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Novel Approach for Vehicle Accident Tracking using IoT

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Abstract:** In recent years, there has been significant interestin integrating Internet of Things (IoT) technology into vehicle safety systems to enhance emergency response capabilities and road safety. This paper introduces a comprehensive Vehicle Accident Tracking System (VATS) that utilizes IoT principles. The proposed system incorporates various sensors and communication devices installed within vehicles to monitor theirstatus and detect potential accidents in real-time. When anaccident is detected, the system automatically triggers an alert mechanism, notifying relevant stakeholders such as emergency services and fleet managers. Key components of the VATSinclude accelerometers, GPS modules, and onboard communication units, which work together to provide precise accident geospatial data and vehicle condition data. The systemutilizes cloud-based platforms for data storage and processing, ensuring seamless integration with existing infrastructure and scalability. By continuously monitoring and analyzing vehicle telemetry data, the VATS facilitates proactive accident prevention measures and post-accident analysis. Additionally, it offers benefits such as reduced emergency response times, improved accident documentation for insurance claims, and enhanced overall road safety. Privacy and security concerns areaddressed through encryption protocols and access control mechanisms to protect sensitive information. Overall, the Vehicle Accident Tracking System presented in this paper represents a significant advancement in leveraging IoT technology to mitigate the impact of accidents on roadways, thereby contributing to a safer and more efficient transportation ecosystem.

I. INTRODUCTION

The advent of IoT technology has revolutionized various industries, and one area where its potential shines is in road safety through a Vehicle Accident Tracking System. By integrating IoT sensors and devices into vehicles, this system ispoised to revolutionize the way accidents are detected, reported, and responded to. It operates by constantly monitoring key metrics such as acceleration, deceleration, and changes in direction, enabling it to promptly identify and flag potential accidents or collisions. the occurrence of a mishap, thesystem swiftly transmits crucial data, impact severity, andstatus, to emergency responders and relevant authorities. This real-time information empowers emergency services to dispatch assistance swiftly, potentially reducing response times and minimizing . Moreover, the system's ability to collect and store cloud facilitates comprehensive accident records, enabling authorities to analyze trends, identify risk factors, and implement targeted safety measures. Furthermore, post- accident investigations can benefit from detailed event logs andevidence given by the system, aiding in determining liability and improving accountability. Overall, this devices harnesses the power of IoT to enhance road safety, mitigate risks, and save lives on our roads.

A. Objectives

To Implement Real-time Monitoring and real-time tracking ofvehicles to promptly detect and respond to accidents
To Ensure Accurate Accident Detection Implement sensors to detect sudden accelerations, decelerations, or collisions indicative of accidents.
To Facilitate Emergency Response Automatically generate and transmit alerts to relevant authorities, emergency services, and designated contacts The occurrence of a mishap.
To Develop a Easy to use for both vehicle owners and administrators to access and manage the system.

II. LITERATURE SURVEY

In paper [1], the author addresses the critical issue of increasing road accidents in Bangladesh. The authors introduce a comprehensive system utilizing Arduino Nano, SIM808, and MPU6050 modules to detect and confirm vehicle accidents. Motivated by a tragic incident,the system aims to reduce response time in emergencies by automatically notifying authorities and nearby help centers via SMS, providing the exact accident location through GPS.
The proposed system incorporates various sensors and algorithms to detect anomalies in acceleration, deceleration, and angular

offset, ensuring a wide range of accident scenarios are covered. The paper concludes with the system's limitations and outlines future enhancements, emphasizing the potential to save lives by efficiently utilizing post-accident time for prompt response and aid coordination.

In paper [2], An Arduino based automated vehicle accident detection and messaging system The paper addresses the pressing issue of increasing road accidents in Bangladesh. The authors, students from the United International University, introduce a comprehensive solution that utilizes Arduino NANO, SIM808, and MPU6050 modules for real-time accident detection. Motivated by a tragic incident, the system aims to provide immediate aid by detecting accidents in various scenarios, such as sudden accelerations, decelerations, and angular offsets. The proposed system uses GPS and GSM technologies to send automated SMS notifications containing the precise accident location to authorized contacts. By incorporating features like a cancel option for non-fatal situations and overcoming limitations to overcome accidents underwater, the authors present a robust system with the potential to significantly reduce response time and save lives. The paper concludes with a focus on future improvements, emphasizing enhanced notification systems and collaboration with response institutions for more efficient postaccident interventions.

