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Parking Zones with EV Chargers

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Abstract: ***Parking has long been a persistent challenge in urban centers and crowded areas, often leading to frustration and wasted time for drivers searching for available spaces. To address this issue, we present our project, the "Parking Zones with EV Chargers", a web-based application designed to revolutionize the parking experience for users. The system offers a user-friendly platform where individuals can easily find and reserve parking spaces in advance. This web-based application also aims to revolutionize urban parking by providing drivers with a seamless platform to locate available parking spaces equipped with electric vehicle charging infrastructure for their electric vehicles.***
Index Terms: ***smart parking, parking system, ev chargers***

I. INTRODUCTION

The infrastructure that facilitates the widespread adoption of electric vehicles must include an electric vehicle (EV) charger. It is a gadget made to provide electric energy for an electric car's battery to be recharged. EV chargers are becoming more and more necessary as the automotive industry moves toward environmentally friendly and sustainable modes of transportation. By enabling users to recharge their vehicle's battery and increase its driving range, these chargers are essential in meeting the charging needs of electric vehicles. In addition, the establishment of infrastructure for charging encourages the wider adoption of electric vehicles. By lowering reliance on fossil fuels and lowering total greenhouse gas emissions, it aids in the shift away from conventional internal combustion engine vehicles. When an established and easily accessible network of charging stations is in place, the environmental advantages of electric vehicles are optimized. The goal of our web development project "Parking Zones with EV Chargers" is to make parking in busy urban areas easier. With the help of cutting-edge features and an allencompassing online platform, our solution aims to enhance the parking experience for both users and vendors by making parking space reservations easier and maximizing available space. The fusion of intelligent urban planning and sustainable transportation is another ambitious endeavor symbolized by this project. By providing an easy-to-use platform for finding and reserving parking spots in advance that also have EV chargers, our system aims to close the gap between vehicle convenience and environmental responsibility.

In order to manage parking and save users money, time, and effort, we developed a smart parking management system. It is now vital to enhance techniques for finding parking that is available and reduce traffic at the parking entrance in the context of modern life. It is preferable to look for or reserve parking online in advance rather than at a parking lot where there is a chance you won't be able to find space. Our intelligent parking management system was created to: 1) Effectively manage parking and address issues through technology.

2) Use technology to advance the idea of smart cities.

II. RELATED WORK

Aaron Paul Abellon et al. conducted research with the primary goal of creating a Smart Parking system for small and midscale parking lots in its [1]. Using IoT devices, they created a system in this study. To determine whether the parking lot was occupied, they employed ultrasonic sensors for item and vehicle detection. An effective real-time data showcasing is another feature of this system. Another early study conducted by Lathushanan Koneswara et al. who were at the Srilanka Institute of Information Technology [2]. They presented an algorithm in this study to determine the kind of vehicle based on size. The usage of CCTVs in this system is crucial since it aids in the detection of dangers in the parking lot. For security reasons, CCTV footage of check-in and check-out is also recorded. A smart reservation system for parking areas with EV chargers was developed by Tayfur Gokcek et al. Their primary goal was to give EV PLs the best possible charging schedule. They used the Analytical Hierarchy Process (AHP) from Multi-Criteria Decision Making (MCDM) approaches to create a bi-level optimization model. It reduces overall power loss as well as the cost of parking for EV customers. I-Chen Lin et al. have developed an urban area system that offers dynamic pricing and multi-period reservation in [4]. With the help of this intelligent technology, users can reserve a parking spot for up to 30 minutes at a time. Reservations must be made at least one hour in advance, though.

A different study conducted in [5] by Marie Angelika Bagadiong et al. also created a car parking system. The QR system serves as the foundation for all reservations in this system. The driver must first scan the QR code to reserve a space, and then they must scan it once more to make a payment when they leave. Moreover, it offers self-tracking through the App Interface of hours used.
Another creation by Norah Farooqi et al. This system helps to ensure that only authorized entries are made into the parking area by using an Automatic Number Plate Recognition (ANPR) [6] camera at the entry point. The parking slot's availability is also verified using the TCRT5000 sensor. Android Studio, Java, PHP, MySQL, Arduino, and APIs like PayPal and Google Maps are among the technologies used. A smart parking system was developed in the beginning by Dae- hyun kim et al. [7]. Using the A Star algorithm, this system shows the user the shortest route through the parking lot. In addition, it offers a collision avoidance system that directs warning systems and prevents collisions between cars. Muhammad Khalid et al. [8] With this system, a driver parks their car at a designated pickup spot, where it is picked up by the vehicle controller and parked. It makes use of a number of algorithms to optimize scheduling and pricing.

