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Real Time Multideck Smart Parking Guidance System

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Abstract: ***With the rapid increase in population and a huge amount of traffic created by the automobiles, the Transportation system has faced a major challenge. The parking of vehicles in an allotted area needs a proper strategy to minimize the wastage of fuel and to save the driver's notable time. To surpass the gap between all the issues concerned, the system of Smart Parking has been proposed. The conventional system of parking the vehicles has been replaced by leveraging the power of IoT and embedding the whole parking system with sensors. The proposed system consists of Multi-deck implementation of parking system in which each slot is provided with an Infrared sensor (IR sensor) thus detecting the presence of a vehicle and communicating with the nearby cloud server. The status of the reserved and vacant spaces is known to the user by logging on to the Web Portal designed, in which the status is updated regularly based on the availability/non-availability of vehicles by collecting the information received from the sensors. Moreover, the Multi-deck implementation of parking system is an alternative approach in reducing the space-related issues thus facilitating more parking space.***
Keywords: Internet of Things(IoT), IR sensors, Smart Parking, Node Mcu, User-Interface.

I. INTRODUCTION

Nowadays every individual possesses their vehicle. In fact, with the increase in population, there is a progressive increase in the number of vehicles owned by each individual. The concept of urbanization has worsened the lifestyle and has also created an adverse impact on the people's quality of life. Besides all these negative factors, the traffic jam which is quite irritant is completely unavoidable. Many surveys and research papers [7] have contributed plenty of research works in the field of transportation. These papers aim to find a worthwhile solution to the existing transportation problems. Moreover, many papers aim to incorporate enormous strategies which would overcome the disadvantages of the existing parking methodologies. In busy areas and congested cities, the problem of finding a bigger space for parking the vehicles is a significant issue. The towns and cities which have densely spared population have to undergo alternative approaches to parking management methodologies. The current technology which is followed all over the globe is the Internet of Things(IoT) which assures inter-connectivity among the devices [5,8,10,12]. The IoT finds applications in major fields such as augmented reality, manufacturing, smart cities, transportation, manufacturing etc. Summarizing all these glitches and keeping in view the technology of Internet of Things, we have designed a smart parking system which is an effective remedy much needed for the current scenario.

The system designed aims to find a productive solution for the space-related issues for the existing parking method. It aims to minimize the overall space and try to adapt to the multi-level implementation of parking the car. The hardware prototype is built with three levels taken into consideration namely ground floor, first floor and second floor. The Infrared sensors are placed across each parking lot on different floors to detect the vehicles passing through the particular lot.

The IR sensors are connected to the main entity namely the Node Microcontroller unit and thus the Node Mcu controls the user interface part designed. The user interface is continuously updated based on the status of the output of the sensors. The hardware prototype designed has been seen as an alternative approach to space-related parking issues. In Section 2, the Related works have been discussed, while in Section 3,4 and 5 the proposed system, Design and Implementation and Conclusion have been presented.

II. RELATED WORK

A. Implementation of Smart Parking System using Lab View.

In [3], P.B. Natarajan and Samit Kumar Ghosh propose a smart parking system using IR sensors which could accurately detect the parking area and indicate the total available parking spaces to the user when the user is entering the parking area. For applications that require test, measurement, and control Lab VIEW (A systems engineering software) has been used with rapid access to hardware and data insights which has been used for checking the true and false conditions depending on the status of IR sensor. The results of the paper could imply the vacant parking spaces clearly but is limited for only a small scale parking area and could not cover multiple decks of parking space.

B. RFID and WSN Based Smart Vehicle Parking System.

In [4], Aamir Shahzad and Jae-young Cho propose a user convenient Smart Vehicle Parking System(SVPS) in which a web-based application is designed for the convenience of the user to reserve the parking space according to their interests. The RFID (Radio Frequency Identification and Detection) and WSN (Wireless Sensor Network) aid in knowing the reserved and vacant spaces through the user application which is been accessed by the users. But in this system RFIDs are used where active RFID tags are quite expensive and programming of those tags require a more amount of skill besides external electromagnetic interference could hinder the RFID tag from reading the user credentials which is a major disadvantage.