In paper [3], Blackspot Alert and Accident Prevention System The paper tackles the critical issue of road accidents in India, where a death occurs every 4 minutes.The authors propose a solution through a GPS-based Portable software that alerts drivers about historically reported accident blackspots. The system utilizes a cloud database to store blackspot locations and their speed limits, with the mobile app providing voice notifications 500 meters before reaching a blackspot. Integrated with a microcontroller, the system takes control of the vehicle's accelerometer, automaticallyreducing speed to match the designated limit in the blackspot zone. The technology stack involves smartphones, Android development, GPS, accelerometers, and cloud computing. The paper discusses related work, presents the proposed system's architecture, and demonstrates positive results inreducing vehicle speed in simulated blackspotscenarios. Future enhancements could involve accidentreporting and emergency services integration

In paper [4], held in December 2020, addresses the critical issue of car accidents through the design of a smart system utilizing Internet of Things (IoT) technology. Recognizing that many accidents result from driver unawareness and uncontrolled speed, the proposed system employs an Arduino-based collision detection and tracking system. Integrated with ultrasonic, vibration, GPS, and GSM modules, the system monitors the distance between vehicles, providing real-time alerts to drivers through LED indicators and a buzzer. The occurrence of a mishap, the system automatically notifies family members and the nearest rescue team with the vehicle's GPS location. Additionally, the paper discusses the system's potential for theft prevention and tracking using GPS technology.The proposed system demonstrates promise in enhancing road safety and emergency response capabilities.

In paper [5], Multi-Sensor Multi-Vehicle (MSMV) Localization and Mobility Tracking for Autonomous Driving The paper presents a comprehensive frameworkfor enhancing vehicle localization and mobility trackingin autonomous driving scenarios. The proposed system integrates data from (IMUs), and advanced sensing systems such as LiDAR and cameras, to improve accuracy and robustness. The framework employs a two-layer structure, comprising global and local filters, to fuse information from multiple vehicles. Notably, it considers communication delays during information sharing via Vehicle-to-Vehicle (V2V) links. The authors demonstrate through simulations that the proposed framework significantly improves accuracy and robustness compared to traditional methods, making it valuable for applications like autonomous vehicles and intelligent transportation systems. This research has implications for enhancing the performance of accident detection systems by providing more precise and reliable localization and mobility tracking information.

In paper [6], Analysis of Vehicle Activities and Live Streaming using IoT The paper by Philo Stephy A, Preethi C, and K. Mohana Prasad presents a comprehensive incident detection system in vehicles. The Suggested framework utilizes IoT technology, including Detectors like GPS, cameras, and external sensors like vibration and fuel sensors. The system aims to analyze accidents by tracking vehicle activities and, accident scenario, sends an notification to pre-stored contacts. Live streaming Of the collision scene is made possible through cloud computing.

The system integratesimage processing techniques, background subtraction,and face detection to optimize the Study of accidents. Additionally, Array of sensors, including a fuel sensor and vibration analysis sensor, Support to a holistic the accident management protocol prevention. The paper discusses the existing system's drawbacks and presents anovel system architecture, detailing the hardware implementation. The authors also describe the proposed system's components, including Raspberry Pi, webcam, and streaming capabilities. The findings and discussions highlight the effectiveness of the Setup in accident detection, video capture, and live streaming. Overall, the paper provides a valuable foundation for the development of an collision detection system using advanced IoT technologie

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III. METHODOLOGY

1) Libraries: The code includes several libraries for different components such as Liquid Crystal_I2C for the display panel, AltSoftSerial for the GPS module, TinyGPS++ for GPS parsing, and SoftwareSerial for interact with the cellular module.

2) Pin Definitions: Defines the pins used for various components like GSM module (RX, TX), GPS module (RX, TX), buzzer, button, and accelerometer sensor.

3) Initialization: - Initializes serial is interact with theArduino, Cellular module, and GPS module.

- Initializes the Display panel
- Initializes variables and sets up initial configurationsfor the Cellular module (AT commands).

4) Impact Detection (Impact() function)

- Reads accelerometer sensor values and calculates magnitude.
- Determines if an impact is detected the magnitude exceeding a certain threshold.
- Sets a flag (updateflag) when an impact is detected.

