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# A Comprehensive Study of Web-Based Real-Time Vehicle Tracking and Analytics System

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***Abstract:*** ***Real-time vehicle tracking systems have become an important part of modern transportation and logistics industries. With the help of web-based systems, it is easy to access vehicle data atany time and from anywhere. These systems have improved significantly over time. In the beginning, these systems were simple devices used to record the data only. But with time, began to work in real-time using GPS and mobile networks to track vehicles live. As the number of vehicles increases, managing them have become difficult. So, there is a growing need for the systems that can easily track a vehicle's location, movement and behaviour in real-time. It is a modern solution which helps to improve fleet management through real-time GPS tracking and intelligent route optimization.In this paper, we study different vehicle tracking and analytics systems and explains how they work.It includes technologies like GPS and GSM, IoT-based solutions, cloud-based systems and computer vision. Most of the research mainly focus on improving vehicle safety, fuel consumption and providing support during emergencies. Our study shows that GPS-based systems are more affordable and easier to use, while IoT and computer vision-based technologies are more advanced and can manage large systems easily.Instead of these advantages, there are still some major problems like poor network, data security risks and environmental challenges which are faced in the vehicle tracking systems. Choosing the right technology is very important. It depends on how and where the systems are used. In some cases, hybrid systems which combine different technologies, can give good results.***

***Keywords: Real-time vehicle tracking, GPS-based tracking, GSM communication, Internet of Things (IoT), Fleet monitoring, Smart transportation, Computer vision, Traffic management, Route Optimization***

## I. INTRODUCTION

Real-time vehicle monitoring systems are very important in today's logistics and transportation sectors. They help in organizations to keep track of their vehicles and manage them more efficiently and effectively. These systems mainly use GPS technology which give accurate location datawhich is used to improve safety, reduced fuel usage and plan better routes.

### *A. Background of vehicle tracking system*

Vehicle tracking systems are used to trackthe location and movement of vehicles. Earlier, tracking was done using manual methods like written records or phone calls from the driver. These methods are time consuming and risk inaccurate information. After the development of GPS technology, vehicle tracking system became more reliable andefficient. Through GPS satellites, real-time location of vehicles becomes possible. Nowadays, vehicle tracking system have become an important part of logistics, public transport and safety applications. Vehicle tracking system plays a significant role in smart cities and intelligent transportation.

### *B. Need for Real-Time Vehicle Tracking*

In today's era, there is a rapid increase in the number of vehicles, and because of that, the management of vehicles has become difficult. Vehicle tracking systems are used for real-time location, speed, and information of route. These systems improve cost control and operational efficiency for fleet management companies. For emergency services like ambulance and fire vehicles, provide fast response through tracking and help. To reduce the theft and misuse of vehicles cases. Beside these, provide fuel monitoring and route optimisation needs**.**

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Fig 1. Benefits of Vehicle Tracking System

*C. Limitations of Traditional GPS-Based Systems*

Traditional vehicle tracking systems are limited in comparison to modern GPS systems. Traditional systems use manual reporting and radio communication. No facility of real-time is provided, due to which delay and inaccurate information result. No proper data storage and analysis. Traditional systems have more hardware dependency, which increases cost and maintenance. Scalability and remote access are also a great problem because of which large-level implementation is difficult.

Table 1: Comparison with Traditional tracking vs Modern Tracking Systems

| Traditional Tracking | Modern Real-Time Tracking |
|---|---|
| Basic GPS devices and manual logs | GPS + IOT sensors |
| Periodic updates (via SMS, calls) | Continuous via 4G/5G satellite, cloud servers |
| Not continuous, often delayed | Live updates every second |
| Limited information, manual monitoring | Cloud based dashboards, AI-based analytics |

*D. Role of Web Technologies and GPS Simulation*

Web-based technology makes vehicle tracking systems more accessible and flexible. Through web applications, users can access any information regarding vehicles. Cloud-based web systems provide scalability and handle a large number of vehicles efficiently. Due to this, web-based technology has become an important part of modern vehicle tracking systems.GPS simulator is a virtual tool that generates artificial location data. This is used for mainly for testing and research. Users may replicate different routes, speeds, and movements with the help of GPS simulator. By providing an environment That is monitored, researchers and developers can improve their applications before deploying them in real world situations. Also, GPS simulator opens the door for new and innovative solutions in various fields like navigation, robotics etc. This paper gives an overview of existing vehicle tracking technologies, along with their advantages and limitations. It can help researchers and developers for better understanding and improves transportation systems.

