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Traffic Management System Using IOT

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Abstract: ***Traffic congestion is a major threat to transportation sector in every urban city around the world. This causes many adverse effects like, heavy fuel consumption, increased waiting time, pollution, etc. and causes major challenge to the movement of emergency vehicles. The reaction time required by the emergency responders plays a vital role to handle the situation. The greatest challenge they face is congestion of traffic flow. This paper presents an approach to schedule emergency vehicles in traffic. The approach combines the controlling of traffic congestion by IR sensors and detection of emergency vehicle using by RFID scanner method. The IR sensors is responsible for vehicle counting and RFID for the emergency vehicle. An IR sensors continuously count the passing vehicles & records the delay time between two vehicles. Flow of vehicles is normal means there is smooth traffic flow, or if in case, the passing time between two vehicles is decreased that means traffic congestion is happen ahead. In this situation traffic light turns to green, so that the emergency vehicle will reach its destination as fast as possible. The aim of this article is to identify and monitor the congestion system in order to provide efficient facilities. This journal also sets out a method that uses 433 MHZ RF Transmitter and receiver Wireless communication device technique and Internet of Things (IoT) to transmit the treatment request from the ambulance to the nearby hospitals and at the same time the LCD is installed on the road junction which displays the nearby hospital name and contact number for the ambulance, this smart traffic system which in turn changes the traffic signal cycle. This system can be implemented throughout the city thereby to reducing the delay.***

Keywords: IOT sensors, Vehicle counter, RFID, 433 MHZ RF Transmitter and receiver Wireless device, Traffic congestion, Smart traffic control system.

I. INTRODUCTION

Traffic congestion reduction is the main goal in the development of efficient traffic control system. Many research works focus in the field of traffic safety control system. In addition, giving priority to the vehicle and changing the traffic signals must be the important functions for all the emergency vehicles to develop the safety measures in the road transportation. Ambulance and police vehicles are the emergency vehicles, must be reach the location without a maximum delay. The reaction time required by emergency responders plays major role in effectively addressing emergency situations, underscoring the urgency of mitigating traffic congestion to facilitate expedited response. The advanced development in electronics and communication systems provides different traffic control techniques. Historically, in urban areas across the globe, traffic congestion represents a pervasive and multifaceted challenge that significantly impacts the transportation sector and the overall quality of life for residents. The detrimental effects of traffic congestion extend beyond more inconvenience. However, the unique demands placed on emergency vehicles, such as ambulances and fire trucks, necessitate a specialized approach to traffic management. A comprehensive literature survey reveals a substantial research focused on traffic congestion management within urban environments. Existing studies have predominantly explored traditional traffic control mechanisms, including signal optimization, congestion pricing, and infrastructure enhancements, to ameliorate the challenges posed by congestion for regular commuter traffic. While these efforts have yielded advancements in conventional traffic management, there exists a notable gap in the literature concerning some specific considerations. The existing literature predominantly focuses on macro-level traffic congestion mitigation strategies, often neglecting the intricate micro-level considerations vital to facilitating swift emergency vehicle movement. The research gap thus encompasses the absence of a robust framework for integrating advanced technologies, such as real-time traffic monitoring, predictive analytics, and dynamic traffic signal control, to afford priority to emergency vehicles amidst urban traffic congestion.