5) Main Loop (loop() function)

- Calls the Impact() function to check for impacts periodically.
- If an impact is detected (updateflag is set), it triggers actions like activating the buzzer, displaying a message on the LCD screen, and initiating an alert procedure.
- It's checks the data from the cellular module module and processes it accordingly.
- Resets the impact detection if a button press is detected.

6) Parsing GSM Data (parseData() function)

- Parses incoming data from the Cellular module
- Handles SMS reception and processes specific commands embedded within the SMS messages, like requesting GPS coordinates.

7) GPS Handling (getGps() function)

- Retrieves GPS coordinates from the Location tracking module
- Formats the GPS data for further use (e.g., sending SMS with location data).

8) Text and Phone Functions

- Includes functions to send SMS messages (sendSms()) and make emergency calls (makeCall()).
- SMS messages include the identified impact and GPSOrganize.

9) Utility Functions

- Includes a utility function (SendAT()) to sendAT commands to the Cellular module and wait for responses.i

A. Algorithm

1) Step 1: Sensor Calibration

Calibrate the g-sensor intrinsically and extrinsically.
Rectify the input data using complementary filters.

2) Step 2: Data Collection

Set the sampling rate (e.g., 10ms).
Collect information from the g-sensor.
Apply sensor calibration to the collected data.

3) Step 3: Purposed Crash Detection

Calculate the vector sum (vSum) of the calibrated x, y, zvalues using Equation (6).
vSum = √((x2 - x1)^2 - (y2 - y1)^2 - (z2 - z1)^2)

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Compare the calculated vSum with a set limit value(vTHRD).
If vSum > vTHRD, it's a chance for crash event.
Consider time in crash detection by calculating the difference between the current time and the time when vSum > vTHRD occurred.
t = current time - time when vSum > vTHRD occurred
Determine a time threshold (tTHRD) according to thesampling rate and calibration count.
tTHRD = sampling rate * calibration count * n
If both conditions (vSum > vTHRD && t > tTHRD) aresatisfied, declare a crash event.

4) Step 4: Event Handling

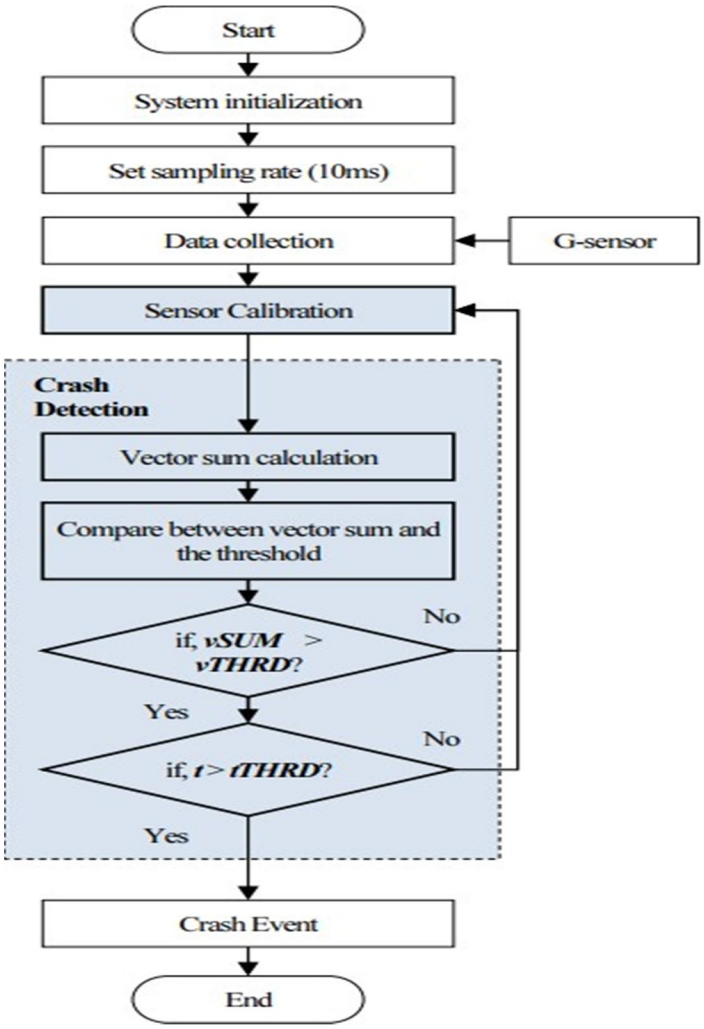
Record crash event data.
Initiate appropriate actions (e.g., video recording, systemlog file creation, alarm sound).

