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IoT based Smart Parking System using NODE MCU ESP8266

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Abstract: ***So basically, we know that the number of vehicles sold every day that number is increasing day by day. This continues increasing of vehicles on the street with the lack of car parking is becoming a problem in most urban cities. To avoid this problem our Smart Car Parking System comes into the picture. This solution is cost-effective as we are automating the system that we are using will eliminate the need of human operators also this will save the fuel that is burnt in searching of the parking slot in the parking area and also this will save our precious time. And as we are accommodating a greater number of vehicles in same parking area therefore there will be more revenue collection by the government. And this automated system can ensure that safety is provided as vehicles cannot be taken away from the designated parking slot without the authorized person's permission. And as this system is automated it is user friendly and will allow hassle-free parking of the vehicle***
Keywords: NODE MCU ESP8266, IR Sensor, Traffic Congestion, IoT, cloud database

I. INTRODUCTION

Due to the surge in urbanization, people don't depend on public vehicles. They use their vehicles to travel. So, traffic increases. When people travel through a city the most difficult problem is to park the vehicle. It causes not only a waste of time and fuel for drivers looking for parking, but it also leads to additional waste of time and fuel for other drivers as a result of traffic congestion. The usage of automobiles has increased which in turn has led to traffic and parking difficulties. The most widespread solution used currently is to increase manpower to handle such traffic. Even in malls, trade centers, and business parks, the parking of vehicles has become an issue. We have all experienced the chaos, confusion, and time-consuming queues to find an appropriate parking space in such places. Nowadays finding parking in busy areas is very hard and there is no system to get the details of parking availability online. Imagine if you can get the parking slot availability information on your phone and you don't have to roam around to check the availability. This problem can be solved by the IoT-based smart parking system. Using the IoT-based parking system you can easily access the parking slot availability over the internet. This system can completely automate the car parking system. From your entry to the payment and exit all can be done automatically. So here we are building an IoTbased Car Parking System using NodeMCU, five IR sensors, and two servo motors. Two IR sensors are used at the entry and exit gate to detect the car while three IR sensors are used to detect the parking slot availability. Servo motors are used to open and close the gates according to the sensor value. Here we are using the Adafruit IO platform to show publish the data on the cloud which can be monitored from anywhere in the world. Smart Parking is one of the most adopted and fastest-growing Smart City Solutions across the world. Airports, universities, shopping centers, and city garages are just a few entities that have begun to realize the significant benefits of automated parking technology. The ability to connect, analyze and automate data gathered from devices, powered by and described as the Internet of Things, is what makes smart parking possible. Smart Parking involves the use of low-cost sensors, real-time data, and applications that allow users to monitor available and unavailable parking spots. The goal is to automate and decrease time spent manually searching for the optimal parking floor, spot, and even lot. Some solutions will encompass a complete suite of services such as online payments, parking time notifications, and even car searching functionalities for very large lots. A parking solution can greatly benefit both the user and the lot owner. The implementation of a smart parking solution would surely be a great investment for any city government or company. As the global population continues to grow and urbanize, it is vital to implement a well-planned and convenience-driven parking solution that can be utilized globally. More automation and less manual activity save on labor cost and resource exhaustion. A seamless experience can skyrocket a corporate or commercial entity's brand image to the user. Whether the destination is a retail store, an airport, or a corporate business office, visitors will surely be impressed with the cutting-edge technology and convenience factors. In a nutshell, Smart Parking is a parking solution that can include in-ground Smart Parking sensors or counting sensors. These devices are usually embedded into parking spots or positioned next to them to detect whether parking bays are free or occupied. This happens through real-time data collection. The data is then transmitted to a smart parking mobile application or website, which communicates the availability to its users.

II. METHODOLOGY

A. Relevance of the project)

Advanced technology is the importance of the IoT-based Smart Car Parking System. It includes the latest technology and concept that is assured of profitable outcomes.