Problem Discussed	Proposed Solution	Technology Used	Contribution	Research Gap
EV crossing at the intersection	Reactive DICA	Genetic algorithm	Optimize the sequence of vehicles reducing travel times of EVs minimal effect on the performance for normal vehicles	Only address autonomous vehicles
EV crossing at peak hours	Emergency vehicle detection and management framework	RFID-based system	Better performance in detection as well as management of emergency vehicle	The Lane clearing process in case of congestion is not discussed
Distance measure of EV from the intersection	Visual sensing techniques developed VANET model	PE-MAC protocol, NS-2	Emergency vehicle information is measured accurately, the measured information is delivered to the TMC in less time	Distance measurement in bad weather and high traffic conditions
Meeting the target travel time of an EV	An Intelligent Traffic Signal system	IoT	Meet the target travel time of an emergency vehicle set by the Department	Do not discuss the normal traffic flow and the process of vacating lane for EV
Sending EV quicker to the incident place	EVPS	SUMO	Recommend an appropriate intervention number that assists an EV in reducing response time	Do not discuss the process of vacating lane for EV
Better management of EV traffic	Prototype	IoT	Management of EV in an effective way	Do not discuss the normal traffic flow and the process of vacating lane for EV
Emergency Vehicle Detection and Management	Prototype	RFID, High Priority Encoder	Emergency Vehicle Detection and Management system	Validation in a real setting is missing, Do not discuss the process of vacating lane for EV

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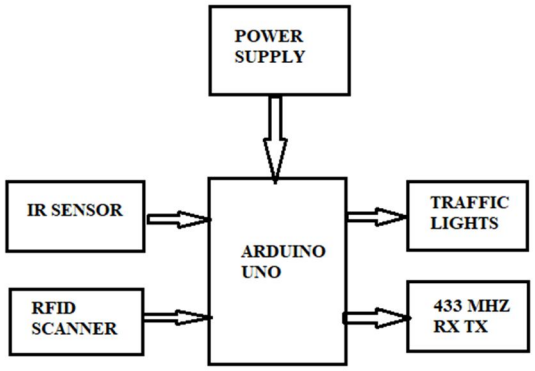
The primary objective of this research is to propose and evaluate the efficiency of a smart traffic system to enhance emergency vehicle response time in urban areas. The aim is to develop a system that leverages advanced technologies to dynamically mitigate traffic congestion and expedite the passage of emergency vehicles through urban traffic networks.
This research is focused on addressing the constraints associated with existing traffic management systems in a specific urban area. The proposed smart traffic system aims to optimize emergency vehicle response time within the confines of this urban environment, acknowledging the unique challenges and intricacies of its traffic dynamics.

II. PROPOSED SYSTEM & COMPONENETS

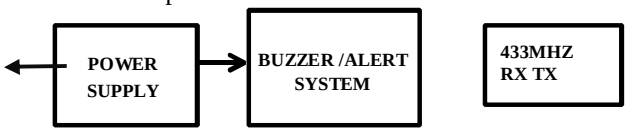
A. *Block Diagram*

The block diagram is divided into two parts: Traffic section and Hospital section.

1) *Traffic Section:* The block diagram of traffic section is shown below in which RFID readers are connected to Arduino Uno to control the traffic signals.



2) *Hospital Section:* The block diagram of hospital section is shown below where the Arduino Uno is connected to 433 MHZ RX TX to receive the request and transmit the response to the ambulance.



B. *Hardware Components*

1) *IR Sensor:* An Infrared sensor is an electronic device that are going to be deployed some distance away from road junction. These IR sensors are used for sensing of vehicles.
2) *RFID (Radio Frequency Identification) Reader:* It is a machine which uses frequency signals to transmit the information wireless network between it and an RFID tag/label to recognize, characterize and monitor properties. It is used to integrate an RFID tag. In this project, RFID readers are used, for detect the emergency vehicles. The transmitter and receiver pins of the RFID reader are connected to the transmitter and receiver of Microcontroller respectively. The reader then detects the information from the Tag and sends the perceived data through signal port to the Circuit board. It is one method of Automatic Identification and Data Coupling (AIDC).
3) *433 MHZ RF Transmitter and receiver Wireless Device:* This hybrid RF Transceiver Module provides a complete RF transmitter and receiver module solution which can be used to transmit data at up to 3KHz. The transmitter module is very simple to operate and offers low current consumption. Data can be supplied directly from a microprocessor or encoding device, thus keeping the component count down and ensuring a low hardware cost.
4) *Arduino Uno:* It is an open source electronics platform based on easy to use hardware and software. It has 14 digital input or output pins. It is used in traffic section to control the signals, ambulance section to transmit a request to the hospital and hospital section to transmit an acknowledgement to the ambulance section.
5) *Memory Card:* A memory card is an electronic data storage device used for storing digital information, typically the program code using flash memory.