5) Step 5: Evaluation and Adjustment

Evaluate the Execution of the crash detection algorithmunder various scenarios.
Adjust threshold values (vTHRD, tTHRD) based onexperimental results to improve detection accuracy.

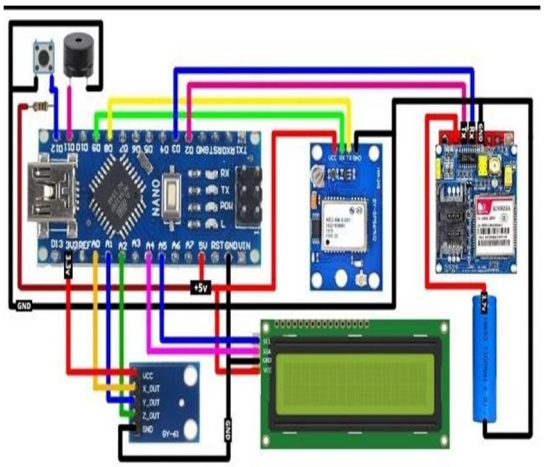
6) Step 6: Conclusion

Conclude the effectiveness of the proposed crash detectionalgorithm.
Consider further evaluations and refinements for futuredevelopment.
Purposed flow chart of crash detection



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IV. CIRCUIT DIAGRAM



The vehicle accident tracking system using IoT requires a comprehensive circuit setup to effectively monitor and respond to accidents. This system incorporates a microcontroller, such as Arduino or Raspberry Pi, to manage the various components. Sensors, including accelerometers or gyroscopes, are integrated to detect sudden changes in motion indicative of collisions, while a GPS module tracks the vehicle's real-time location. Communication modules like GSM, Wi-Fi, or Bluetooth enable the transmission of accident alerts and location data to a emergency contacts. A reliable power supply, such as a battery or vehicle power, ensures continuous operation. Data storage solutions, such as SD cards or cloud storage, store accident data for analysis. A user interface, whether a mobile app or web dashboard, provides configuration options and receives alerts. Enclosures protect the circuitry, and algorithms analyze sensor data to difference the normal driving and accidents. Additionally, an emergency protocol is defined to automatically alert emergency responders or designated contacts in the occurrence of a mishap. Testing, scalability, maintenance, and compliance with regulations are crucial considerations for the system's deployment and operation.

A. GSM SIM900 A



The SIM900A GSM module is a compact and versatile communication solution used in various electronic projects. Its GSM/GPRS capabilities enable functionalities such as SMS, voice calling, and data transmission. Integration is simplified through its backing of standard AT commands, making it accessible for developers. Operating on GSM networks, it ensures reliable communication across different geographical regions. Its compact size and low power consumption make it energy efficiency are crucial. From remote monitoring systems to IoT devices, it finds extensive use in diverse projects. Its robust performance makes it a preferred choice in security systems, vehicle tracking, industrial automation, and more.

One of its notable features is its Harmony with a wide range of microcontrollers, making it easy to interface with popular development platforms. Additionally, it offers various interfaces for connecting peripherals, expanding its capabilities in different applications. Its ability to handle both voice and data communication further enhances its versatility. Moreover, it supports features like caller ID and call waiting, adding convenience and functionality to voice communication applications.

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B. Arduino UNO



Arduino Uno is a widely used microcontroller board, featuring an ATmega328P microcontroller chip, which provides numerous digital and analog input/output pins for versatile connectivity. With a clock speed of 16 MHz, it supports rapid processing of instructions. The board is equipped with essential components such as a USB interface, power jack, and reset button, facilitating easyinterfacing with computers for programming and power supply. Its compatibility with a vast array of sensors, actuators, and other electronic components makes it ideal forprototyping and creating interactive projects. Arduino Uno'sopen-source nature fosters a vibrant community, offering extensive resources including libraries, tutorials, and forums for support and collaboration. Its simplicity and accessibilitymake it a preferred choice for beginners and experienced enthusiasts alike in the field of electronics and embedded systems development.

