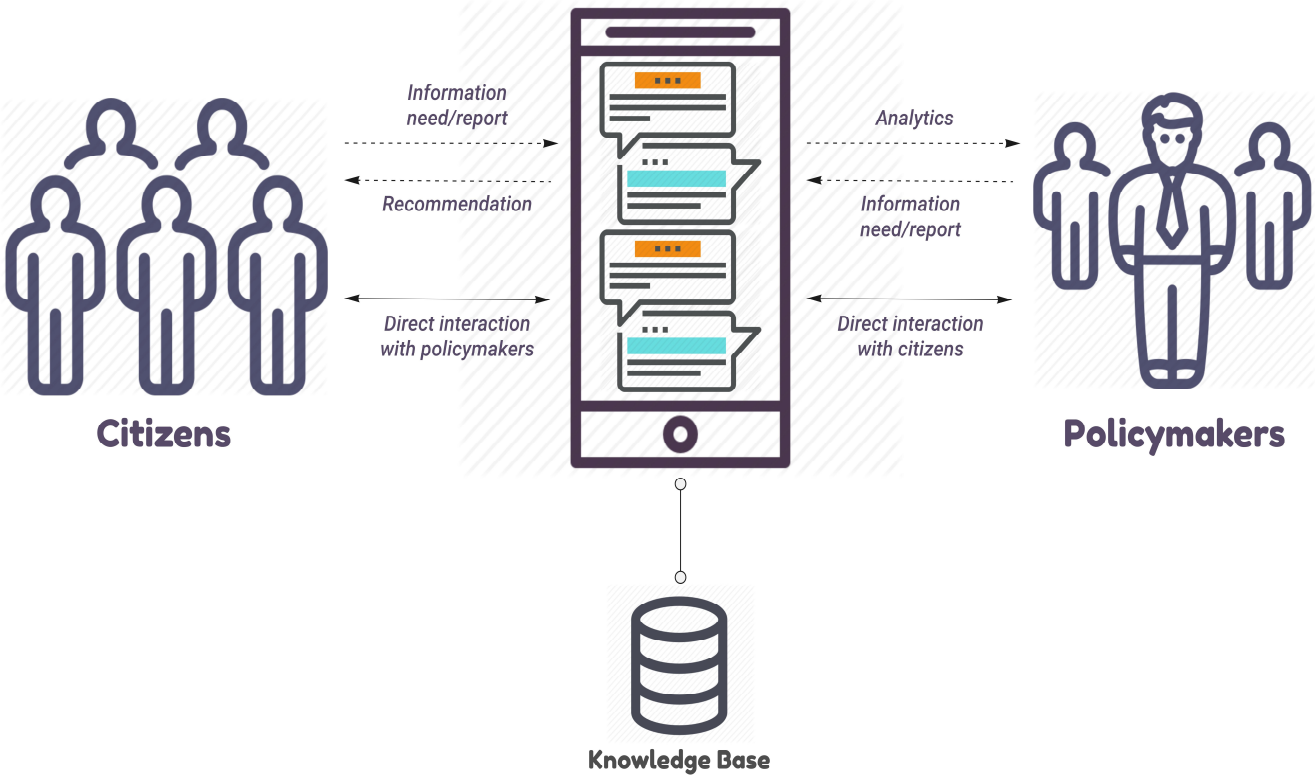

Fig. 1 Conceptual Scheme of Chatbot in an Urban Context

A chatbot or virtual assistant is a computer program that is meant for emulating a natural conversation flow between a human and a computer much like a human-human interaction. The year 2015 saw an exponential increase in active users for messenger applications like Facebook Messenger, WhatsApp and Telegram [2]. These messenger applications are capable enough to be converted into an automated chat application. There are various automated chat applications already in the marketplace like Apple's Siri and Google Assistant which are powerful and robust enough to handle any type of user input either in text or voice-based input. But these applications are more focused on providing user with value added services which are more focused commercially and fall short in handling social issues like in urban contexts. Though there are virtual assistant made for urban context like navigation and social reporting [3], but they just aren't enough to completely eliminate the urban issues which the citizens' are facing. We have proposed an automated chatbot that is supposed to solve city specific problems within an urban context [1]. This particular chatbot can handle citizens' queries and solve civic problems. We have decided to use Facebook Messenger as a deployment channel due to its popularity and familiarity among large users and also having a user interface with minimum to no learning curve [4]. To provide the chatbot an ability to logically think and reason we have decided to use an enabling technology named Flow XO [8]. Using this tool, one can easily build virtual assistants using supervised learning methods particularly tokenization technique where the bot creator can use keywords or tags that will trigger the bot to perform specific action(s) within the application when detected. When the user types a query into the chatbot, it first parses the query and then transforms them using Natural Language Processing methods. From NLP, intents and entities are extracted and matched against keywords or tags specified by the bot creator which is then used to perform actions within the same context. This extracted knowledge is searched in knowledge base which often comprises of the databases. When matched, the required information is sent back to the user as an output through the chat interface. The automated chatbot tries to have further communication within the same context, as long as user's freedom and liberties are not violated. Using this chatbot, the users or citizens' can ask queries, report complaints and even participate in a discussion with the policymakers of the city. For the policymaker to effectively monitor city issues, an analytical dashboard has been provided which tracks open issues that need to be addressed immediately and also interact with the citizens' directly or indirectly.

II. ORIGIN OF RESEARCH PROBLEM