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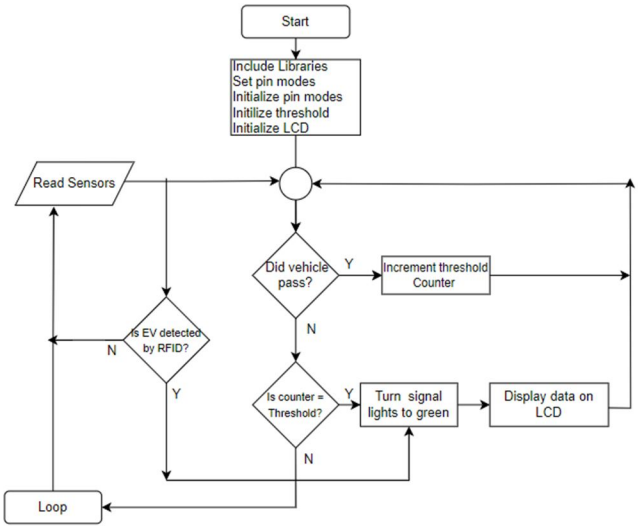
6) *Power Supply Battery:* A 5V 2A SMPS Power Supply is used to convert incoming alternating current power into regulated direct current voltage and current. The 5V 2A rating means that the power supply can deliver a constant output voltage of 5 volts and a maximum output current of 2 amps.
7) *LCD Display:* An electronic device that is used to display data and the message is shown on LCD 16×2. As the name suggests, it includes 16 Columns & 2 Rows so it can display 32 characters. This can display the nearby hospital name and contact number.
8) *Traffic Signal Lights:* Traffic Lights are used to control vehicular traffic on the road and publics streets for the smooth traffic flow to avoid the traffic jams and accidents.
9) *I2C Driver:* An I2C driver is a software component that enables communication between an Integrated Circuit (IC) master (host controller) and multiple I2C slave devices (peripherals) connected to the same I2C bus. The connection between the 433MHZ RX TX and arduino uno can be established with the help of I2C driver.
10) *Connecting Wires:* A connecting wire is a flexible conductor that is used for the connection of all the components with each other.

III. FLOW CHART



1) Include libraries and set pin modes
2) Include any necessary libraries, such as those for the RFID reader, LCD screen, and sensor.
3) Define the pin modes for the input and output pins. This will tell the Arduino board how to interpret the signals from the sensors and how to control the LCD screen and signal lights.
4) Initialize threshold and LCD screen
5) Set the threshold value for the sensor. This value will be used to determine whether a vehicle is considered to be passing through the fire hydrant.
6) Initialize the LCD screen. This will prepare the screen to display information such as the sensor readings and the status of the system.
7) Read sensors
8) Read the values from the sensors. These sensors could be, for example, ultrasonic sensors that can detect the presence of a vehicle, or pressure sensors that can detect if a vehicle is driving over the fire hydrant.
9) Check if vehicle passed
10) Compare the sensor readings to the threshold value. If the sensor readings are above the threshold, then the system determines that a vehicle has passed through the fire hydrant.
11) Check for EV with RFID
12) If a vehicle is detected by the sensors, check if it is an electric vehicle (EV) using the RFID reader. This could be done by having the EV tags contain an RFID chip that the reader can identify.
13) Increment counter if not EV