Due to its design and implementation of every concept on IoT-based Smart Car Parking, it makes it very easy to manage and supervise. Because of the well-organized structure, this Car Parking System can be easily handled by the owner and all the staff members who implement this system in their parking area.

In this Car Parking System, the sensors that we use are of low cost, and also the system gives real-time data and application. This makes the user identify the available and unavailable slots for parking easily.

The motive to make this system automatic is that it decreases the time that is spent during searching for parking slots or floors and even the parking lot manually. Also, some other solutions include services in their Parking Systems like online payment of slots, pre-booking of the slot, parking time notifications, and also car searching functionalities for huge parking lots that give more importance to the Car Parking System. Lastly, this IoTbased Car Parking System can give greatly to both the users and the parking lot owner.

B. Problem Statement

According to the Latest research, mostly in urban and metro cities, the parking problem is getting worse day by day as a high number of vehicles getting sold every day, and this results in parking problems as it is very difficult in finding parking slots in the parking area. In search of parking slots in the parking area, drivers waste their time and effort and finally end up parking their vehicles on the street which further leads to traffic and space congestion. In most of the worst-case driver fails in finding safe parking area, especially during the festive season and peak hours.

1) *Optimized Parking:* This Smart Parking System makes the user save time, resources, to find the best and safe parking slot available and also the effort in finding the parking slot. Also, this system utilizes the parking area properly in filling the parking lot efficiently by all entities like commercial and corporate.
2) *Reduced Traffic:* As time reduced in finding parking slot in the parking area and this makes lower in traffic flow.
3) *Reduced Pollution:* In searching for parking slots in parking areas, a lot of fuel gets burned in a day. And this Smart Parking System significantly will decrease the time and fuel that gets burned while searching parking area, so by all this, the daily emissions of the vehicle will decrease and ultimately will help in reducing the pollution.
4) *Increased Safety:* This Parking System increases the security that prevents violation and suspicious activity in the parking area as it gathers real-time data and also license plate recognition cameras that help parking employees and security guards.
5) *Decreased Management Costs:* As this Parking System makes the parking activity more automated and less manual that saves cost on labor and resource exhaustion.
6) *Enhanced User Experience:* As this system makes Parking a smart parking solution that will integrate the user experience. It makes all the activity more user friendly in which driver's payment, parking notifications and also slot searching and identification and many processes get more interactive and user friendly.

III. LITERATURE SURVEY

1) *"The Smart Parking System Using Ultrasonic Control Sensors" Yousif Allbadi, Jinan N Shehab, Musaab M Jasim IOP Conference Series: Materials*

Science and Engineering 1076 (1), 012064, 2021 - Over the past decade, the concept of smart cities has become very popular thanks to the Internet of Things (IoT) development and expansion for increasing the reliability of building the infrastructure of cities. The continuous increase of vehicles in the streets with the lack of car parking is becoming a problem in most urban cities. Therefore, the demand for smart car parking systems is increased for helping drivers to find a suitable car space quickly. This paper presents a smart parking system using infrared and ultrasonic sensors, which is controlled by Arduino Mega 2560. The Radio Frequency Identification (RFID) reader provides authorization to enter the smart parking system. On the other hand, a mobile application is added to allow users to know about the empty spaces based on the WiFi application. This smart parking system is implemented in a smallscale model, and the results show that simulates the car parking with the mobile application, all the sensors, and the Liquid Crystal Display (LCD) screen display, to describe a view of the system architecture.