City authorities or municipal employees are appointed to resolve citizens' queries and problems that they're facing. However, the increasing number of queries can become labour intensive, exhaustive and time consuming for the authorities which ultimately result in inefficiency or incomplete work. There is a need for an automated system for the same purpose.

III. OBJECTIVE OF WORK

The global push for smart cities and the availability of last mile internet connectivity has made it possible for chatbots to grow for large audiences. Virtual Assistants can be seamlessly integrated into smart city projects. Users can chat with their assistant anytime and anywhere. Current chatbot systems cannot solve citizens' issues and are mainly focused on providing commercial services than social whereas with this system the citizens' can report complaints and give feedbacks to the policymakers about their cities.

IV. LITERATURE SURVEY

A. *Pavel Kucherbaev, Achilleas Psyllidis, and Alessandro Bozzon - Chatbots as Conversational Recommender Systems in Urban Contexts*

This paper states that a prototype conversational system can be built to address city-specific issues [1]. Using modern cloud-based technologies and advancements in artificial intelligence and machine learning has made it possible for a chatbot application around urban contexts to work. With this application the user or citizen can not only report problems but also take part in discussions with municipal authorities

B. *Michael McTear, Zoraida Callejas, and David Griol - The Conversational Interface: Talking to Smart Devices*

Gives us a brief introduction about building an intuitive chat application that the users love to use. Various case studies have been shown for text based conversational system to voice-based virtual assistance. To avoid redundancies some guidelines have been provided upon which many chat applications can be built. It also mentions some open source tools which can be used to build chat applications [4]. For easy prototyping of an application a use case template for chat has also been provided. Considering all the options we have decided to use Facebook Messenger as the deployment channel for building the automated chat application.

C. Ronan Collobert, Jason Weston, Leon Bottou, Michael Karlen, Koray Kavukcuoglu and Pavel Kuksa - Natural Language Processing (Almost) from Scratch

This paper proposes various methods that can be used to extract relevant information from the sentences using Natural Language Processing. It talks about tokenization method that is used to match given sentences against specified keywords or tags. Using combination of machine learning techniques to extract intent and entities from the user query. Models are trained with supervised learning methods to improve sentence matching algorithm. Classifiers are used to classify keywords from the datasets. Data mining techniques are employed to improve intent and entity recognition. Convolution neural networks are used against datasets to improve information matching algorithms [6].