*E. Data Analytics in Vehicle Tracking Systems*

In today's vehicle tracking systems, data analytics plays an important role. By analysing large amount of data, organizations can understand vehicle performance, route efficiency and driver behaviour**.** Real-time analytics helps in monitoring vehicle speed, route deviations, fuel usage, and travel time. It helps in improving efficiency and reducing costs. Using advanced technologies like machine learning, systems can detect unusual activities, suggest better routes and even predict traffic conditions.

These features make vehicle tracking system smarter and more useful in day-to-day operations. By using past data, fleet management companies can improve safety and track their resources. By combining analytics with vehicle tracking systems, organizations can convert simple location data into useful information that helps in better decision-making.

### *F. Comparison of Different Vehicle Tracking Technologies*

Vehicle tracking systems use different technologies which helps in monitoring the vehicle's real-time location and how they move. Each technology has its own advantages and disadvantages depending on various factors like cost, infrastructure and how accurate it is.

Table 2: Comparison of Different Vehicle Tracking Technologies

| Technology | Description | Advantages | Limitations |
|---|---|---|---|
| GPS-Based Tracking | Used satellite signals to locate vehicle in real-time. | High accuracy, worldwide coverage. | Tunnel network issues. |
| GSM-Based Tracking | Uses cellular networks to transmit location data from the vehicle to server. | Wide network coverage, reliable communication. | Depends on network availability. |
| Bluetooth-Based Tracking | Uses Bluetooth to track a device's location. | Low energy consumption. | Limited range. |
| IoT-Based tracking | Combines internet access and sensors for real-time monitoring and analytics. | Real-time data, scalable system. | Security and connectivity challenges. |
| RFID-Based Tracking | Uses RFID tags and reader to track vehicles when they pass specific checkpoints. | Low cost, useful for toll systems. | Limited to short range tracking. |

From the comparison, GPS combined with IOT and GSM connectivity is commonly regarded as the most effective method for real-time vehicle tracking systems.

## II. LITERATURE SURVEY

Many researchers have worked on vehicle tracking and analytics systems using different technologies. A brief summary of selected research work is given below.

Table 3: Literature Survey of Real-Time Vehicle Tracking and Analytics System

| S.No. | Title / Year | Author | Technologies used | Implications | Limitations |
|---|---|---|---|---|---|
| 1. | Integrated Real-Time Vehicle Tracking and Alert System - 2025 | Pawar Aruna &Dr. D.Kumara Swamy | GPS, GSM/GPRS,Raspberry Pi, Google maps | Create a solid and scalable solution. Accurate real-time tracking. | Depends on cellular network availability. |
| 2. | Real-Time GPS Tracking System for IoT-Enabled Connected Vehicles-2023 | Idriss Moumen et al. | Arduino Uno R3,SIM800L, NEO6M GPS Node.js, firebase | Robust solution for real-time vehicle tracking | It does not offer a precise quantitative evaluation of tracking precision or scalability. |
| 3. | Real- Time vehicle Tracking - 2025 | S Harish Nataraj, K Balaji and V Hariram | YOLOv8 deep learning model, OpenCV, Python, CVzone library | Efficient real-time vehicle tracking for smart traffic, parking, and surveillance. | Counting processes exhibit minimal delays. Require a high computational power. |
| 4. | Real-Time Vehicle | MalgariHarikiran | IoT,sensors, GPS | | Complexity of |