III. PARKING ZONES WITH EV CHARGERS

This section covers the design and analysis steps. Parking will be managed by the system through the management of search, booking, and payment procedures. The user-friendly platform of the system allows users to easily find and reserve parking spots in advance.This web-based program also aims to transform urban parking by providing drivers with an intuitive platform to locate parking spaces equipped with electric vehicle charging infrastructure. Users can also change or cancel their reservations.

A. System Analysis

1) Data flow Diagrams

The context level diagrams in Figures 1 give a high-level overview of the system and demonstrate how data moves through it.

Fig. 1. DFD - Level 0

2) System use Case

The use case diagram that follows describes the activities and use cases that the application can perform with one or more actors in the context of the system shown in Figure 2.

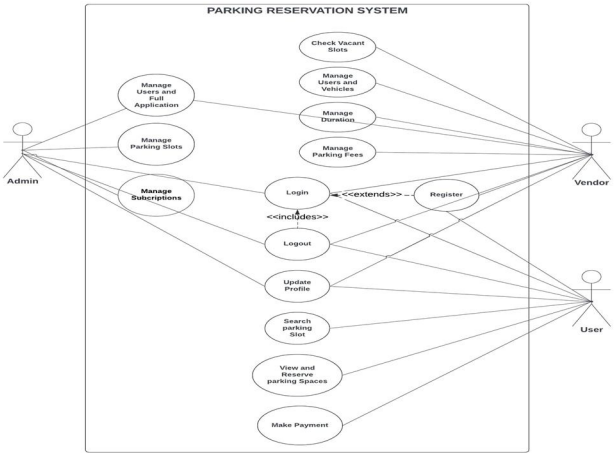

Fig. 2. Use Case

3) Activity Diagram

Figure 3's Activity diagram shows what an administrator can do in the system after login in.The vendor subscriptions and registered parking lots can be managed by the administrator.

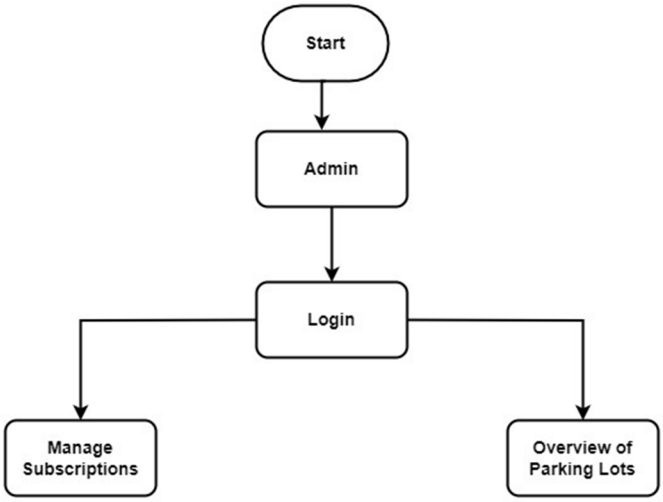

Fig. 3. Admin

The Activity diagram in Figure 4 shows the complete procedure that vendors need to follow in order to register their parking lots in the system. Upon logging in, the vendor will complete a registration form with multiple fields, including the number of parking spaces for both electric and non-electric vehicles, the kind of vehicle, etc. The vendor will be presented with the charges to be paid through a payment channel based on the information supplied.