V. EXISTING SYSTEM

City Municipalities have their own web portals, which citizens' find of no use due to the presence of outdated content on their website. Citizens' also stop using their standalone application as their queries and problems are not been able to resolve immediately and effectively. Virtual Assistants like Google Assistant (Android), Siri (Apple), Alexa (Amazon Echo), Bixby (Samsung), etc. depend on the information available on the internet and are, therefore, limited due to that fact. These widely available, virtual assistants are not meant to solve social and urban issues faced by the citizens'.

VI. REQUIREMENTS

A. Functionality Requirements

1) It should be able to understand natural language.
2) It should be able to fetch the data from database.
3) It should think rationally and fetch the appropriate data from the database in reply to the query.
4) It should save new information in the database.
5) Notification feature for the subscribed user.

B. Hardware Requirements

1) A PC for Coding and Data Visualization.
2) Mobile Phone.
3) Active internet connection with optimum speed and bandwidth.

C. Software Requirements

1) Android Studio
2) Facebook Messenger
3) Flow XO
4) Google Sheets
5) Tableau
6) Power BI

VII. INITIAL IMPLEMENTATION

A. Deployment Channel

For this very purpose we have decided to use Facebook Messenger as a chat interface as it is easy to use with minimum or no learning curves and has a good developer community support [7].

B. Enabling Technology

Flow XO is an online NLP (Natural Language Processing) tool which allows a creator to develop smart chatbots and have them up and running in no time [8]. It can also be used for prototyping chat applications. It has its own bot logic which uses a combination of artificial intelligence and machine learning techniques to extract relevant information that can be used to answer user queries.

C. Intent

It maps the user intention of what he or she says and what action to be taken by the chat agent. The NLP (Natural Language Processing) tool gives an intent score against each sentence the user types into the chat application. A 100 intent score shows strong affinity while 0 is the lowest affinity intent score.

D. Entity

The NLP (Natural Language Processing) tool extracts parameter values from user input sentences which are often the important data for information matching with knowledge base. Entities values are calculated by using powerful machine learning methods which include deep learning and neural networks [5]. Continuous training of phrases is provided to the NLP (Natural Language Processing) tool either in supervised or unsupervised manner to improve the entity scoring algorithm [6].

E. Webhook

Is an abstraction layer which passes information from one application layer to another through web services.

F. Knowledge Base

Contains datasets which include keywords and tags relevant to the context of the chatbot. Data Mining is carried out to match the data passed down by NLP (Natural Language Processing) tool with the dataset present [6]

