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Intelligent Parking Assistant for Shopping Malls

G Vinayaka Bharadwaj[1], Harshita Hegde[2], Husain Totanawala[3], M Krishna Saharsh[4], Prof. Druva Kumar S[5]
[1, 2, 3, 4, 5]*Electronics and Communication Engineering, Dayananda Sagar College of Engineering, Bengaluru, India*

Abstract: ***Parking has become a serious issue in metropolitan cities, because of the increasing number of automobiles. Crowded places like malls have multi-storey parking which provides cars with parking on multiple levels stacked vertically to increase the number of parking spaces and requires printing of a lot of tickets. The user usually wastes his/her time and efforts in search of the availability of the free space in such parking lots. This project uses an IoT based smart parking system which provides an optimal solution for the above mentioned problem.***
Index Terms: QR code, Raspberry Pi, Ticket, Parking slot, Shortest route.

I. INTRODUCTION

With the growth in population and economic development, the number of people owning vehicles has increased. Thus, parking is becoming one of the major problems for cities and-frustrating for the users to search for a parking spot in a parking lot of malls, hotels or at work.

Today, convenient parking and modern retail go hand in hand. Malls have multi- storey parking lots, with space to hold anywhere between 500– 10,000 two and four-Wheeler's depending on their size and popularity. For consumers with private vehicles, a parking lot is the first point of contact with a mall.

A well maintained and convenient lot works wonders for the business. Parking management and security have the potential to significantly increase customers. Thus an efficient automated system which allocates a parking space, guides the driver to the allocated spot and deducts the parking fee, will save time for the user.

II. EXISTING SYSTEM

Existing system in the parking domain requires the user to download an app in order to book the parking slot. The user is given the liberty to book a slot for their parking. However, it poses a lot of drawbacks. Each mall may have different dedicated application for their parking. The users who booked a slot may not even turn up. Our system doesn't require the user to download any application. The use of QR code for the entry is an unique idea and hasn't been implemented much. The finding of the nearest parking slot for the car is also our own unique concept along with provision of a route map asan image is fairly new.

III. SCOPE OF THE PROJECT WORK

In today's world, parking our vehicles is a matter of concern. With so many people having multiple vehicles and travelling everywhere, finding a parking slot is very difficult. So wehave come up with a solution which not only enables youto find a perfect parking slot but it will also show you the shortest distance to get there making this tedious job simple. The inclusion of a QR based ticket over traditional paper ticketcan prevent the losing the parking ticket. The entry gate canbe controlled by the user at the entrance.

IV. METHODOLOGY

The system architecture has 3 tiers, the lowest level com- prises sensing functionality, the middle tier deals with data collection and the upper tier handles data storage, processing and client interfaces. The sensors used in the project commu- nicate with the database over the internet.

Create a HTML page to display the ticket and host the HTML page on the web to create URL link. Create QR code