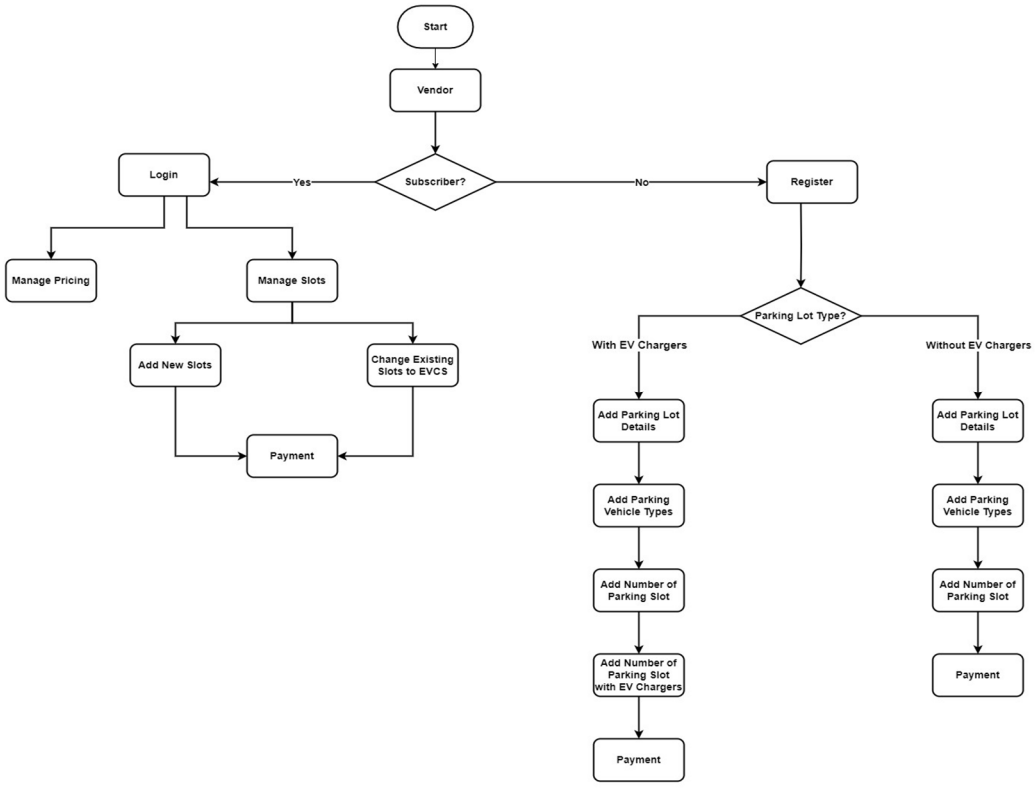

Fig. 4. Vendor

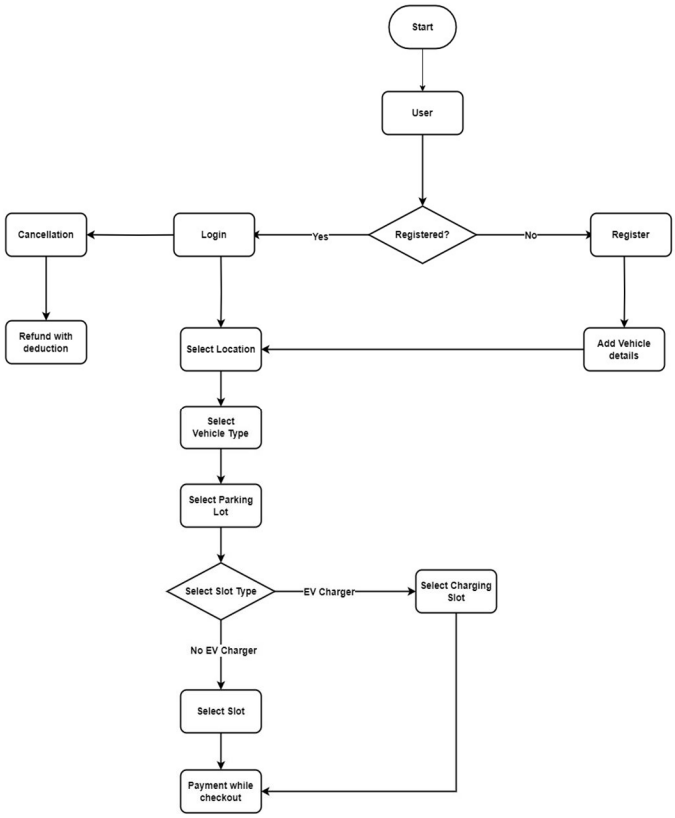

Fig. 5. User

the user receives a map-based route to their location and a chatbot to answer any questions they may have about the booking procedure.

4) Functional Requirements

Numerous features, such as booking, payment, listing available parking spaces, and searching, will be provided by the system. The user will receive alerts from the app. The vendor will have control over parking spots, reservations, and users via the website, while the admin will manage all other vendors.

5) Non-functional Requirements

The system is well-known, easy to use, accessible, and clear for users of all ages and backgrounds. We will adhere to information security regulations by preserving the confidentiality, integrity, and availability of the data.