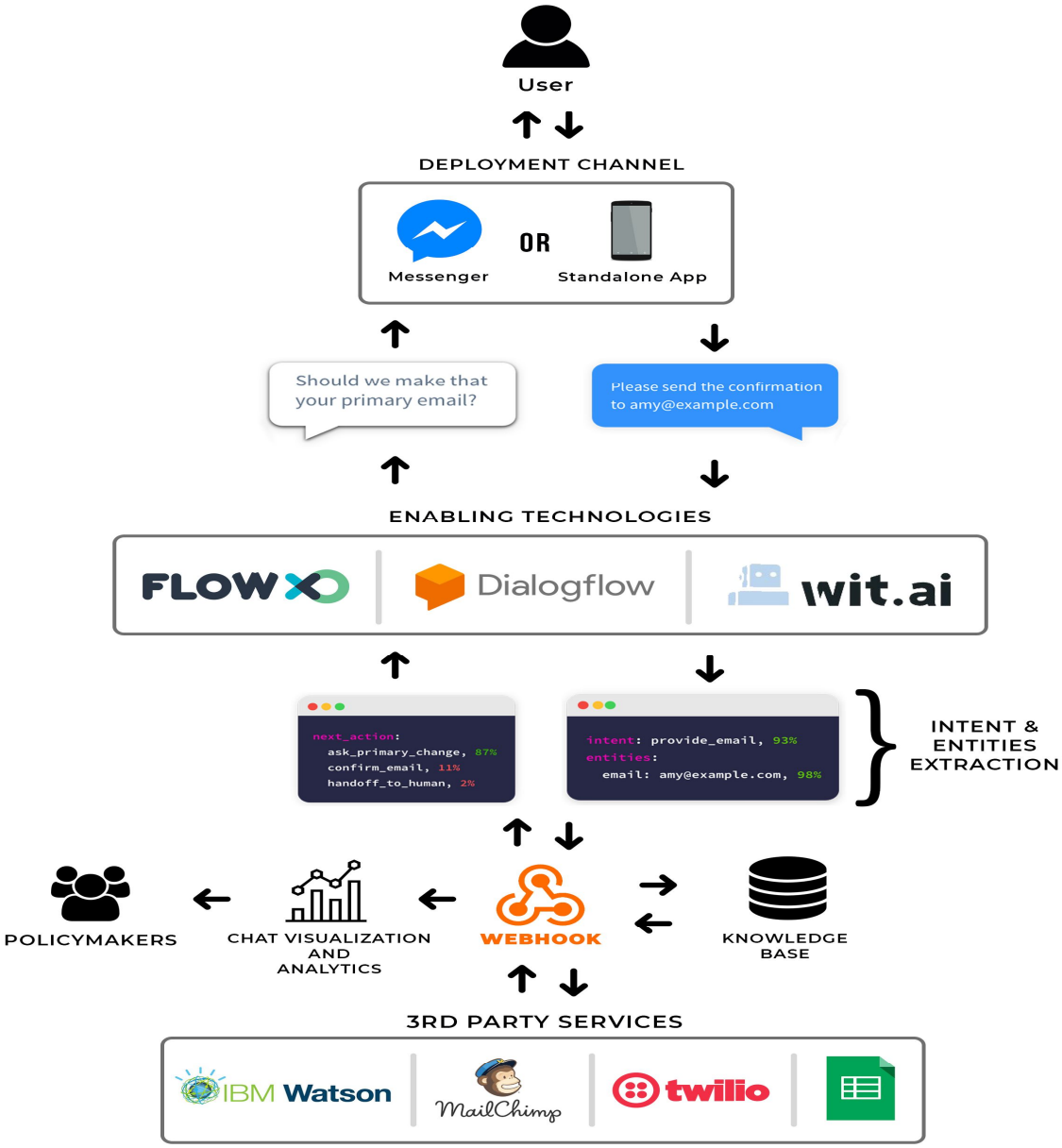

Fig. 2. Architecture of UrbanAssist Chatbot

G. Supervised Learning

Is a type of deep learning method of machine learning models. In this, a machine teaches itself by continuous iteration of examples. The training dataset for supervised machine learning task needs to labelled or tagged. The machine is trained to associate input data with their labels and predict label based on the output. This method is also known as tokenization and it is widely used in NLP (Natural Language Processing) [10].