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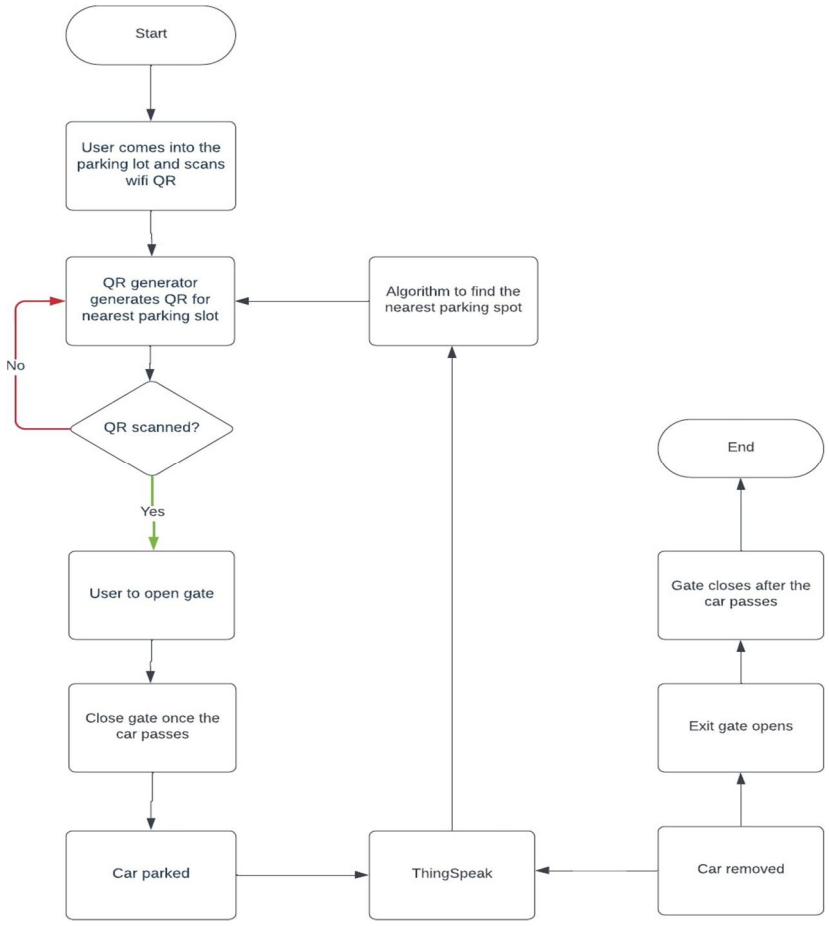


Fig. 1. Flowchart

For the ticket that is to be displayed at the entrance. Control the servo motor using raspberry Pi and code the servo motor to work according to the actions made on the HTML page. Control the entry gate using the user's phone from the link present in the ticket. The gate has to be closed after the car passes. IR sensors at the parking space detect the car and sends data to ThingSpeak. The algorithm collects data from ThingSpeak and provides the nearest parking slot available. The ticket prompts questions to users during the exit gate. The final amount to be paid is displayed in the ticket. At the exit gate, the gate opens when a car is sensed and closes afterit passes.

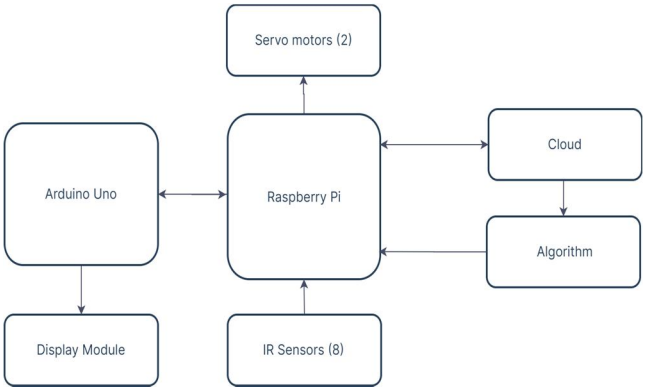


Fig. 2. Block Diagram

Figure 2 shows the block diagram of the proposed system.It consists of :

A. Raspberry pi

It is a low cost,credit card sized computer that plugs intoa computer monitor or TV, and uses a standard keyboard and mouse.It's capable of doing everything a desktop computercan do. [14] In this model, the Raspberry pi is the main processing unit which performs all the actions necessary for smooth functioning of the model. It controls the sensors and runs the motors simultaneously while communicating with theArduino and cloud for information. [15]

B. Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are ableto read inputs - light on a sensor, a finger on a button, ora Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. [17] In this project, it is used to control the display module to display the QR.

C. IR Sensors

An infrared sensor (IR sensor) is a radiation-sensitive opto- electronic component with a spectral sensitivity in the infrared wavelength range 780 nm-50 µm. IR sensors are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm systems to detect unwelcome guests. It is used to sense the presence of the car in the parkinglots and at the entry and exit gates. [26]

D. TFT Display

A thin-film-transistor liquid-crystal display (TFT LCD) is a variant of a liquid-crystal display that uses thin-film-transistor technology to improve image qualities such as address ability and contrast. [25] TFT LCD's are used in appliances including television sets, computer monitors, mobile phones, handheld devices, video game systems, personal digital assistants, nav- igation systems, projectors, and dashboards in automobiles. TFT display is used to display the QR for the nearest availableparking spot for this project.