B. System Architecture

As seen in Figure 6, this system is made up of numerous

The Activity diagram in Figure 5 shows the full procedure that users must go through in order to reserve a parking spot in advance using the system. Upon successful login, all authorized parking lots will be shown to the user, allowing them to schedule a time window. Following their reservation, components, such as the three actors (Admin, Vendor, and Users), frameworks, user interface, N0SQL database, Maps API, Mapping Service, and Payment Gateway.

The vendor, user, and administrator are the three actors in this system who gain from this application. With the help of this system, vendors can manage reservations, user accounts, parking slot status, and database storage. Through the application's user interfaces, users can communicate with the system and reserve a parking space in advance. In contrast, all of the system's registered vendors are under the admin's management.

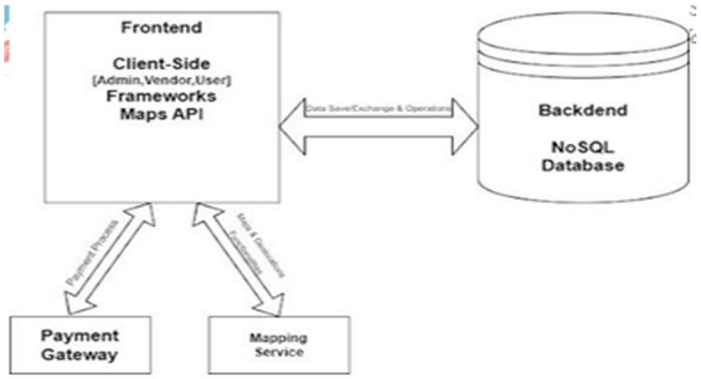

Fig. 6. Architecture Diagram

IV. SYSTEM IMPLEMENTATION

A. Operating Environment

A device with the bare minimum requirements for the hardware environment is required, such as an Intel quad-core processor with 10GB of HDD and 8GB of RAM. In terms of the software environment, the Chrome browser will be used to run the application. The software development platforms that are utilized are Firebase, Figma, Botpress, and Visual Studio Code. In frontend development, NodeJs is used for the backend, HTML, CSS, and JavaScript are used, and Firebase is used as a NoSQL database. The Open Street Maps API and the Stripe API are two examples of the services that are integrated into the system by reusing pre-existing software components.

B. Results

As seen in Figure 7, the admin can manage all the registered vendors and their subscriptions. The admin can either approve or reject the registered parking lots.

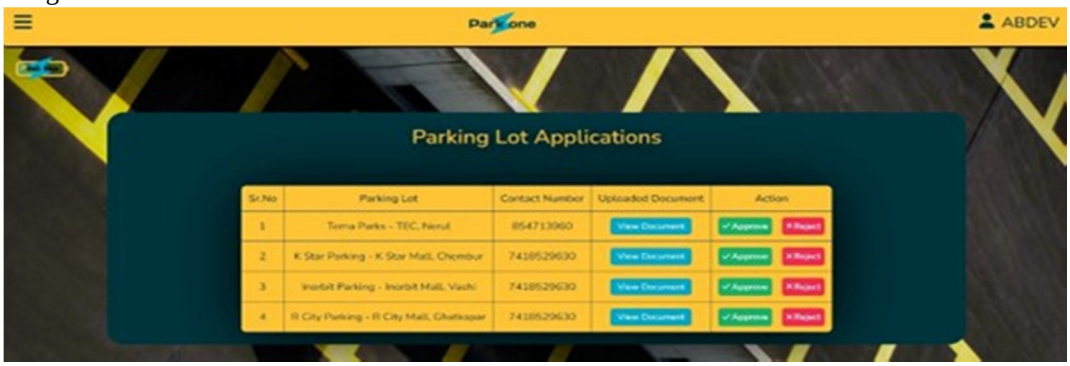

Fig. 7.

As shown in Figure 8, the user can manage their bookings and search processes.