2) *"IoT-based Smart Parking System using Android Application" Nor Bakiah Abd Warif, Mohd Izzat Syahmi Saiful Azman, Nor-Syahidatul N Ismail, Muhammad Akmal Remli 2020 Emerging*

Technology in Computing, Communication, and Electronics (ETCCE), 16, 2020. In this paper, a userfriendly mobile application, named Android-based Car Parking Monitoring System (ACPMS) is built to aid in locating a particular parking place. ACPMS can provide a user with the ability to check vacant parking spaces and locate the nearest parking lot. ACPMS obtained the parking location from the current user's position with the sensor located in the shopping complex's parking lot. ACPMS is tested in a realistic environment for movement detection and location service to notify users using the mobile application. By considering seven test case scenarios, the combination of the ACPMS mobile application with a parking prototype kit shows the proposed work is to solve the parking problem. "The Smart Parking Management System" Amira A Elsonbaty International Journal of Computer Science & Information Technology (IJCSIT) Vol 12, 2020 With growing, Car parking increases with the number of car users. With the increased use of smartphones and their applications, users prefer mobile phone-based solutions. This paper proposes the Smart Parking Management System (SPMS) that depends on Arduino parts, Android applications, and is based on IoT. This gave the client the ability to check available parking spaces and reserve a parking spot. IR sensors are utilized to know if a car park space is allowed. Its area data are transmitted using the WI-FI module to the server and are recovered by the mobile application which offers many options attractively and with no cost to users and lets the user check reservation details. With IoT technology, the smart parking system can be connected wirelessly to easily track available locations.

3) *"Smart Car Parking System Solution for the Internet of Things in Smart Cities" Wael Alsafery, Badraddin Alturki, Stephan Reiff-Marganiec, Kamal Jambi 2018*

1st International Conference on Computer Applications & Information Security (ICCAIS), 1-5, 2018 - This study has proposed a smart parking system that enhances the performance of saving users time to locate an appropriate parking space and reduces the general costs for moving to chosen parking space. The most obvious finding to emerge from this study is that they proposed a smart car parking system that will make ensure the reduction of transmitted data through the network and save energy in the perception layer. While in the application layer side is to save the user time, avoid traffic congestion, find available parking spaces, and reduce cars gas emissions from drivers while searching for the empty parking spaces.

4) *"IoT Based Sensor Enabled Smart Car Parking for Advanced Driver Assistance System" Mahendra B M, Dr. Savita Sonoli, Nagaraj Bhat, Raju, Raghu T. 2017 2nd IEEE International Conference On Recent*

Trends in Electronics Information & Communication Technology (RTEICT), May 1920, 2017, India. Work proposed in this system addresses the issue of parking in smart cities. The system is implemented using low-cost IR sensors, Raspberry pi model 3b for real-time data processing, E-parking mobile application, and Geared DC motor. The developed system provides real-time information on the availability of parking slots in parking areas and allows users to book parking slots from remote locations by using a mobile application and also provides user authentication. The developed system is tested for different cases such as single-user booking, multiple users booking, a user trying to book a reserved slot, and user authentication. The proposed system is designed for 3 parking slots each having a single IR sensor with an adjustable sensing range of up to 30cm. Proposed work not only reduces the traffic congestion, but it is also providing authentication of the user, costeffective, real-time, and helps in reducing carbon footprint.

5) *"Internet of Things based Smart Parking System" Shelena Soosay Nathan, Aida Nabilah Mohd Khairudin, Muhammad Najmi Afiq Saiful Bahri, Muhammad Alifuddin Jaafar Multidisciplinary*

Applied Research and Innovation 1 (1), 45-52, 2020 - This smart parking allows customers to optimize shopping time by helping them find a nearby parking spot, provide real-time information on parking space and provide smart payment services. This study aimed at developing an Auto Gate Smart Parking System which applies the concept of the Internet of Things. The methodology used in the development is the Input Process Output model in steps which include analysis requirement, design and testing, and evaluation. This system uses an Auto Number Plate Recognizer (ANPR) through Raspberry Pi to detect the vehicle's plate number and with the help of an ultrasonic sensor, Raspberry Pi camera, database, and an Arduino board. Testing was conducted by registering the vehicle plate numbers into the database through Google Form and the system was tested with the registered plate number vehicle. It has shown that the system had effectively recognized the vehicle's plate numbers which makes it easy for parking for small organizations to control their parking area.