E. Servo Motor

A Servo Motor is a rotary or linear actuator that produces torque and can rotate with great precision, and also have a precise control over its angular or linear position, acceleration and velocity. [22] It is used as a gate at the entrance and exitin this system. [23]

F. Cloud

An IoT cloud is a massive network that supports multiple devices and applications. ThingSpeak is an open-source soft- ware written in Ruby which allows users to communicate withinternet enabled devices. It facilitates data access, retrieval andlogging of data by providing an API to both the devices and social network websites. Fields are created for each parking slot so that the sensor readings can be stored and retrieved. These fields are updated by the IR sensors connected to the Raspberry Pi. [27] The data can be visualized in either XML, JSON or CSV format. This same data is utilized by the Pi todetermine the closest slot that is available for parking.

G. Threading

Multiple sensors need to operate constantly in various loops, and simple straight-line looping is ineffective. One sensor can only be active at once. As a result, another strategy had to be used. Threading is the name of this procedure. [28] A process's path of execution is called a thread. It enablesyou to use the interpreter to execute numerous operationssimultaneously. It is also referred to as a light procedure.By separating a process into several threads, it enables parallelism. For instance, MS Excel makes use of severalthreads to format text, handle inputs, create tables, and more. A thread in a program is a set of lines of instructions that can run separately from other code. A thread is different from a process. Threads are present in a process ad they run in a shared memory space. Processes run in differentmemory spaces and are independent of each other. Threadsare dependent and share results with other threads. [29]

There are 4 threads used in the project:

1) Thread to control the entry gate servo motor . It can becontrolled by the user.
2) Thread to control the exit gate servo motor.
3) Thread to monitor the IR Sensors.
4) Thread to control serial communication between Pi andArduino.

Each thread has separate loops and are run indefinitelyuntil the program is force stopped. Hence, to collaborate allthe threads, multi-threading is done. Multithreading is defined as the ability of a processor to execute multiple threads concurrently.

H. Algorithm

1) Enter the parking area and scan the QR to connect to the Mall's network.
2) Scan the QR ticket from the display to be assigned the nearest available parking lot.
3) Open the entry gate using the button provided in the ticket.
4) Use the route map to navigate to the slot and park.
5) The IR sensors at the parking slot updates the cloud once the slot is occupied.
6) The algorithm obtains data from the cloud and finds the next best slot.
7) Once the next car arrives at the entrance, the IR sensor senses the new car and immediately changes the display to the next ticket.
8) The ticket is available in the mobile and even displays the amount of time spent inside the mall.
9) During exit, remove the vehicle from the parking lot and click on the "Exit Gate" button in the ticket and follow instructions.
10) The ticket will display the final amount that needs to be paid for parking.
11) The IR sensor at the exit gate opens when it senses the presence of the vehicle near the gate and opens the exit gate. If all the slots inside the parking area are occupied, the display will output a message that reads, "Sorry, no slots available".

V. IMPLEMENTATION

A QR generator is used to generate QR for the mall networkand unique QRs for each parking slot. The QR to connect to the mall network is placed before entering into the parking. The QR for the nearest available slot is displayed with thehelp of TFT. The user on scanning the QR is directed to a webpage which consists of the ticket, a timer and a button to open the gate. The Gate at the entrance can be controlled by the user himself. IR sensors are used to sense the vehicle at the parking slot and update the database. Arduino IDE is used to code the Arduino board for our specifications and functions. HTML and CSS is used to designthe webpage which will help guide the driver to his/her parkingslot. The database is stored in cloud and an algorithm to find the nearest available spot is programmed.