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14) If the vehicle is not an EV, increment a counter. This counter will be used to track the number of non-EVs that have passed through the fire hydrant.
15) Check if counter equals threshold
16) Compare the counter value to the threshold value. If the counter value equals the threshold value, then the system determines that too many non-EVs have passed through the fire hydrant.
17) Turn signal lights to green if counter less than threshold
18) If the counter value is less than the threshold value, then the system turns the signal lights to green, allowing traffic to proceed.
19) Display data on LCD
20) Display the sensor readings, the counter value, and the status of the system (e.g., "green light", "red light") on the LCD screen.
21) Loop
22) Return to step 3 and continue reading the sensors.
23) This is a basic plan of action for the flowchart. The specific details of your implementation may vary depending on the specific sensors and components you are using.
24) Here are some additional things to consider:
25) You may want to add a safety feature to the system that prevents the signal lights from turning green if a vehicle is still detected by the sensors.
26) You may want to keep track of the total number of vehicles that pass through the fire hydrant, regardless of whether they are EVs or not.
27) You may want to add functionality to the system that allows authorized vehicles (e.g., emergency vehicles) to pass through the fire hydrant regardless of the signal light status.

IV. STEP-BY-STEP PROCEDURE

1) *Step 1: Hardware Setup*
- Connection of IR and RFID sensor to the correct input pins on the Arduino.
- Connection of LCD display to the Arduino
- Similarly, to make sure it is powered correctly and connected to the designated input pins.

2) *Step 2: Arduino Programming for IR Sensor*
- Program in the Arduino IDE that reads data from the IR sensor.
- Setting up a threshold value for congestion detection. When the sensor detects a vehicle density exceeding the threshold, trigger the traffic light to switch to green.

3) *Step 3: Arduino Programming for RFID Sensor*
- Program to continuously search for RFID signals from emergency vehicles within its range.
- When an emergency vehicle is detected, retrieve its unique ID or other information stored in the RFID tag.

4) *Step 4: Integration of IR and RFID Programs*
- Merge the programs for the IR sensor and RFID sensor to work concurrently on the Arduino board.
- Setting up a mechanism to prioritize the RFID signal over the IR sensor if both congestion and an emergency vehicle are detected simultaneously.

5) *Step 5: LCD Display and Traffic Light Control*
- Implementing code to display relevant information (hospital name and contact number) on the LCD display.
- Control the traffic light to switch to green when heavy congestion is detected.

6) *Step 6: Paramedics Interaction*
- The paramedics inside the ambulance access the contact number displayed on the displayed with hospital name.
- The hospital make necessary medical arrangements for the patient.

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7) Step 7: Testing and Optimization
- Testing the entire system thoroughly to ensure seamless integration and functionality.
- Optimizing the code for better performance and responsiveness.

8) Step 8: Deployment
- Once the testing results are satisfied, deployment of the system at the desired road junction.
- Monitoring the system's performance in real-world scenarios and make any necessary adjustments.

V. HARDWARE TOOLS & SOFTWARE

A. Hardware Tools

1) Arduino Board (Uno)
2) Power Supply for Arduino and sensors
3) Tools for soldering and assembling components.
4) RFID tags (for testing)
5) Traffic Light System

B. Software

1) Arduino IDE - for programming the Arduino board
2) RFID Library for Arduino - for working with RFID sensors
3) LCD Library for Arduino - for controlling the LCD display

VI. RESULS & DISCUSSION

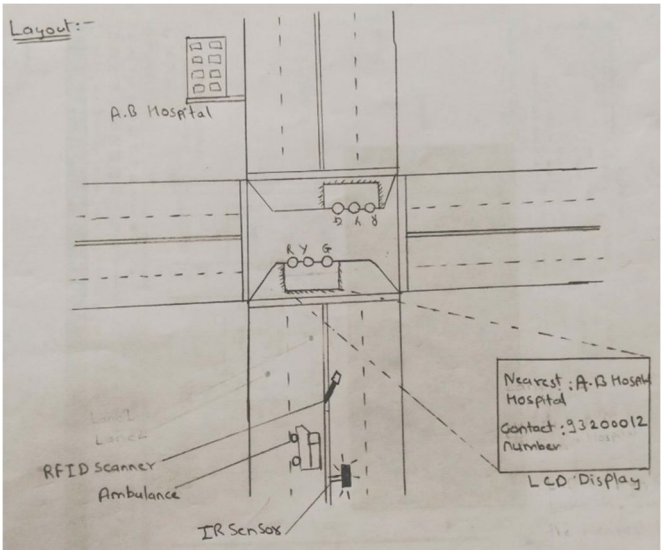
The proposed output has been explained using Figs.