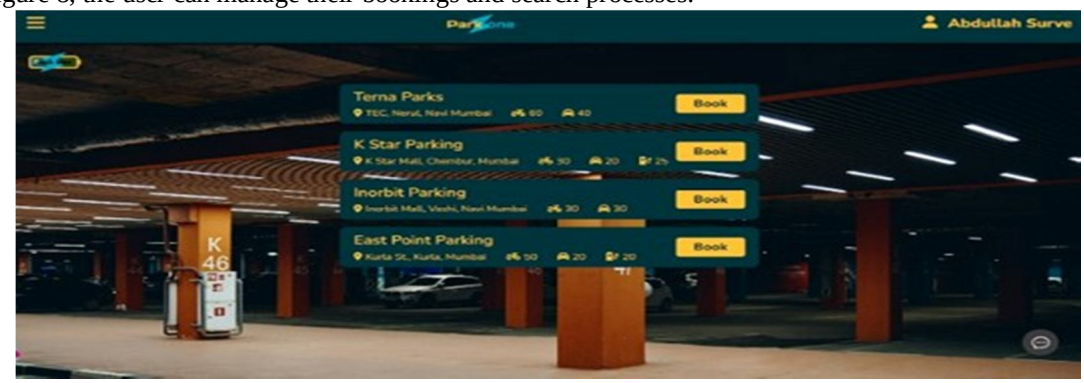

Fig. 8.

Payment gateway is available for both vendors and users as shown in Figure 9.

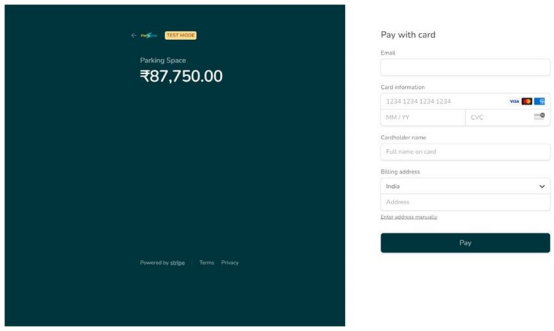

Fig. 9

As seen in Figure 10, the user receives map-based directions to the designated parking lot and can also ask questions or queries to an AI-powered chatbot. Development libraries include Open Street Maps API, Botpress and Stripe API.

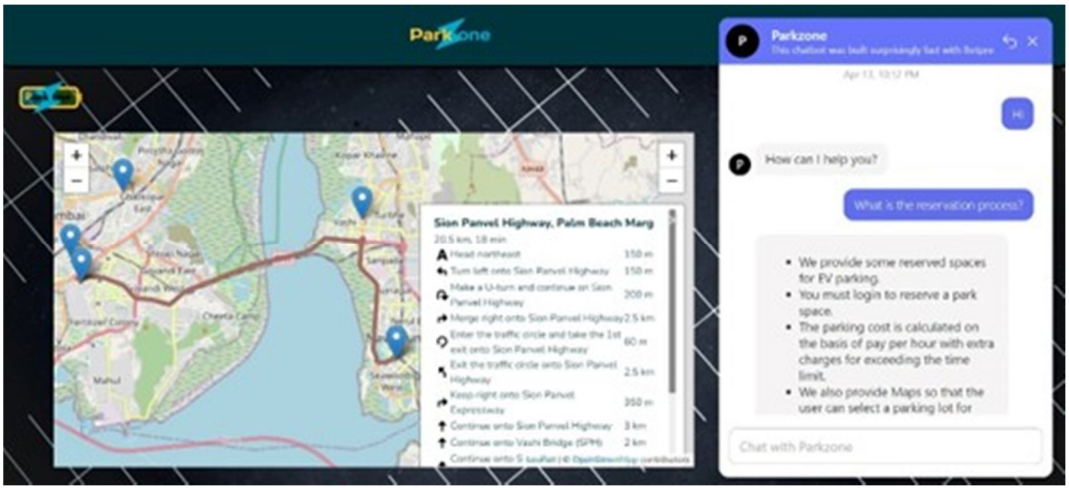

Fig. 10.

C. Testing and Verification

To make sure the system met the functional requirements, we ran tests. Every feature was examined separately, and the outcomes were contrasted with the forecasts. Functions and anticipated and actual results were detailed for every subsystem. The administration side's tested features included managing every registered vendor and going through the indepth authentication and authorization procedures. Concurrently, a thorough testing of the vendor-side features was conducted, including user and reservation management, parking slot control, and sign-in. The user-side features, such as booking, searching, registering, and paying, were also tested. Tests were expanded to include additional functionality and to provide actions to take into account for the outcomes.

In order to assess the system's usability, security, and performance, non-functional components were also tested. Users tested the system using scenarios that included confirming its primary features, assessing its usability in terms of navigation and error handling. In addition, the users assessed the nonfunctional requirements and shared their experiences.

To ensure that every software module's interface correctly interacted with the database, the system modules were also integrated and tested as a whole. The system passed the integration, non-functional, and functional tests with sufficient results.