VIII. METHODOLOGY

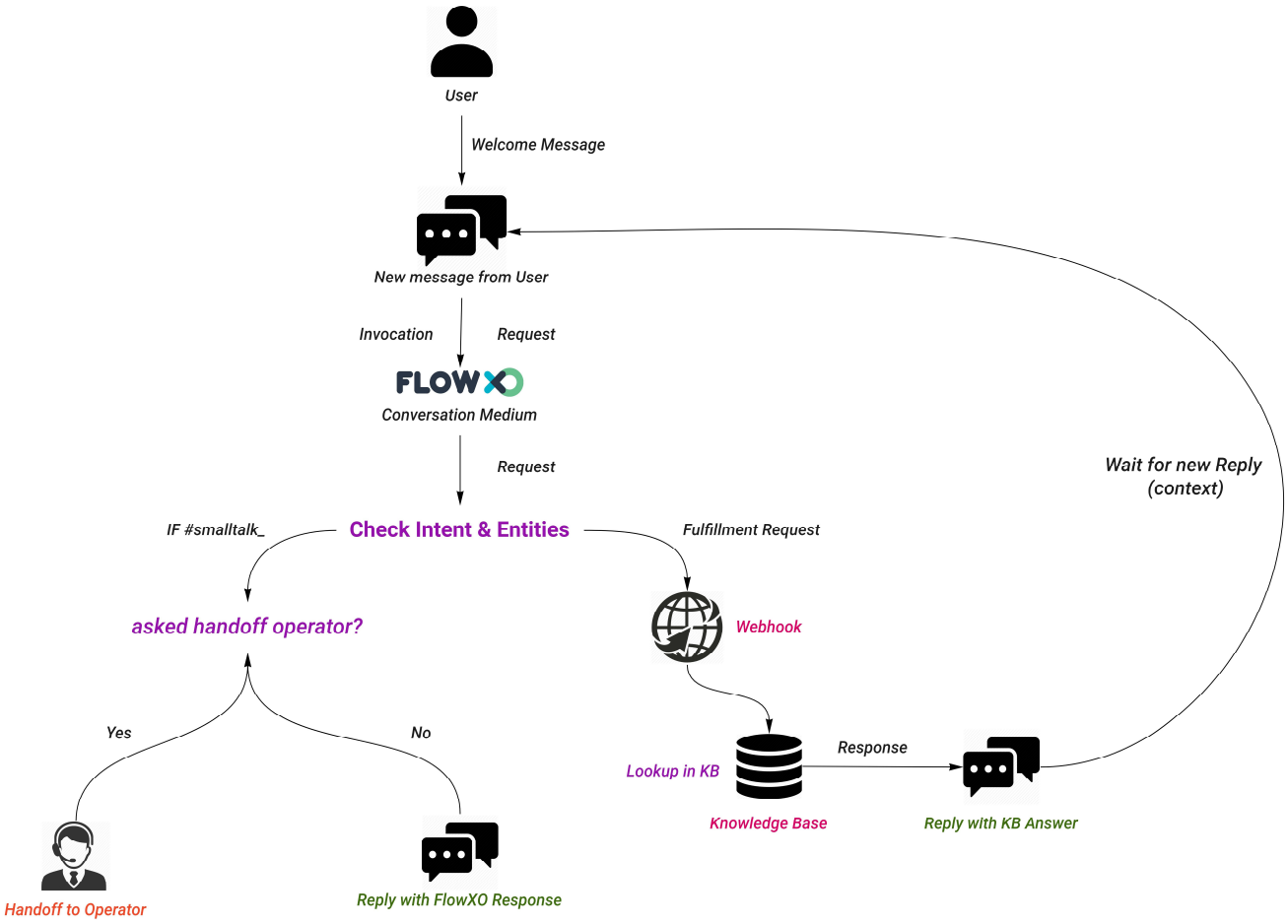

Fig. 3. Flow of User Interaction with Urban Assist Chatbot

The Chatbot agent follows a process from invocation to fulfillment which is similar to someone asking a question, with some freedom and liberties. Algorithm for implementing automated chatbot in urban context is as follows:

1) *Step 1*: Start.
2) *Step 2:* Welcome message is displayed to the user.
3) *Step 3:* To start a conversation the user must invoke the agent.
4) *Step 4:* After invocation the user requests for information by asking questions to the agent
5) *Step 5:* The conversation medium extracts intent and entities from user's question.
6) *Step 6:* This extracted information is sent to webhook as a fulfillment request.
7) *Step 7:* This webhook then starts looking up information in knowledge base.
8) *Step 8:* If the answer is found then the fulfillment request is termed successful and the response is sent back to the user. If not, then the conversation is handed off to an operator.
9) *Step 9:* The agent starts further communication with the user in the current context.
10) *Step 10:* Exit.