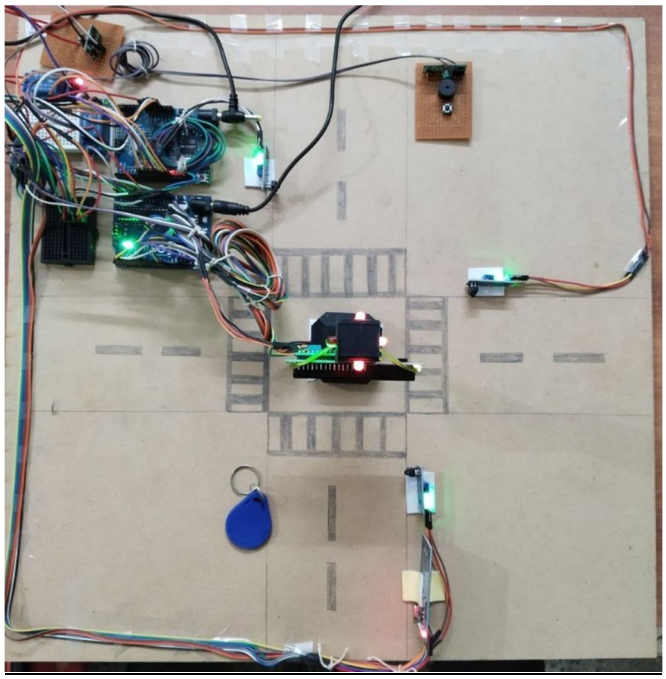
In traffic section, whenever, there is congestion of vehicle raises, IR sensor will detect the traffic congestion, once heavy congestion detected the traffic light get triggered to green signal and at the same time hospital name with contact number is displayed on the LCD display, fixed at the road junction. Along with IR sensor for the traffic management, at the same time RFID continuously search for the emergency vehicle in the traffic within its range. The programming of IR and RFID sensor using the Arduino software which provides the development environment.

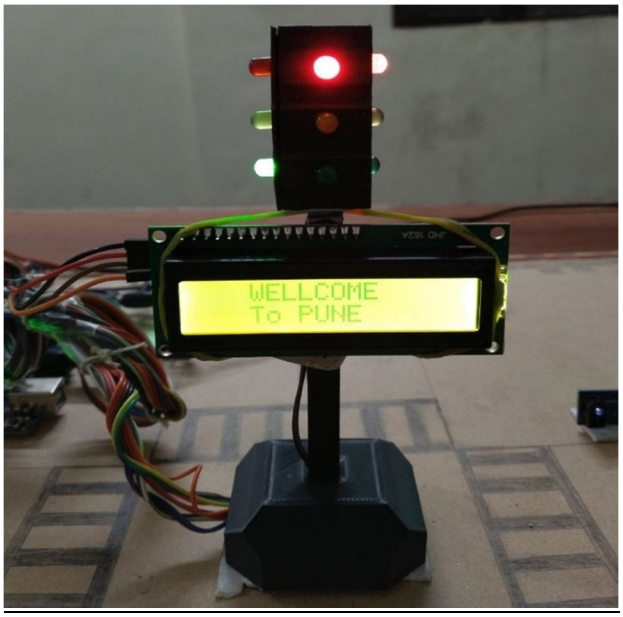
ARDUINO SOFTWARE IDE is used for searching the nearest hospital and responsible for providing data on the LCD display, once the data is displayed on the LCD, the paramedics inside the ambulance, contact to the hospital and make the necessary arrangements for the patient in the hospital section.