V. CONCLUSION

This study described a fully software-based parking system with specific spots set aside for EVs and equipped with EV chargers. For the benefit of both users and vendors, this system serves as a single platform with a range of features and services that make it easy for users to reserve a parking spot in advance. Based on well-defined requirements and analyses, this system offers an integrated solution to improve parking management procedures in an efficient manner. Additionally, the system will be expanded to accommodate more new features. It can be integrated with other systems and will be put to the test in real-world scenarios.

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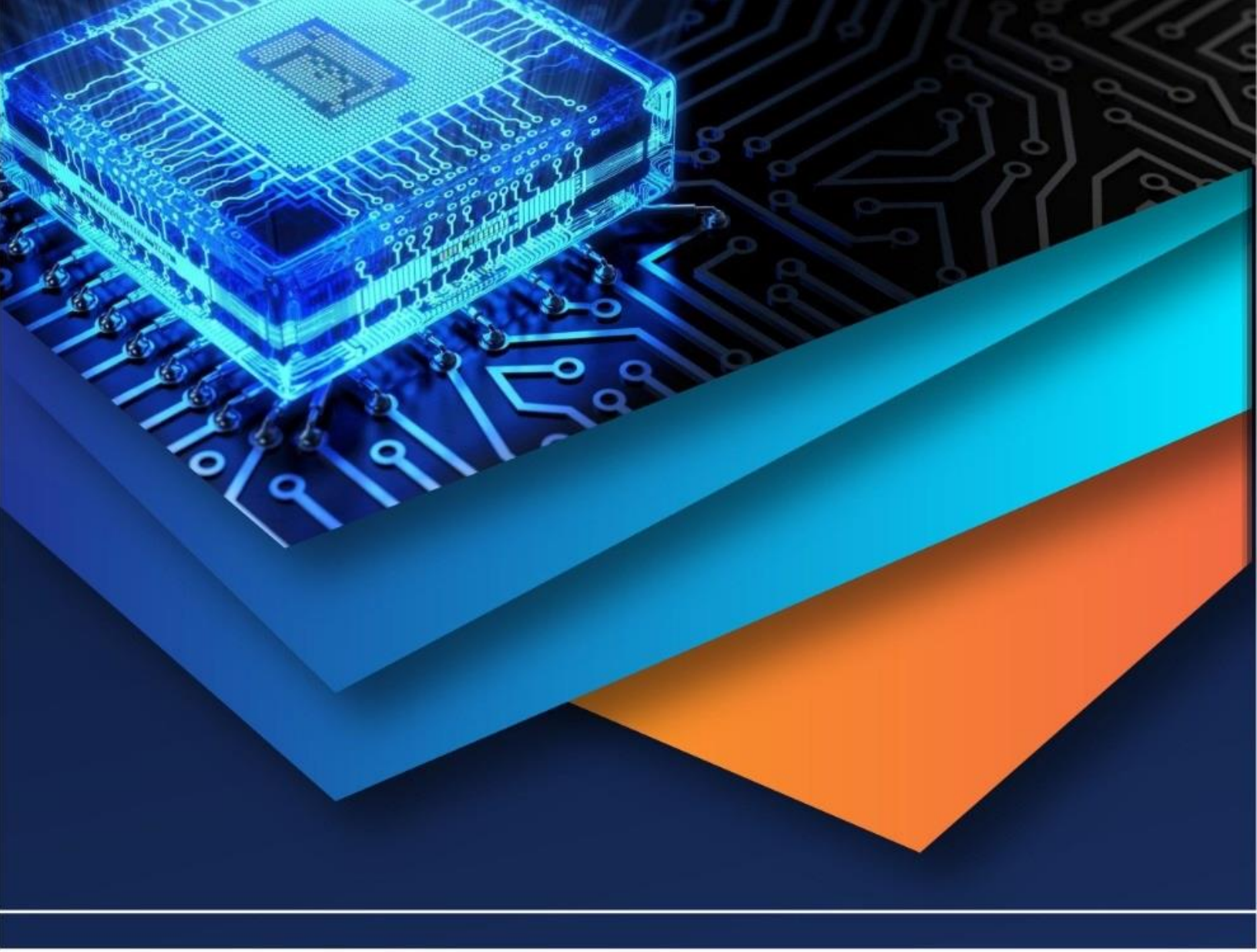

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