C. LCD (Liquid Crystal Display)



A display panel, commonly known as LCD, derives its definition from the unique combination of two states of matter solid and liquid. By utilizing liquid crystal technology, LCD screens produce a visually stunning image that is more used in laptops, televisions, cell phones, and portable video games. Unlike the bulky cathode ray tube (CRT) technology, LCD's ultra-thin composition by its multiple layers, including polarized panel filters and electrodes. LCD technology is a popular choice for displaying images in electronic gadgets like mini computers and notebooks. As light passes through a lens, it interacts with the liquid crystal layer, creating a grayscale image that is then combined with colored light to produce a vivid, high- quality image on the screen. In summary, LCD technology offers a sleek and efficient alternative to traditional display screens.

V. WORKING PRINCIPLE

The system utilizing IoT operates through a network of sensorsthat continuously observe the vehicle's movements andconditions. Arduino Uno serves as the main processing unit, collecting and analyzing data from these sensors in real-time. Unusual patterns indicative of accidents trigger the setup to confirm severity against predefined thresholds. Once confirmed, the system initiates alerts, notifying emergency contacts via SMS and pinpointing the crash sit eusing GPS coordinates. Additionally, precautions such as activating hazard lights can be automated. Detailed accident data, including timestamp, location, and impact force, is logged either locally or on a cloud server for subsequent analysis. Prompt deployment of Crisis response teams. responders is facilitated, and post-accident analysis informs future safety enhancements,ensuring continuous improvement of thesystem's efficiency.

VI. SIMULATION RESULTS

The vehicle crash tracking system simulation demonstrated Precise incident identification through sensor data analysis. Arduino Uno efficiently processed real-time information, triggering SMS alerts promptly upon accident confirmation. GPS coordinates accurately pinpointed accident locations, facilitating rapid emergency response. Automated safetymeasures, such as hazard light activation, were consistentlyinitiated, bolstering on-road safety. Detailed logging of accidentdata provided the system optimization.

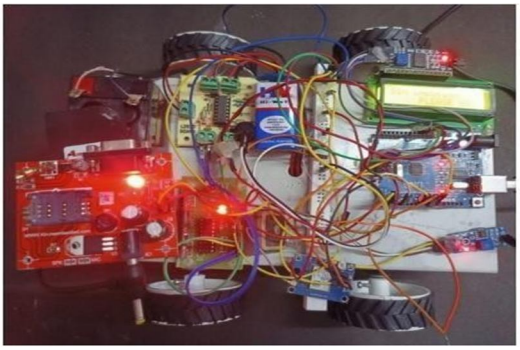


Fig1. Hardware module

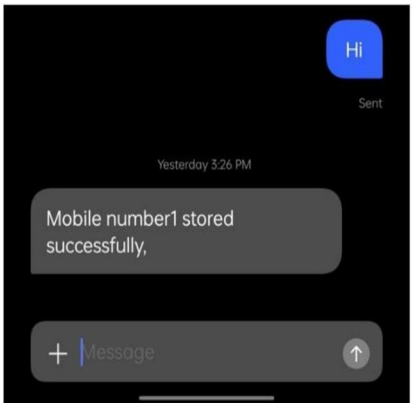


Fig2. When mobile number is stored successfully



Fig3. Latitude and longitude values where the accidentwas detected

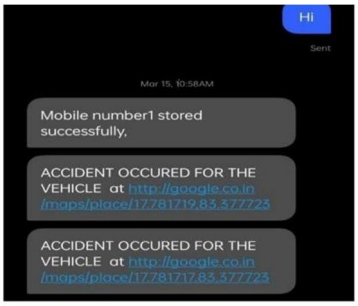


Fig4. Message received by the specified phone number



Fig5. Location of the accident sent via Google Map

IV. CONCLUSION

The execution of a Vehicle Accident Tracking System utilizing IoT technology offers preemptive road safety strategy andaccident management. By integrating sensors and GPS technology, real-time monitoring and notify systems capable of promptly identifying and addressing accidents swiftly. This system enhances emergency response times, life-saving and minimizing property damage. Furthermore, the collected data can be analyzedto identify accident-prone areas, facilitating targeted precautions and infrastructure improvements. Overall, the Execution of this system promotes a safer and more efficient transportation network, aligning with the global goal of reducing road accidents andfatalities

V. ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of research and development of the iot application "***NOVEL APPROACH FOR VEHICLE ACCIDENT TRACKING USING IOT***" would be incomplete without the mention of people who made it possible, whose noble gesture, affection, guidance, encouragement, and support crowned my efforts withsuccess. It is a privilege to express gratitude and respect to all those who provided inspiration in the completion of this research and are extremely grateful to our respective Guides Mr. Md. Shafiulla for the noble gesture, support coordination, andvaluable suggestions given for the completing of the research, also are thankful to Dr. R. N. Kulkarni, H.O.D Department ofCSE, for his coordination and insightful advice that were givenwhich helped in achieving this study

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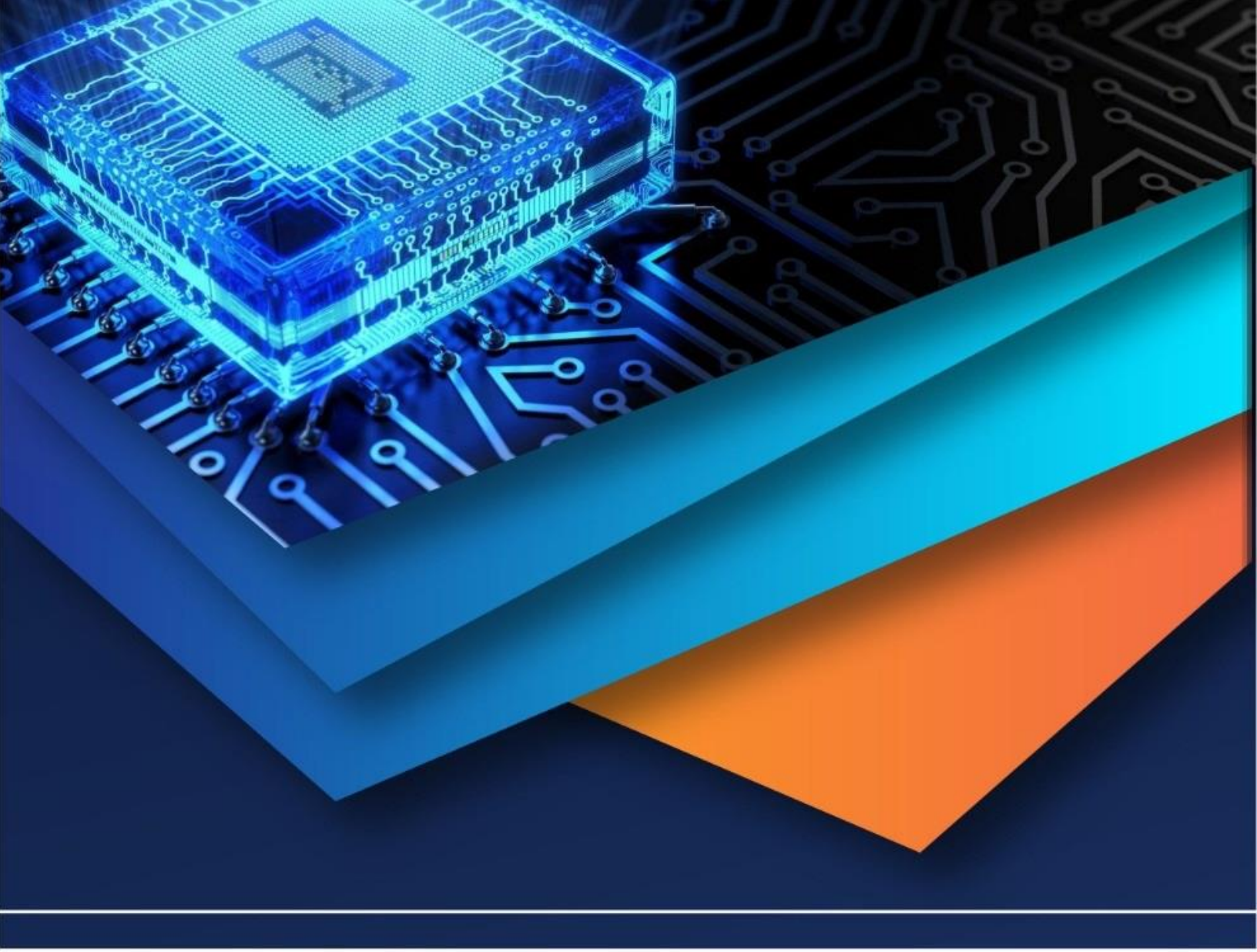
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