A. Hardware and software requirements

1) Hardware

a) Raspberry pi
b) Arduino Uno
c) IR sensors
d) Display module
e) Servo motor
f) Connecting wires

2) Software

a) Software services: Arduino IDE, Atom IDE
b) HTML and CSS
c) QR Generator
d) Cloud service for IoT : ThingSpeak

Figure 3 and 4 show the connections of hardware components.

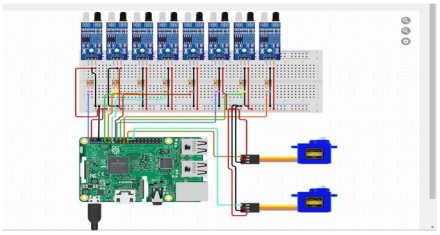


Fig. 3. Connections of Raspberry pi

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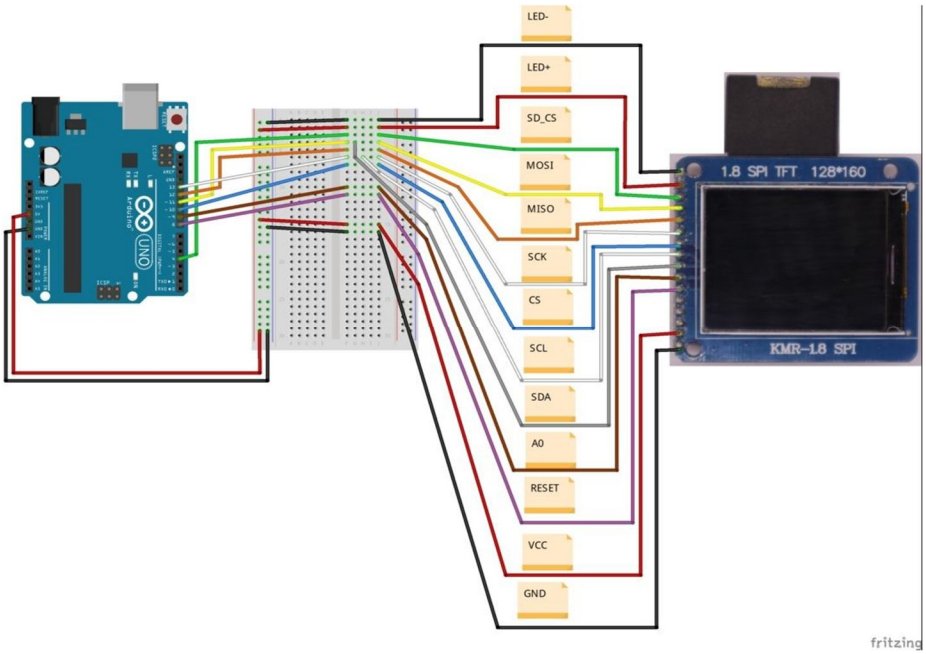


Fig. 4. Connections for TFT Display

VI. ADVANTAGES / APPLICATIONS

1) No need to search for available parking spaces
2) Time saving
3) Consistent parking experience
4) Your car is parked safe and secure (no worry about theft/ damage)
5) Optimizes parking space usage
6) Fuel saving hence environmental friendly

VII. RESULTS AND SIMULATION

The model consists of automated gates at the entrance and exit. The gate at the entry opens when the QR is scannedand the user prompts the gate to open. The gate remains open for a brief time. The duration before which the gate closes is intimated to the user. At the exit gate, the sensor senses thecar and opens the gate. The sensors at the parking area or slot are predicted to constantly monitor the presence of the vehiclein the slot. They communicate to the central system to report on the availability of the parking slot as soon as the vehicle leaves the parking area so that the next vehicle may find the closest parking slot instead of taking rounds in the basements. This project aims to provide the nearest available parking spot. This is achieved by using an algorithm that prioritizes the closest empty spot from the periodically updated database on the occupancy of the parking slots. The ticket generated using the QR shall display time present in the mall and the slot allotted to the vehicle to park.