A. Snapshots

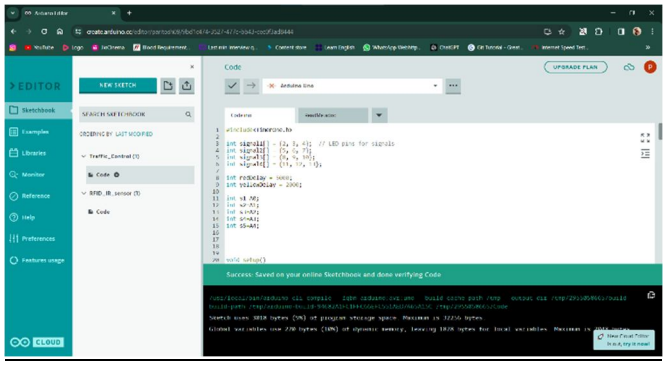
1) Layout



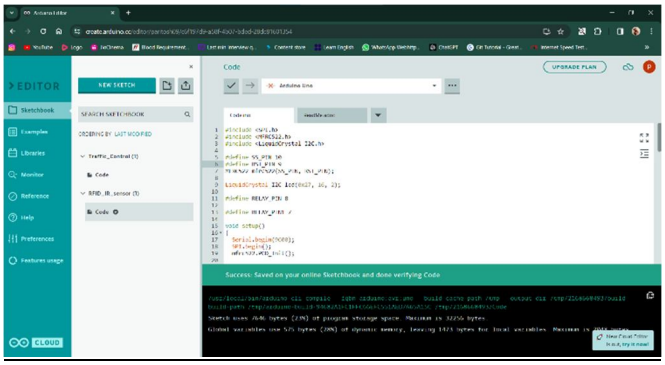




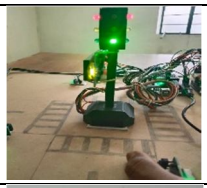
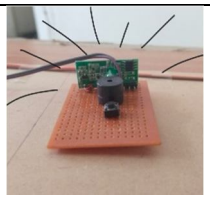
2) Arduino Traffic Control Code



3) Arduino RFID & IR Sensor Code



Results

Scenario I	When there is no traffic.	
Scenario II	When traffic is more, vehicles are not moving forward so traffic signal becomes green.	
Scenario III	When heavy traffic is congested & RFID scanner detects emergency vehicle. LCD displays Hospital name and contact no.	
Scenario IV	RFID detects and Alarm alert at hospital section.	

VII. CONCLUSION

A. Objective

The primary objective of this system was to enhance traffic management during congestion, promptly detect emergency vehicles using RFID technology, and facilitate quick communication between paramedics and hospitals. The integration of IR and RFID sensors with Arduino, coupled with the use of an LCD display and traffic lights, aimed to create an intelligent traffic control and emergency response system.

B. Review of Key Findings

Through the implementation and testing of the system, it was observed that the IR sensor effectively detected traffic congestion, triggering the traffic light to green and displaying relevant hospital information on the LCD display. Simultaneously, the RFID sensor successfully identified emergency vehicles within its range, providing essential data for swift response and communication.

C. Implication or Application

The developed system has significant implications for urban traffic management and emergency services. By dynamically adjusting traffic lights based on real-time congestion data, the system contributes to smoother traffic flow. Additionally, the RFID technology ensures the prioritized passage of emergency vehicles, minimizing response times and enhancing overall road safety. The LCD display serves as an informative interface, displaying critical hospital information during emergencies.

D. Recommendation for Future Work

1) Integration with Smart City Infrastructure: Explore the integration of the system with broader smart city initiatives, allowing for seamless communication with other urban systems such as traffic cameras, emergency services, and central control centers.

2) Enhanced Hospital Search: Invest in developing more sophisticated algorithms for hospital selection, considering factors like real-time hospital occupancy, specialized medical services, and road conditions for optimized emergency response.

3) Advanced Communication Features: Incorporate advanced communication modules, such as 5G or satellite communication, to improve the reliability and speed of communication between emergency vehicles and hospitals.

4) Expandability for Additional Sensors: Design the system with expandability in mind, allowing for the integration of additional sensors or technologies that can further enhance traffic management and emergency response.