IX. RESULTS

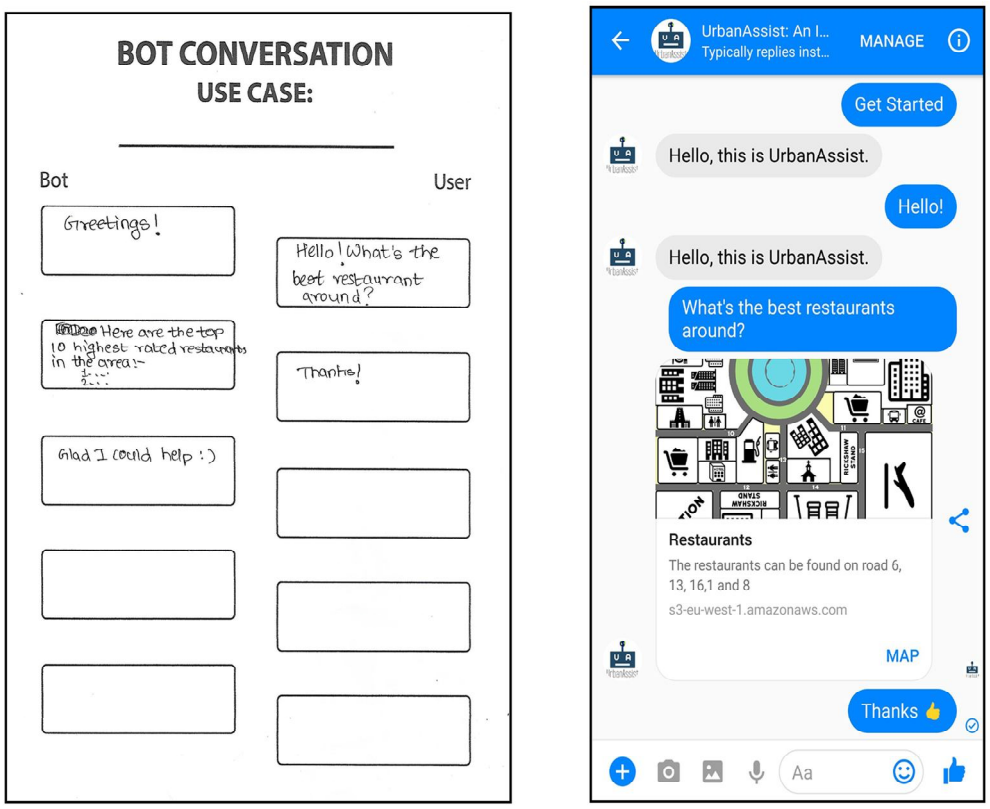

Fig. 4 Concept and Implementation proposed chatbot system

X. FEATURES

This chatbot system can assists citizens' in

A. Receiving recommendation information (restaurant, parks, schools, parking locations)
B. Reporting information to municipalities authorities (waterlogging, pothole, fire)
C. Directly communicating with municipality authorities if the requested information is not available.
D. Decision making and urban planning with city policymakers and authorities.
E. Assigning a municipal employee or authority if the requested information is not present in the data source.
F. Actively participating in the discussion with the policymakers to provide feedback and implement new policies and regulations.

XI. FUTURE SCOPE

This chatbot system can be equipped with multilingual support to cover larger audiences. More platforms and deployment channels would increase the user base and won't be restricted to just a single chatbot ecosystem. Other than text, voiced-based interaction with chat agents can also be incorporated. Ability to work in offline mode i.e. without internet using USSD (Unstructured Supplementary Service Data) protocol by partnering with telecom companies. Improved analytics with artificial intelligence assistance to improve citizens' policies and quality of life.

XII. CONCLUSIONS

Citizens' engagement in policy making and contribution to the city by facilitating discussions about urban issues with city authorities is possible using this system. By using Facebook Messenger as the deployment channel, we make the system accessible to large audiences and also minimize the learning curve due to high familiarity among users. There is a global push for smart cities and thus smart virtual assistants are a good choice of implementing in cities of developing countries and also to involve its citizens' with city stakeholders.