The system provides convenience to users as no direct interaction is needed for access. Given the current situation in facing Covid19, it is very important to have contactless systems. Therefore, this Auto Gate Smart Parking will be a great tool to be used in an authorized parking area

IV. PROBLEM STATEMENT

To implement IOT BASED SMART CAR PARKING SYSTEM USING NODEMCU ESP8266 With the increase in the population, the number of vehicles increases and due to unmanaged parking, it leads to many problems. In center cities, people face difficulties as increasing number of vehicles creates congestion, wastage of space, time, traffic problems, carnapping, car vandalism, and many other difficulties.

V. OBJECTIVE

1) The main objective of this project is reducing the risk of finding parking slots in any parking area.
2) It eliminates the unnecessary traveling of vehicles across the filled parking slots in a city.
3) Using the IoT-based parking system you can easily access the parking slot availability over the internet.
4) This project helps the drivers of the cars to park their vehicles with minimum wastage of time with accurate information of the availability of the space.
5) Enhance the security by simplifying the parking system.
6) Smart system that parks several vehicles with the least space possible.

VI. SPECIFICATIONS

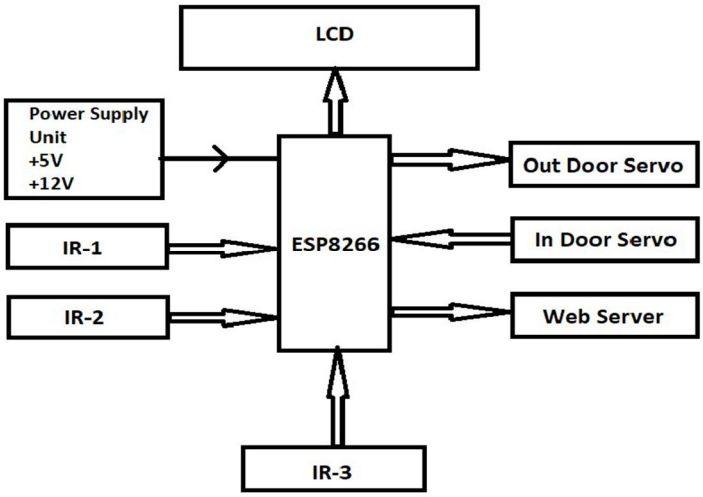
A. *Hardware*

1) NodeMCU ESP8266
2) Jumpers
3) Servo Motor
4) Power Supply
5) IR Proximity Sensor

B. *Software Requirement*

1) Adafruit IO (Online Service)
2) C language

VII. BLOCK DIAGRAM



VIII. DISCRIPTION

A. *NODEMCU ESP8266*

1) NodeMCU ESP8266 is an open-source Lua-based firmware and development board specially targeted for IoTbased applications.
2) It includes firmware that runs on the ESP8266 WiFi SoC from Express if Systems and hardware which is based on the ESP-12 module, and like this, it can also be programmed using Arduino IDE and can act as both Wi-Fi Hotspot or can connect to one.
3) It has one Analog Input Pin, 16 Digital I/O pins along with the capability to connect with serial communication protocols like SPI, UART, and I2C.
4) NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs

B. *Servo Motor*

1) Operating Voltage is +5V typically
2) Torque: 2.5kg/cm
3) Operating speed: 0.1s/60°
4) Gear Type: Plastic
5) Rotation: 0°-180°
6) Weight of motor: 9gm

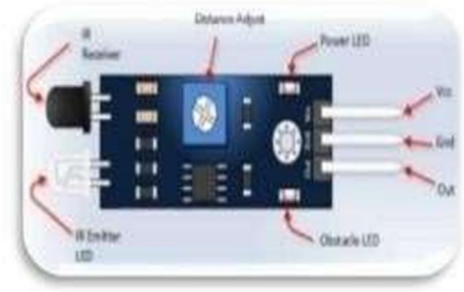
C. *Jumper Wire*

1) Standard 0.1" (2.54mm) spacing when placed next to each other
2) Length: 200mm (7.87")
3) Wire Colors: brown, red, orange, yellow, green, blue, purple, grey, white, black (Each cable includes 4 of each color)
4) Fits breadboard
5) Weight: 31g