C. Dynamic Public and Private Parking Guidance using Occupancy Detection Sensors.

In [6], Jong-Ho Shin, Namhun Kim and more authors have proposed dynamic Information-Based parking guidance for both public and private parking in megacities. The proposed work provides centrally managed parking guidance system to the users to utilize the parking spaces properly. This system aims to maximize the spatial resources of the megacities by providing proper reservation based on utility functions. But the major drawback of the system is that maintaining such a vast network is tedious and the reassessment of parking selection should be performed discretely during driving to the parking spot. However, the decision of reassessment policy needs more study.

D. Performance Analysis of Light Sensors and IR Sensors.

In [9], Mamta Bachani ,Umair and Faisal have discussed the performance analysis of proximity sensors such as IR sensors and light sensors such as LDR(Light Dependent Resistor).LDR sensors would work on the shadowing principle and IR sensors would work on the object detection principle.Here,it is said that the IR sensors could outperform LDR because IR sensors are not affected by the environmental conditions whereas the latter sensors are easily affected by the external environments when there are rapid changes in the climatic conditions. Moreover, IR sensors would easily identify the different types of vehicles unlike LDR sensor but the only disadvantage of IR sensor is that it is slightly costly compared to LDR but it could give the best performance than LDR which is mostly desired.

E. Sensors Employed in Smart Parking Systems.

In [1], Fadi Al-Turjman and Arman Malekloo have discussed all possible sensors and IoT techniques which could assist in the parking-related activities for the fastest identification of vacant space. The authors have managed to gather all the parking- related models and techniques such as Smart Payment System, Parking Reservation System(PRS), E-Parking system etc. They have studied the comprehensive techniques involved in the below parking systems and have suggested their merits and demerits. Besides analyzing these systems and various sensor techniques, they have come into a conclusion to follow the Hybrid system which consists of many types of sensors (light sensors, magnetometer, CCTV) used for detecting the vehicles. In case of failure of any sensor, the remaining sensors could be intact preserving the reliability of the whole hybrid system.

F. Street Parking System using Wireless Sensor Networks.

In [11], Zusheng Zhang, Xiaoun Li, Hauqiang Yuan and Fengqi Yu have proposed a street parking system in which a smart parking solution has been devised to reduce the controversies faced by the users in parking their respective vehicles. This system consists of a base station, remote server, routers and many sensors in which each of these sensors are embedded in each of the allotted parking spaces. The sensors deployed could get the input from the respective vehicles entering the parking area and it would transmit the message to the router which in turn forwards the packets to the base station. The base station collects all the information sent from the sensor nodes and it would transmit it to the remote server. Likewise, the process is being carried out but the proposed system would cover only a small portion of the area which is the main drawback.

G. Barcode based approach to smart parking solutions.

In [2], the authors Sahil Rupani and Nishant Doshi have discussed the challenges to be faced while implementing the smart parking system using Internet of Things. They have designed a barcode system authentication solution for the problem approached in parking a vehicle. Barcode system is one of the most followed and archaic approaches of solution which has been carried out since the past. They too have many disadvantages. To find a futuristic solution [13] for the problem discussed, sensor-based approaches have been proposed by various researchers around the globe. There are many kinds of research conducted in embedding the sensors in the parking space and establishing a connection between the sensors and base station to communicate the information which is been received with the sensor node.

III. METHODOLOGY

A. Proposed System Block Diagram

The proposed system suggests that the space provided for parking can be used effectively by parking exactly in their slot and not parking randomly. The proposed system consists of Multi-deck implementation of the smart parking system which includes three decks of car parking availability area. The designed, each deck consists of four slots available for parking resource and therefore twelve slots are built which constitute a Multi-deck parking area. Each single parking space is being provided with an Infrared sensor which indicates the reserved and unreserved parking space based on the inputs from the user and updated to the cloud. The cloud database is continuously updated based on space availability and is been differentiated by the red and green colour which means reserved and vacant space respectively so that the user can check out the status for parking his car where the space is free. The user interface would tell the user regarding the parking spaces. If there is any slot allocated for the pre-registered user, that is if there is any new user/pre-registered user who can benefit by using the parking slot within the provided time slot for the other user, the slot is made available to the late comer to park his vehicle. The block diagram of the proposed system which consists of Node Microcontroller unit, IR sensors have been depicted in Figure 3.1.