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| | Tracking and Fleet Monitoring - 2024 | Reddy & B. Bhuvan | modules, Cloud | Enhancing operational efficiency and safety within logistic sector. | machine learning models. |
| 5. | Comparative analysis of machine learning techniques for enhanced vehicle tracking and analysis - 2024 | Seema Rani, Sandeep Dalal | GPS, Machine Learning | Emphasize the importance of analytics in tracking systems. Improves data - driven decision making. | Requires large datasets. There is a lot of complexity in implementation. |
| 6. | Smart Vehicle Tracking and Location Monitoring System - 2025 | C. Ganesh & C. Suganthi | GPS, Google Maps or web interface Angular, ASP.NET,SQL | Reduce manual labour, increase fleet productivity and ensure security. | System performance is influenced by the availability of GPS signals and the strength of the mobile network. |
| 7. | GPS-Based Efficient Real-Time Vehicle Tracking System with Security-2024 | S. Jeevan et al. | GPS module (NEO-6M), GSM module (SIM800L), Arduino Uno, sensors, Biometric | Uses authentication and real-time monitoring to improve car security. | Extra hardware increases cost. Maintenance is complex. |
| 8. | IoT-Based GPS Vehicle Tracking and Monitoring System - 2025 | Para Keerti et al. | ESP32, GPS module (NEO-6M), cloud | Enables real-time fleet visibility. Cloud access improves monitoring efficiency. | High initial cost. Data security needs improvement |
| 9. | Literature Survey on Integrated Vehicle Tracking with Speed, Tilt and Geofencing - 2024 | Nayana J. et al. | ESP32 NodeMCU, GPS, IoT, sensors, Geofencing | Offers an efficient solution for vehicle theft protection and real-timemonitoring. | Mostly theoretical work. No real-time testing included |
| 10. | Intelligent Transportation System – Real-Time- 2023 | Hassan Khaled, Karim Tarek et al. | SIM808 GPS module, Arduino Uno, ThingSpeak cloud server, Flutter mobile application | Supports sustainable travel, improved scheduling, resource optimization and | There is no predictive analysis, only one university bus is used and the scalability evaluation is |

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| | | | | intelligent transportation system. | limited. |
| 11. | Intelligent Traffic System for Urban Conditions Using Real-Time Vehicle Tracking - 2024 | Dr. Adelina Johnsan, Gangone Ganesh et al. | GPS-based vehicle tracking, IoT devices, Server infrastructure, Data analysis | Enhanced traffic efficiency, decreased urban congestion and real-time car position updates. | Depends on network dependability, GPS coverage and integration with urban infrastructure. |
| 12. | Real-Time Vehicle Tracking System Using GPS and GSM - 2024 | Narayan Ghatul et al | GPS Neo-6M, GSM SIM800, Arduino Nano, Google Maps API | The system provides real-time vehicle location through SMS and maps. It is cost-effective. | GPS signals fail in indoor or tunnel areas |
| 13. | Advancing Connected Vehicle System Through Real-Time Data Analytics - 2022 | Utham Kumar Anugula Sethupathy et al. | AI, ML,V2X communication networks, real-time data analytics | Enhance connected vehicle performance through real-time data analytics for traffic safety and efficiency | Requires a strong communication infrastructure, latency-sensitive systems, and standarprotocols. |
| 14. | Driving Behaviour Analysis and Classification by Vehicle using ML - 2022 | Raman Kumar & Anuj Jain | ML algorithms, OBD, ELM327, Python | Helps in identifying driving behaviour using vehicle data. | Accuracy depends on data quality. |
| 15. | UAV-Based Intelligent Traffic Surveillance System: Real-Time Vehicle Detection, Classification, Tracking, and Behavioural Analysis -2025 | Ali Khanpour, Tianyi Wang Wt al. | Deep Learning, Computer Vision, Object Detection & Tracking, Aerial Video Analytics | Makes it possible to monitor accidents, analyses traffic, and surveillance. | Limited flying duration, weather dependent, privacy and regulatory limits. |
| 16. | AI and IoT-Enhanced Emergency Response System for Vehicle and Human Safety - 2025 | N. Satheesh, N. Gopi Sankar et al. | Deep learning models, IoT devices, high-resolution cameras, | Improve human and vehicle safety, especially when traveling at night. | Complexity of implementation, dependence on chemical systems and sensors, and possible financial limitations |
| 17. | Edge Based Intelligent Secured | K. N. Apinaya | | Improved real-time monitoring, | Depending on lighting, edge |