D. Power Supply

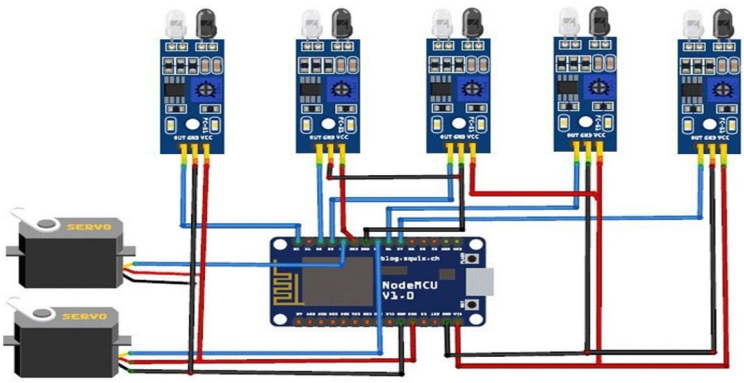
Power banks can be used as power supply. They are almost X. SOFTWARE IMPLEMENTATION universally rated in milliampere hours, abbreviated as "mAh".

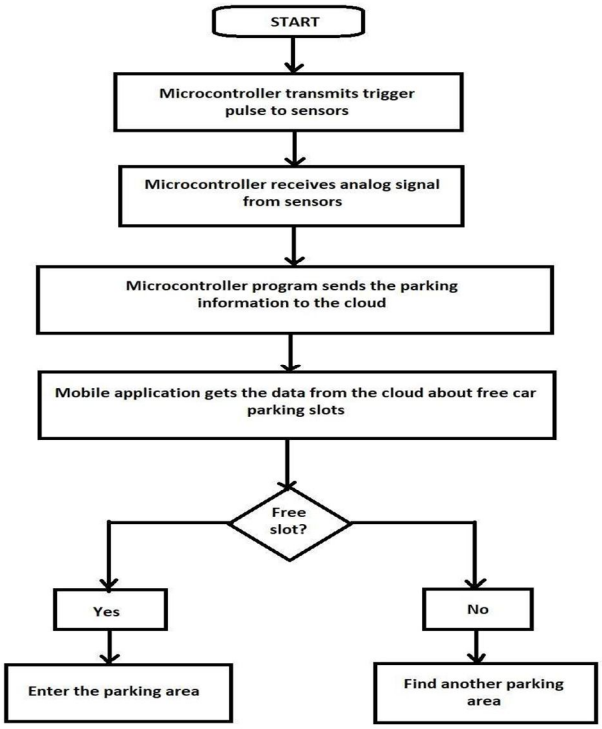
E. IR Proximity Sensor



1) IR transmitter
2) Pin easy interface connectors
3) Indicator LED & Power LED
4) Distance 2cm to 30cm
5) Active Low on object detection
6) 3.3 to 5V operation

IX. CIRCUIT DIAGRAM





X. FUTURE SCOPE

1) *Development And Deployment:* The idea is that having cars that self-park will help improve traffic congestion considerably as riders could be dropped off in front of their destination and the car would park itself and minimize the time spent taking up space on the road.
2) *Automated Parking:* An automated parking system is capable of moving cars
3) *Parking Counter:* A system capable of detecting vehicles entering and leaving a parking facility. This connected counting system will successfully provide motorists with a count of available parking slots in real-time.
4) *AI, ML:* AI-based smart parking solutions include special IoT tools that can count the number of parked vehicles and empty parking spaces in a parking lot. It detects if there is a car presence in a parking space and sends the information to the management platform. The best part is that this AIbased solution collects and formats the information in real-time.