Fig. 5. QR code

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Fig. 6. Data logged in ThingSpeak

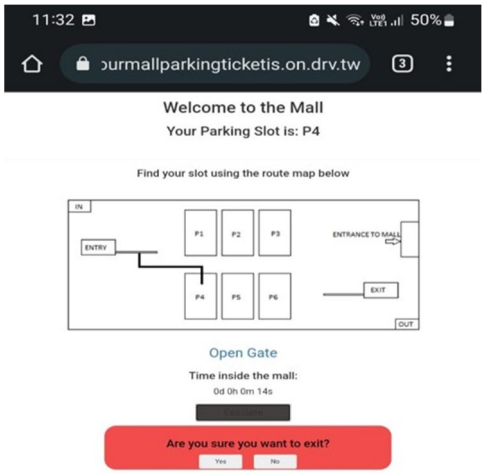


Fig. 7. Web Page for the User

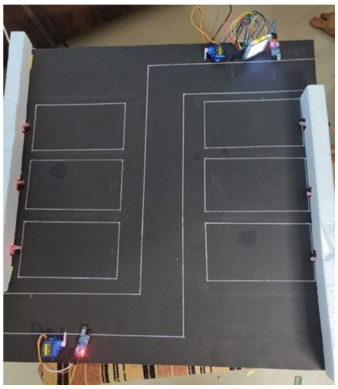


Fig. 8. Project Model

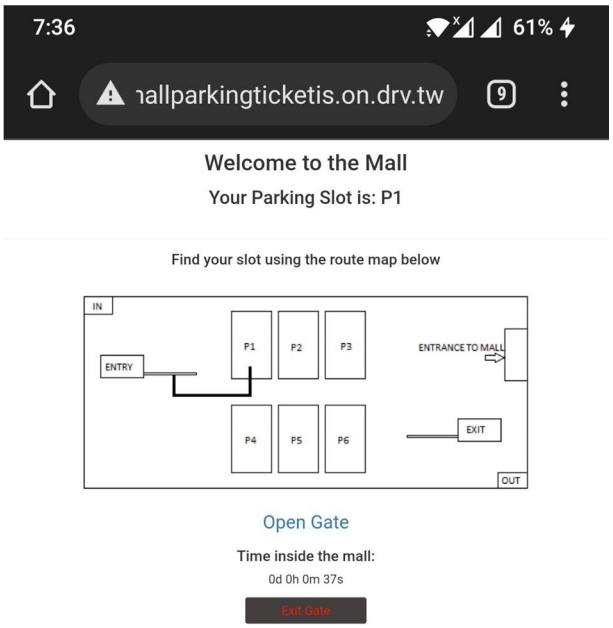


Fig. 9. Parking Ticket

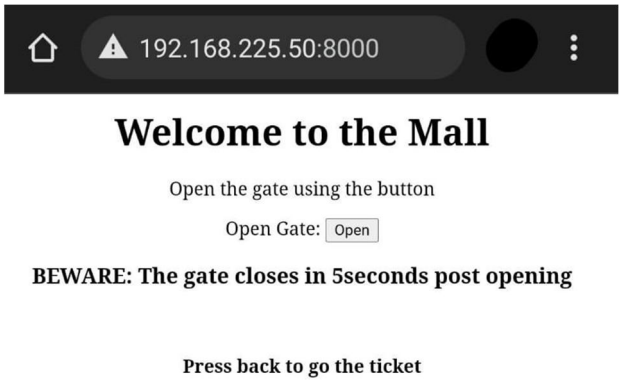


Fig. 10. Webpage to open the gate

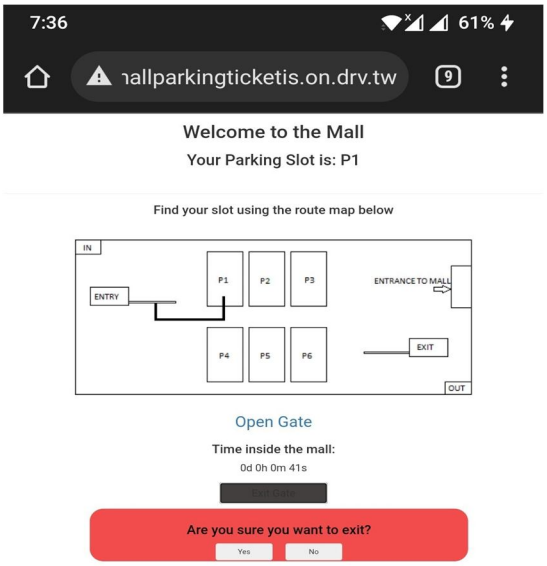


Fig. 11. 1st alert after pressing exit gate

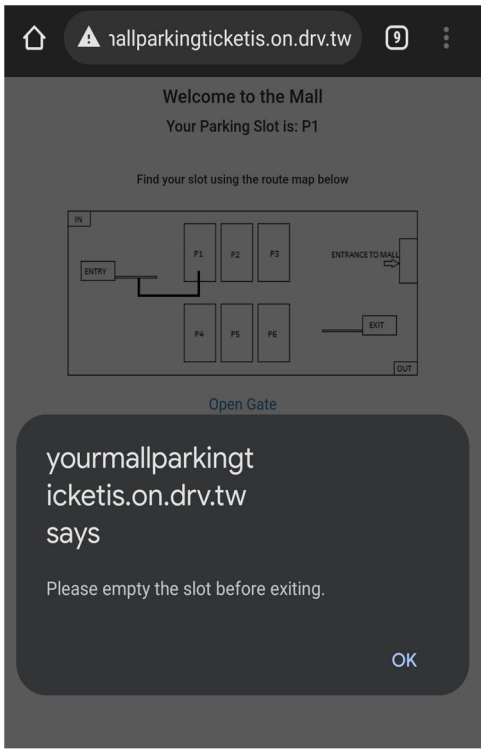


Fig. 12. Prompt if slot is not emptied