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| | Vehicle Filtering and Tracking System Using YOLO and EasyOCR 2025 | Preethi et al. | Edge computing, YOLOv5, colour masking, Google Maps integration | faster localization, and effective tracking of several vehicles. | device capacity, and video quality. |
| 18. | Building the Future of Transportation:A Comprehensive Survey on AV Perception, Localization, and Mapping 2025 | Ashok Kumar Patil, Bhargav Punugupati, et al. | Cameras, LiDAR, Radar, Sensor Fusion, Deep Learning | Developing dependable AV systems and undertaking a detailed examination of AV mapping, localization and perception techniques. | Sensor cost, adverse weather, scalability and cost associated with data annotation. |
| 19. | Advanced Traffic Clearance System for Emergency Vehicle - 2024 | P Chandra Vamshi Yadav, Dr. Md Asif | Vehicle detection sensors, control algorithms, communication networks. | Intelligent traffic management can provide real-time priority clearance for emergency vehicles. | Its performance depends on Sensor coverage, communication efficiency and infrastructure availability. |
| 20. | Hardware Design for IoT-Based Vehicle Tracking and Theft Detection System through SMS Alert - 2025 | Dr. P. Sanal Kumar, Dr. B. Rajalingam et al. | GPS module, GSM module, Microcontroller (Arduino/ESP series), IoT communication | Accurate location tracking and timely SMS alerts help in monitor vehicles and detect unauthorised movement efficiently. | Depending on GSM network coverage, GPS signal accuracy and microcontroller capabilities. |
| 21. | IoT Based Vehicle Tracking and Monitoring Using GPS – 2024 | D. Rajeswari, Sri Harsha R. et al. | GPS, IoT Sensors, Web Server | Provides real-time vehicle location monitoring through IoT integration and web-based interface for fleet tracking. | Depends on internet connectivity and may face GPS signal issues in dense urban areas. |
| 22. | Vehicle Monitoring and Tracking System-2024 | Adnan Shaout, Hisham Gaber | GPS, RFID, OBD Sensors, IoT | Enhances vehicle monitoring by integrating driver behaviour analysis and theft detection features. | Multiple sensors and hardware components increase the complexity of system. |
| 23. | Vehicle Theft Detection and | Nikhil Mishra, Manav, Pinkoo | GPS, GSM communication | Provides a cost-effective solution | Limited real-time analytics and |

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| | Tracking Based on GSM and GPS – 2024 | Gupta et al. | | for vehicle theft detection and real-time tracking using SMS alerts. | depends heavily on GSM network coverage. |
| 24. | V-Track: Blockchain-Enabled IoT System for Reliable Vehicle Location Verification – 2024 | Mritunjay Shall Peelam, Kunjan Shah, Vinay Chamola | IoT, Blockchain, GPS | Improves reliability and security of vehicle location data using decentralized blockchain architecture | Blockchain integration may increase computational overhead and system cost. |
| 25. | Real-Time Vehicle Tracking System Using GPS and GSM Technology – 2022 | A. Sharma, R. Gupta | GPS, GSM, Microcontroller | Develops a basic real-time vehicle tracking system capable of sending location updates to users. | Limited scalability and lack of advanced analytics capabilities. |
| 26. | IoT-Based Smart Transportation and Vehicle Monitoring System – 2024 | P. N. Reddy, S. Mahesh | IoT sensors, GPS, Cloud computing | Enables smart transportation monitoring with features like vehicle movement analysis and remote monitoring | Data security and privacy concerns in cloud-based systems. |
| 27. | Machine Learning Based Vehicle Tracking and Traffic Prediction – 2023 | S. Verma, A. Patel | Machine Learning, GPS data, Data analytics | Uses machine learning techniques for traffic prediction and route optimization. | Requires large datasets and high computational resources for accurate predictions. |
| 28. | GPS and IoT Based Vehicle Monitoring System for Smart Cities – 2023 | T. N. Rao, S. Kumar | GPS, IoT, Smart city infrastructure | Integrates vehicle tracking with smart city systems to improve traffic management and urban mobility. | Implementation may require high infrastructure investment. |

## III. RESEARCH GAP

Many studies have been done on vehicle tracking systems in which different technologies are used like GPS, IoT and machine learning. These studies have improved tracking, safety and monitoring in many ways. However,after looking at these works, we can still see some common problems and missing areas. The table below show the main research gaps present in existing systems.

Table 4: Research Gaps in Existing Vehicle tracking systems.

| S. No. | Research Area | Existing Work | Research Gap |
|---|---|---|---|
| 1 | Basic Tracking | Systems mainly focus on vehicle location using GPS. | Lack of smart decision and detailed data analysis |
| 2 | Data Usage | Collect data from the systems. | Data is not fully used to improve performance. |
| 3 | Technology Integration | GPS, IoT, and AI are used in different | Technologies are not properly |

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|---|---|---|---|
| | | systems. | combined in one system. |
| 4 | Real-Time tracking | Systems claim real-time tracking. | Network issues can cause delay and reduce accuracy. |
| 5 | Security and Performance | Systems collect important data. | Data security and privacy are not strong in all systems |
| 6 | Scalability | Systems work well for small number of vehicles. | They face problems when used for large vehicles. |
| 7 | Advanced Technologies | Systems use machine learning, IoT, aloud computing and others. | Features like prediction and smart routing are not fully developed. |
| 8 | Overall Performance | Systems provide tracking and monitoring. | More efficient and smarter systems are still needed. |

## IV. CHALLENGES AND LIMITATIONS

Even though vehicle tracking systems are very useful, they still have some problems.