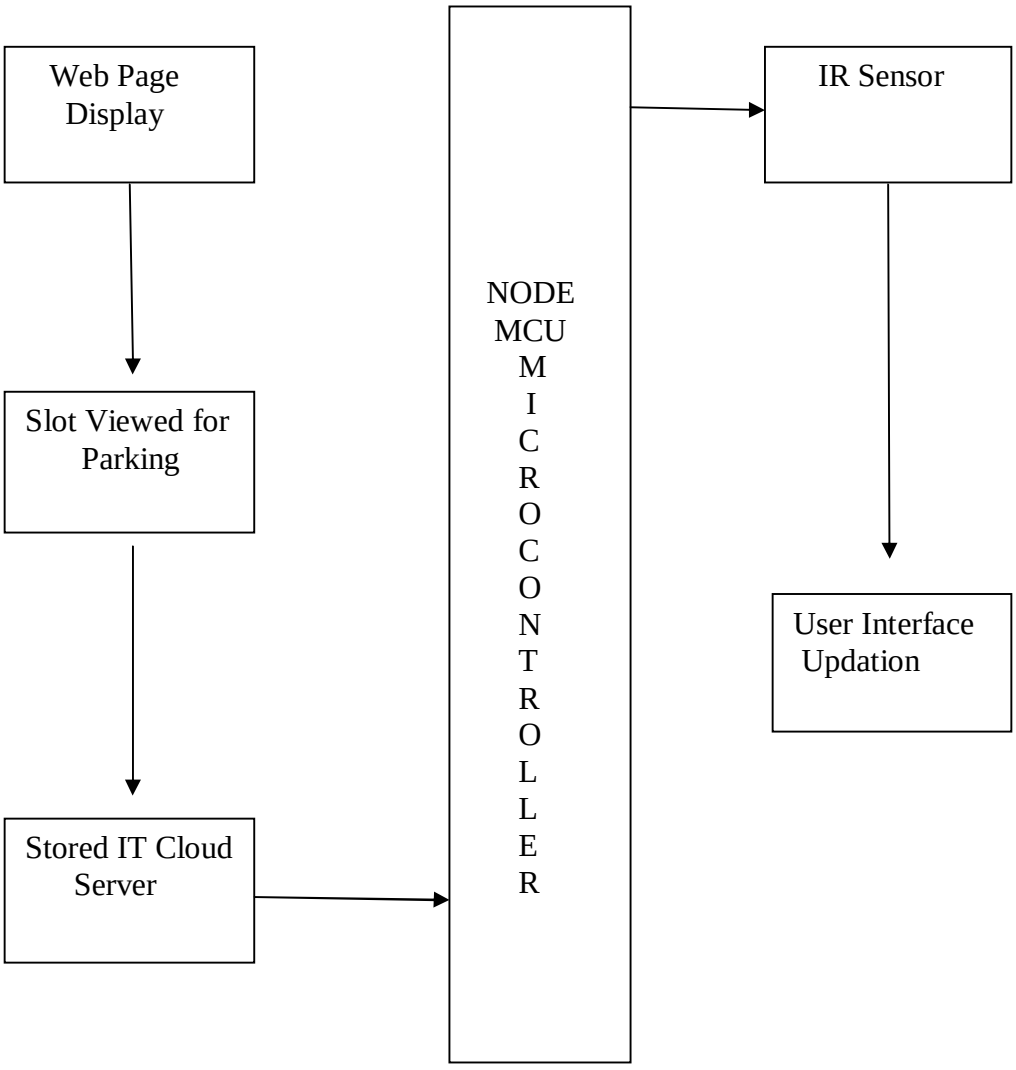

Fig 3.1 PROPOSED SMART PARKING BLOCK DIAGRAM

B. Design

The central entity of the hardware prototype designed is the controller. The controller serves as the core irrespective of any user application and real-time projects to be designed. The Node Microcontroller unit is employed for controlling twelve numbers of Infrared sensors and to update the user-interface continuously based on the status received from the output of the LED in the IR sensor. The controller and sensor part are discussed below. Besides the software employed for controller and user-interface are also explained.

C. Node MCU

Node MCU(ESP8266) is a single board microcontroller employed for developing real-time projects. It is an open source platform and allows tie-up with WIFI network through the wireless communication technology. The development board has seventeen GPIO pins which can be used for miscellaneous functions such as I2C, IR remote control etc. Figure 3.2 shows the Node MCU.