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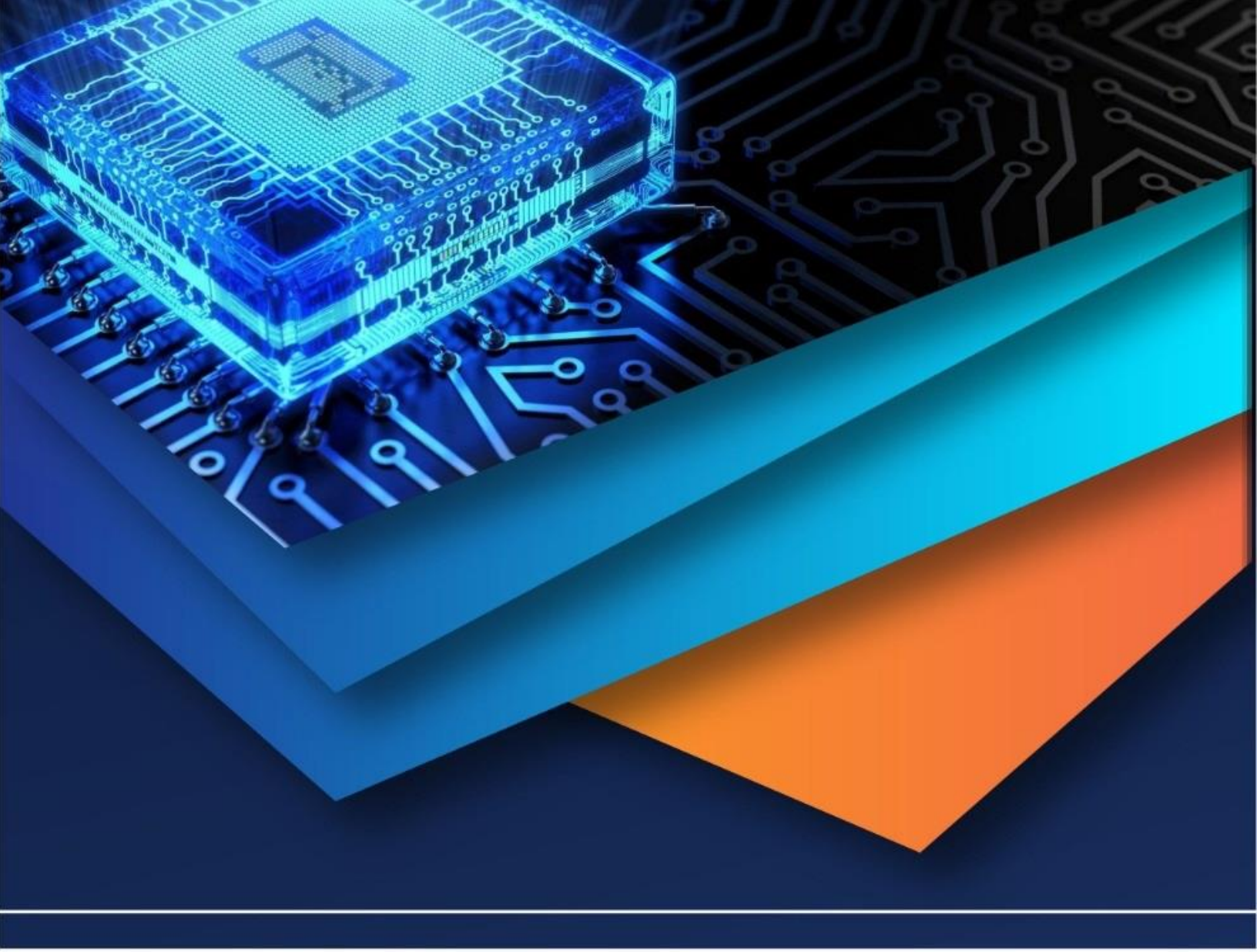

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