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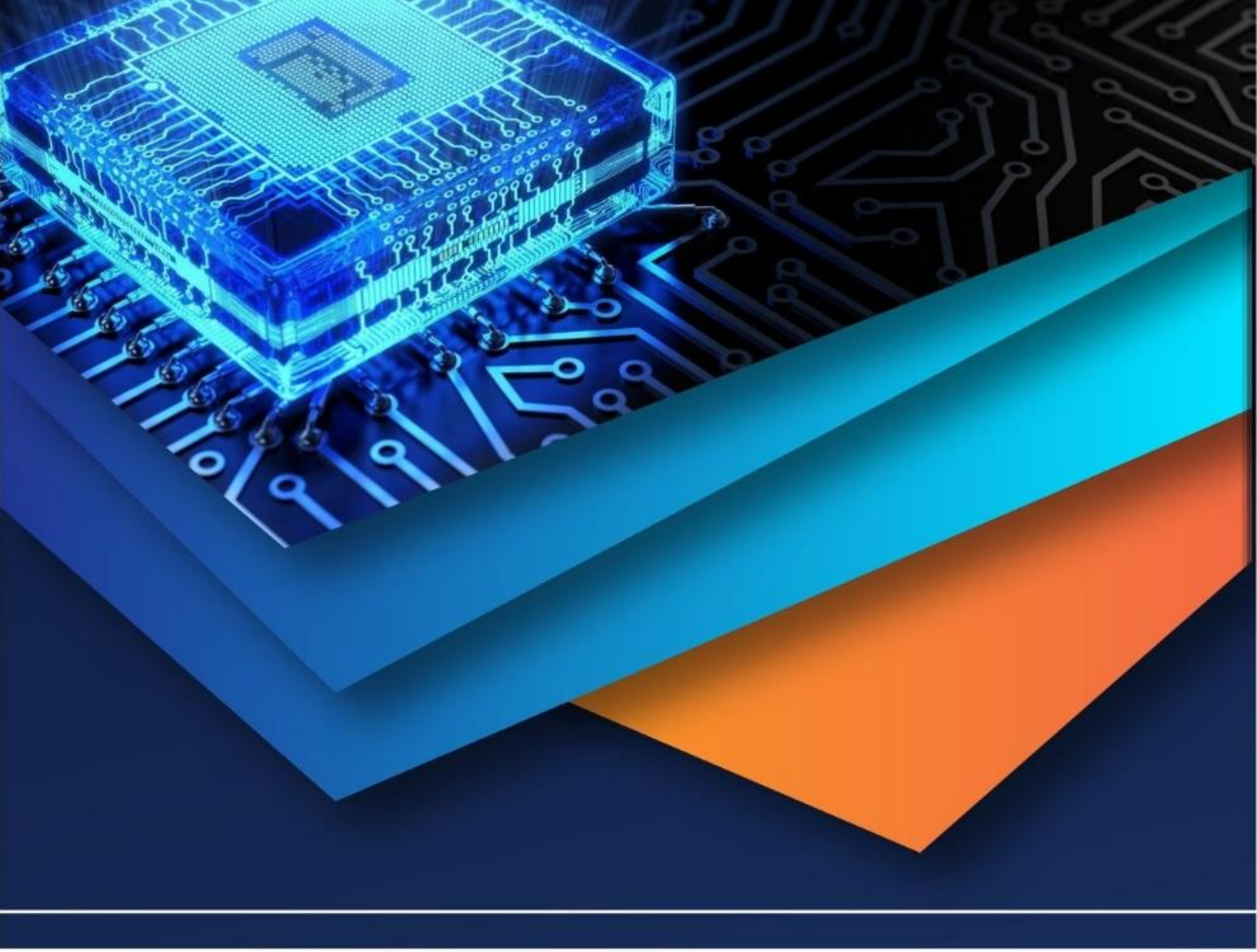

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