5) User Feedback and Iterative Improvements: Collect feedback from emergency services, paramedics, and city authorities to make iterative improvements. This involves refining the system based on real-world usage and addressing any challenges or limitations identified during deployment.

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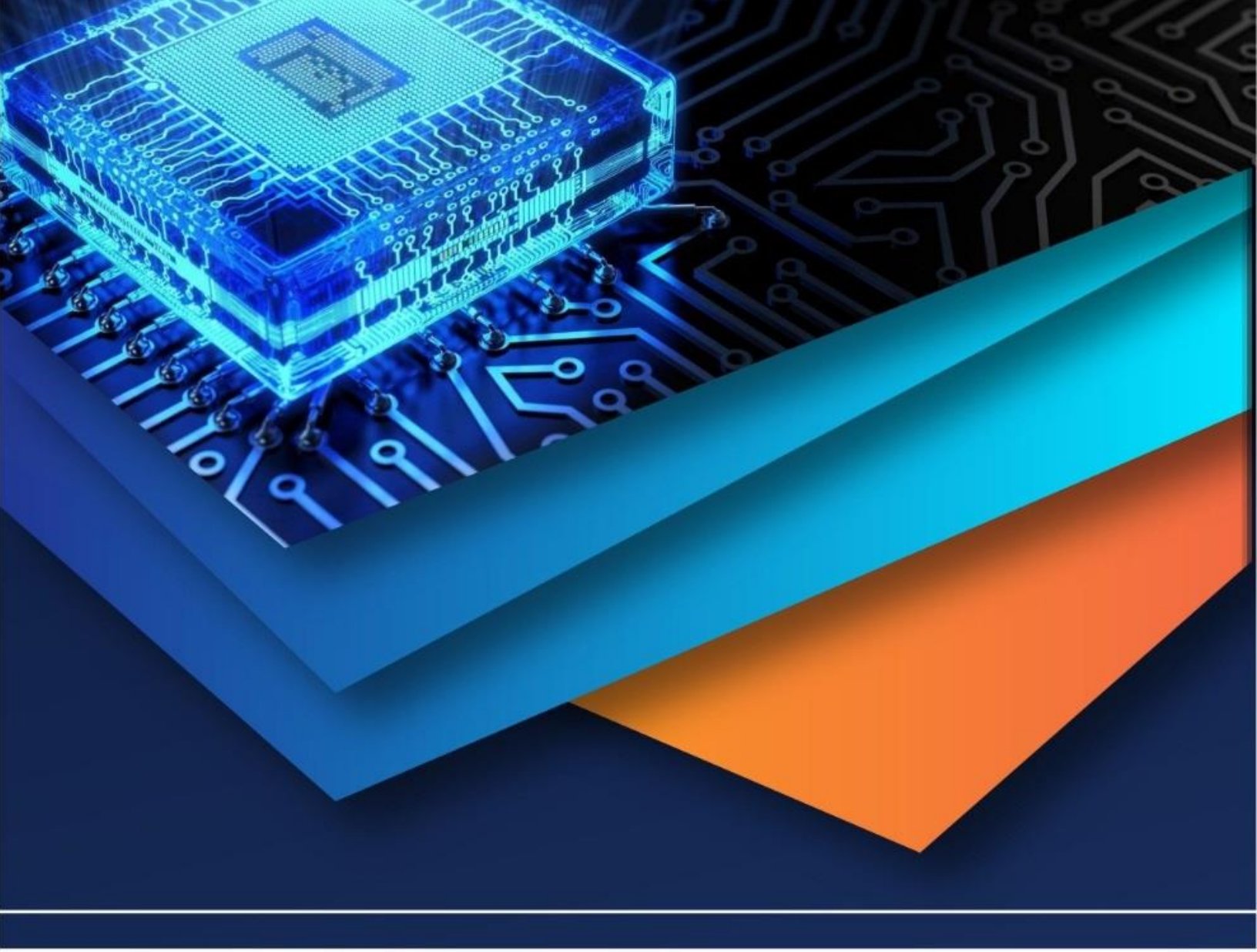

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