Fig 3.2 Node MCU Development Board

D. IR Sensors

An IR sensor is a proximity sensing element that works in the Infrared region and is based on the object detection principle. Infrared radiations are invisible to the human eye but are easily perceived via a camera. The IR sensor consists of a transmitter and receiver part. When an object is being detected by the Infrared radiations from the IR transmitter part, a part of the light is reflected from the object to the photodiode so- called the receiver part. Figure 3.3 picturises the IR sensor.

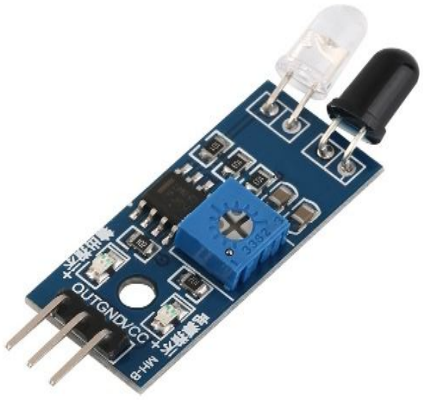

Fig 3.3 IR Sensor

E. Software Essentials

For the development of real-time effective embedded systems, a programming language called Embedded C is used. The program for the application of smart parking system is written in the Arduino platform and is dumped in the flash memory of the Node Mcu controller. The front end serves as the User-Interface and is designed with Hypertext Markup Language (HTML) and Cascaded Style Sheet (CSS).

IV. SYSTEM IMPLEMENTATION

A. Prototype Model of the Smart Parking System.

The Multi-Deck implementation of the smart parking system is designed by constructing three levels of parking area one above the other in which each level of the parking area is provided with four spaces allotted for parking the vehicle. Each parking space is equipped with an Infrared sensor for detecting the presence of a vehicle. The smart parking prototype model which consists of twelve IR sensors is shown in Figure 4.1

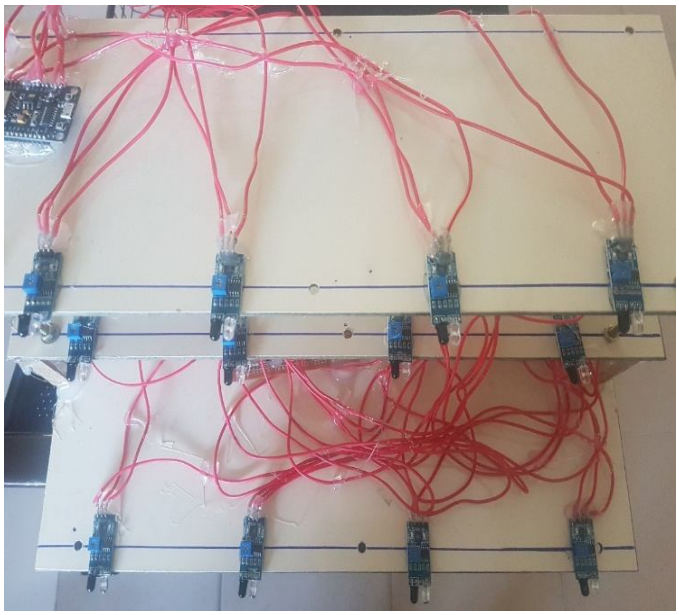

Fig 4.1 Prototype Model of Smart Parking System.

B. Sensing Of The Vehicles

The Infrared sensors are used to sense the movement of the vehicle when the vehicle approaches the scope of the sensors. In real-time, the sensors could be fixed on the parking lane or else on the walls adjacent to the vehicle to be parked. Figure 4.2 shows sensing of vehicles.