*1)* Network Issues:Most tracking systems need a mobile network or internet to work. If a vehicle goes into a remote area or a place where the signal is poor, the system can stop updating show the wrong location.

*2)* GPS Signal Problem: GPS does not work properly everywhere. For example, in tunnels, basements the signal can be lost so the actual location is not always accurate

*3)* Security Risks:These systemscollect a lot of data of vehicles location. If that data goes into the wrong hands, it can cause big problems. To maintain these data is not an easy task.

*4)* HighCost:Advanced systems like IoT or camera-based tracking are expensive, so small business may not be able to afford them easily.

*5)* Data Management: With the increasing number of vehicles, a lot of data is produced. Managing and understanding this data is not easy. Good managing databases and processing methods are required to make it more efficient.

*6)* Weather and Environment:Bad weather like heavy rain, fog or too much heat can disturb GPS signals and sensors, because of these situations system doesn't work properly.

*7)* Maintenance and Support: Like any other system, tracking systems also need updates from time to time. If support isn't available when something goes wrong, it can become a big issue.




**Fig 2. Challenges of Tracking System**

## V. APPLICATIONS

These systems are useful in many areas and make transportation safer and more efficient.

*1)* In fleet management, companies utilize tracking to monitor the locations and performance of their vehicles. They may use that information to change their itineraries, conserve fuel, and do more tasks with less difficulty.

*2)* There is a rise in public transportation. Buses and taxis can share their current location to their passengers, so people do not have to assume when their ride will come.

3) Logistics and delivery companies use tracking system to keep an eye on shipments and make sure everything reaches on time. Having a full understanding of what's happening throughout their supply chain allows them to manage resources more effectively.
4) Emergency services like police vehicle, fire engines and ambulances can benefit highly from tracking, Bydiscovering approximately the fastest route to an emergency, they can save significant amount of time.
5) Infrastructure for smart cities come last. Tracking systems helps in monitoring traffic, minimize delays and improve everyone's quality of life in the city when they connect to metropolitan hubs.

## VI. CONCLUSION

The real-time vehicle tracking significantly improves monitoring, safety, and operational efficiency. System based on GPS and GSM technologies find that real-time location tracking is reliable, cost-effective, and easy to implement for small-scale fleet monitoring. The IoT-based and cloud-enabled systems show stronger findings in terms of scalability, data analysis, and decision support. Several studies based on computer vision and deep learning models particularly YOLO based approaches, report good accuracy in vehicle detection, classification and counting. However, these systems face certain challenges when operating in low light conditions, during bad weather and when highly computational resources are required. Real-time data plays an important role in enabling quick response and improve decision making in areas such as traffic management, emergency response and fleet operation. Many studies show that combining vehicle tracking data is used with analytics and visualization tools, makes the data easier to understand and improves the overall performance of the system.

From the comparison, that GPS-GSM based systems are mostly preferred because they are low cost and easy to use. They require less hardware and provide reliable location tracking. On the other hand, because vision-based techniques do not require the installation of tracking devices within vehicles, they are especially helpful for traffic monitoring and analysis. Additionally, IoT and cloud-based solutions are better suited for large-scale deployments and intelligent transportation monitoring systems due to their increased scalability and sophisticated data processing capabilities.Because each approach has its own limits, the evaluated studies conclude that hybrid system, which integrate different technologies, are a more feasible and reliable solution for future real-time vehicle monitoring applications.

## VII. FUTURE SCOPE

In future, the vehicle tracking system may grow more advanced.By using GPS along with IoT, AI and cloud technologies, traffic prediction, accident alerts and vehicle health monitoring will be possible. Networks like 5G and V2X communication will makereal-time datatransmissionto be shared quickly and more reliable. The system can be enhanced with a dedicated app for drivers and admins, AI- drivenroute optimization and live traffic update for dynamic rerouting.For electric vehicles energy-efficient tracking system can be developedin the future. More work is needed to improve the system, overcome the current limitations and make tracking and detection more accurate in real-world problems.