Fig. 13. 2nd alert

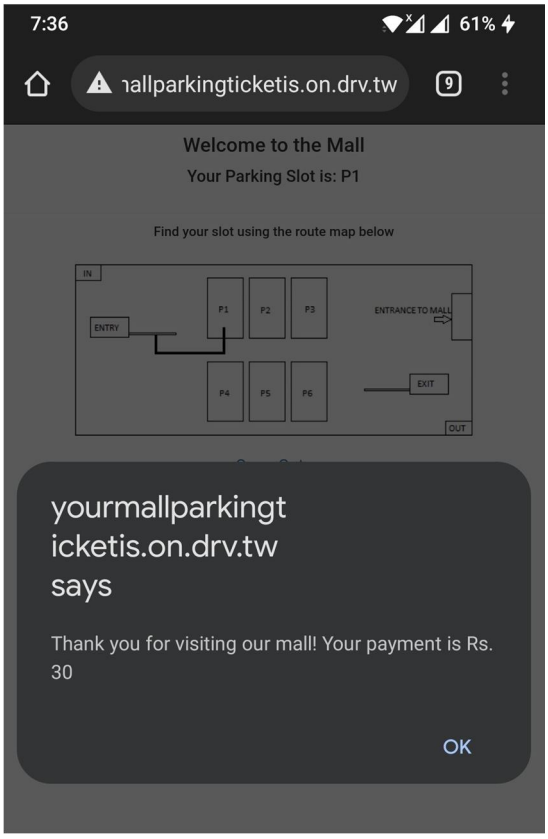


Fig. 14. Payment prompt

VIII. CONCLUSION

The growth of the Internet of Things has given rise to new possibilities in terms of smart cities. Smart parking facilities and traffic management systems have always been at the core of constructing smart cities. We have proposed an intelligent system which will help vehicle owners park their vehicle with ease and save time and fuel in parking complexes. This system will ease the parking system in malls and offices.