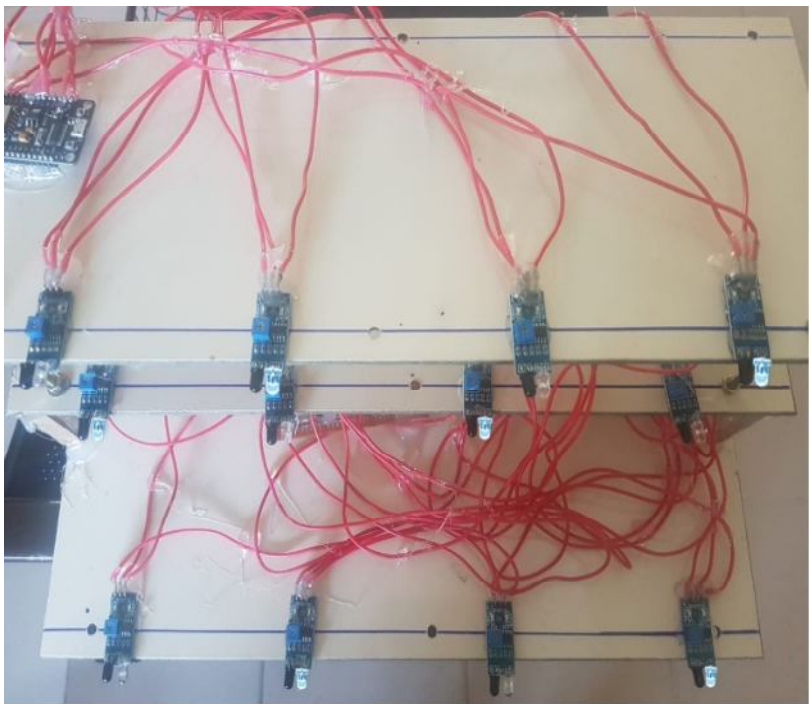

Fig 4.2 Output of The Prototype Model

The Web portal is designed for user convenience for checking the status of vacant and filled lots. The information received from the IR sensors are sent to the cloud server and automatically displayed on the front end for the display to the user. Figure 4.2 and 4.3 illustrates the login page and web portal output of the parking system respectively. The user interface part is designed in such a way that the filled spaces are indicated with red colour and the vacant spaces are depicted with green colour for the convenience of the user. Figure 4.3 illustrates the login page and Figure 4.4 shows the Front end designed for the sake of users.

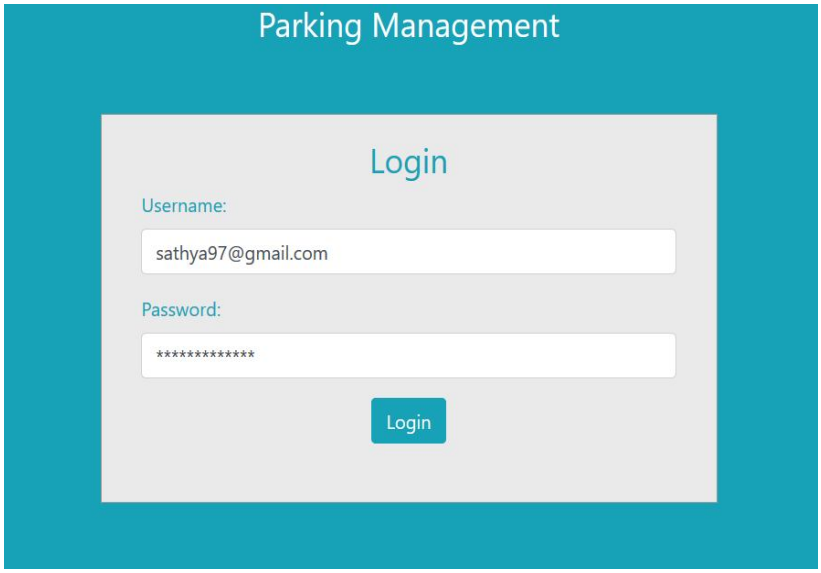

Fig 4.3 Login Page

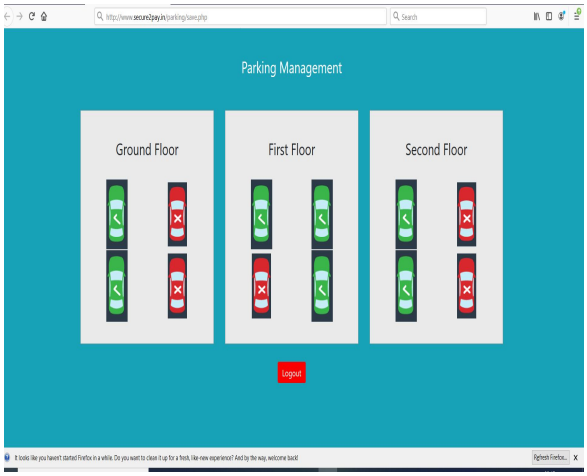

Fig 4.4 User-Interface

V. CONCLUSION

With concern to the rise in population and challenges in utilizing parking spots effectively, many solutions are considered and formulated. Hence to overcome the current parking problems an IoT based Multi-deck implementation of smart parking system is proposed. The system is equipped with Infrared sensors all over the three decks built and the status from the sensors is communicated to the user with a web portal designed. The IR sensors play a significant role in collecting the information from the vehicles received and thereby updating the database with the current value. The multi-deck implementation is considered in the project to overcome the space required to park the vehicles as an alternative to a large area usually utilized for parking management. The conceptualization of the project can be extended over to considering building more and more decks to overcome the space-related issues in megacities. For making the smart parking system more efficient and reliable, the current infrastructure has to be strengthened and many deep learning algorithms have to be implemented which are the futuristic goals.