Advanced technologies like Internet of Things (IoT), artificial intelligence (AI), cloud computing, and advanced communications networks plays a significant role in improving vehicle tracking systems. These technologies help in making the system more efficient, reliable and secure. IoT sensors are used to collect real-time data, while AI helps in analysing the data and making better decisions Cloud computing makes it easier to store and process large amounts of data. Communication networks also help in fast data transfer. In future, these technologies can improve the accuracy and performance of systems. This will help in better transportation management and efficiency.

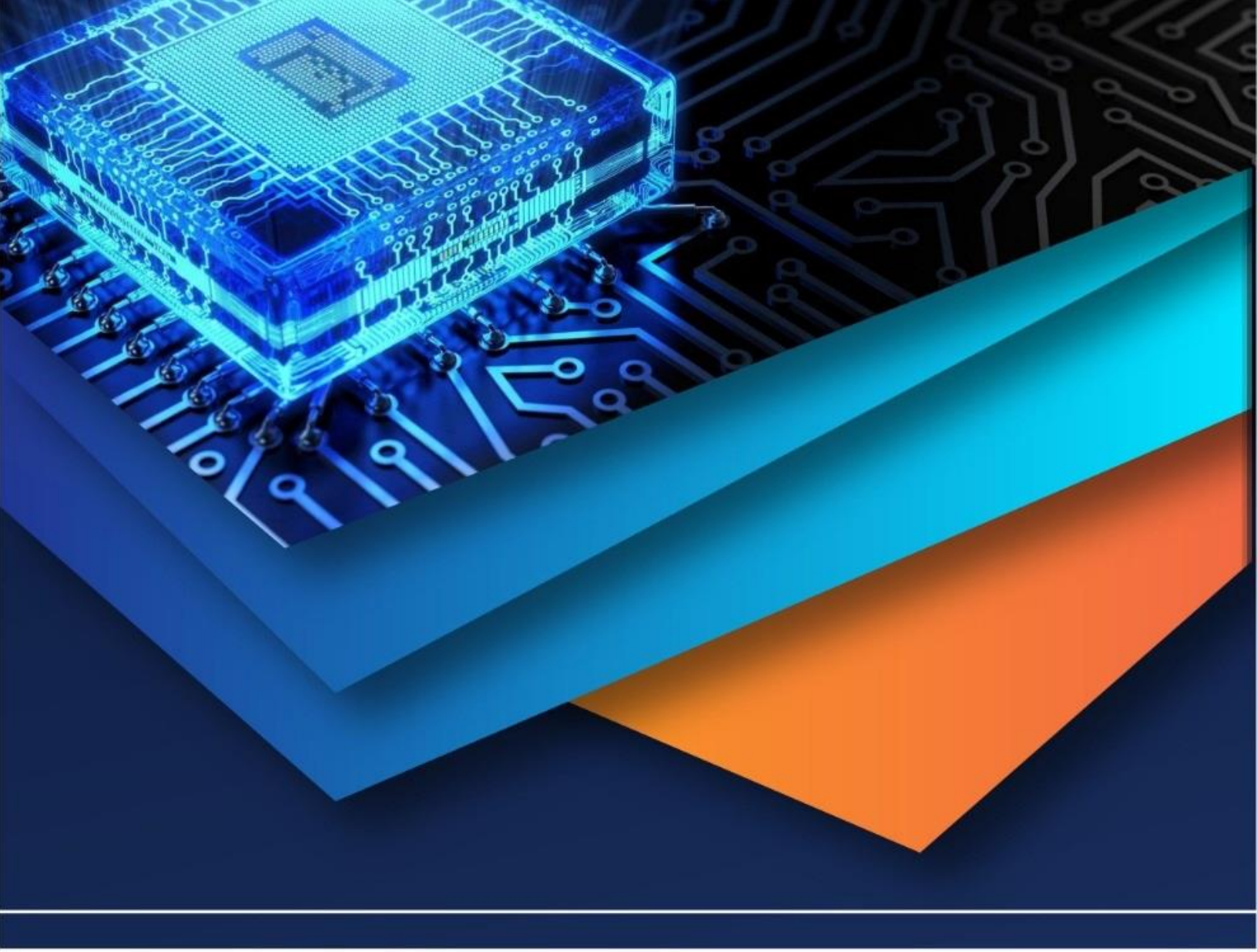
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