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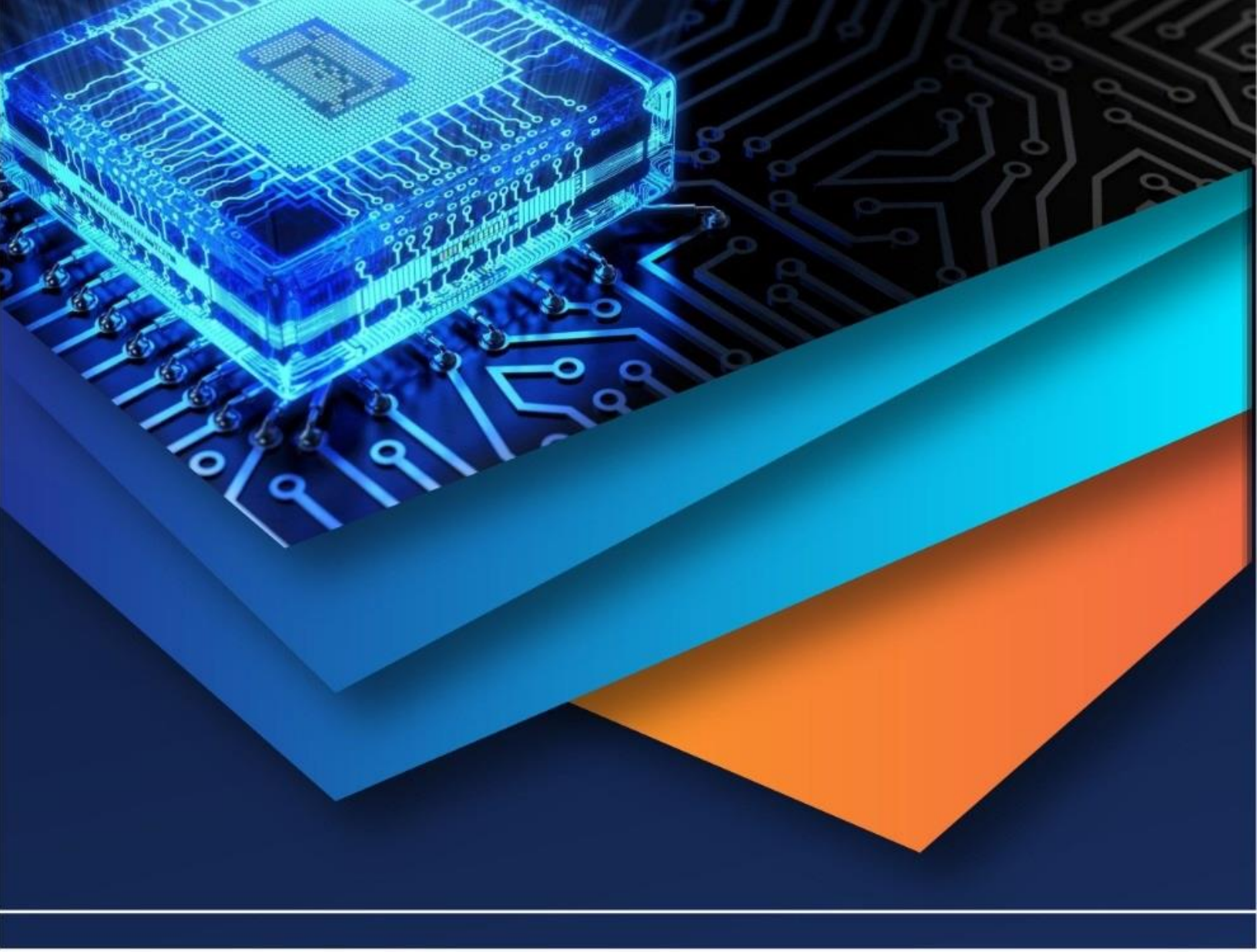
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