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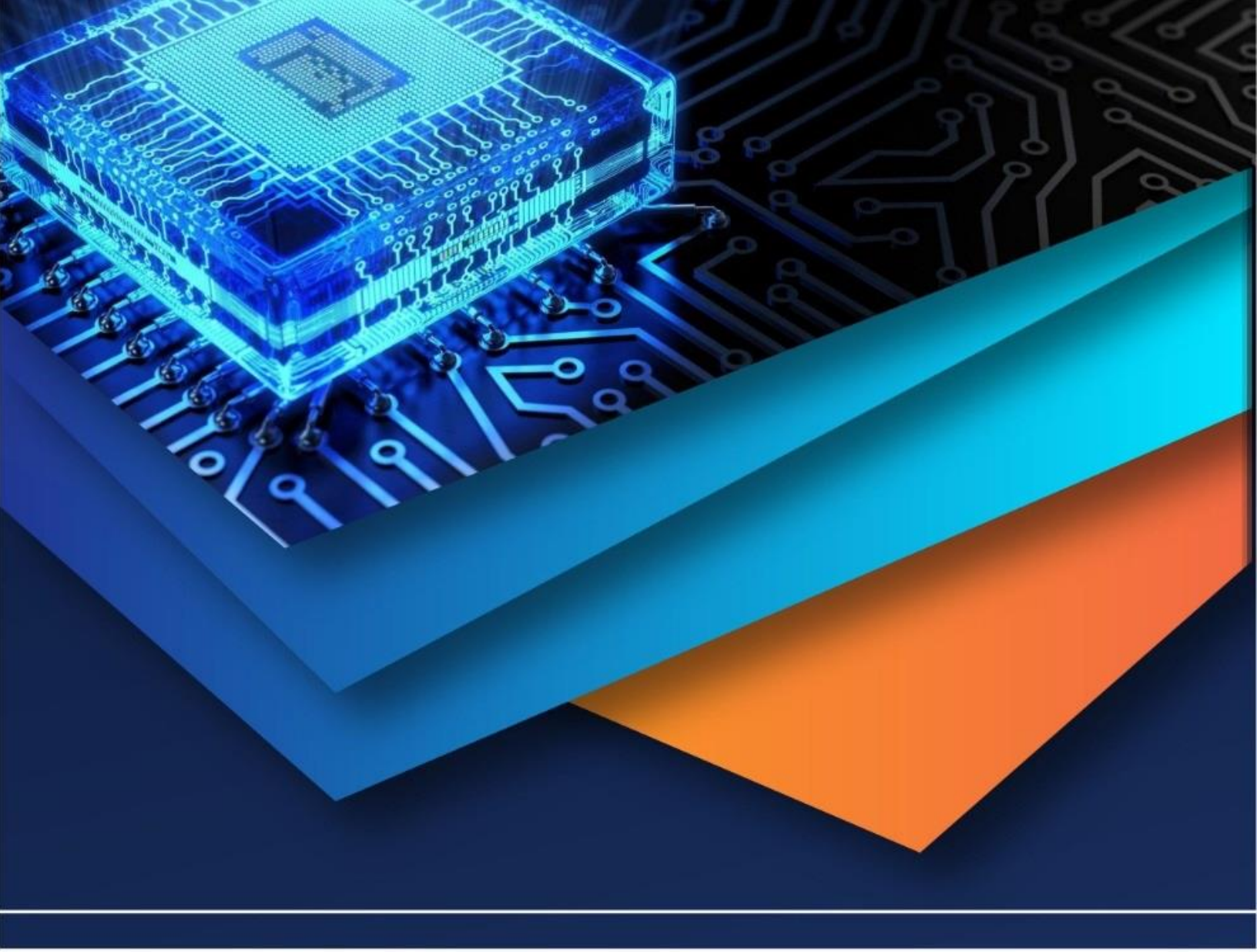

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