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Advancing Vehicle Image Recognition via Cloud Computing: A Review

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Abstract: This review paper explores the transformative impact of cloud computing on intelligent transportation systems, with a specific emphasis on vehicle image recognition. By deploying sophisticated deep learning algorithms on cloud platforms, the study investigates the potential for achieving real-time, scalable, and precise vehicle detection. The evaluation of system effectiveness includes an in-depth analysis of platform performance metrics and image recognition accuracy. The research highlights significant contributions in optimizing cloud-based solutions for traffic management, law enforcement, and autonomous vehicles. It serves as a catalyst for advancements at the intersection of cloud computing and image recognition, promising enhanced transportation intelligence and efficiency. Through a synthesis of current research and technological innovations, this review paper underscores the pivotal role of cloud computing in revolutionizing transportation infrastructure. It discusses implications for future developments, aiming to shape a transportation landscape characterized by heightened responsiveness, safety, and sustainability.
Keywords: Cloud computing, intelligent transportation systems, Vehicle image recognition, Deep learning algorithms, Real-time detection.

I. INTRODUCTION

Approach that analyzes and comprehends media containing automobiles through the use of complex algorithms and machine learning. Innovation in this area, which has many potential uses in many different sectors, has led to rapid expansion in recent years. By utilizing the power of artificial intelligence, VIR systems can recognize, classify, and grasp many characteristics of vehicles, contributing to better safety, security, and efficiency in transportation and beyond. The process of Vehicle picture Recognition commences with picture gathering from multiple sources, including cameras, sensors, and other imaging devices. These photos serve as the raw input for the subsequent phases of analysis. Preprocessing follows, where obtained images undergo a series of optimizations to increase quality and permit rapid analysis. Before the complicated calculations can begin, the images must undergo processing such as resizing, normalization, and noise reduction [1]–[3]. In vehicle image recognition, feature extraction is a crucial step.

This process involves extracting relevant details from the processed images. These features encompass a broad spectrum and include spatial arrangements, texture details, shape attributes, and color distribution. In order to train machine learning models to properly detect and differentiate between different types of cars, it is important to extract these features. Another major element of VIR is classification, which uses machine learning models trained on massive datasets. These models leverage the extracted attributes to classify vehicles into separate categories, such as cars, trucks, motorcycles, and bicycles. This classification skill is crucial for a range of applications, from traffic monitoring to security surveillance. Beyond simple categorization, Vehicle Image Recognition systems often integrate object detecting capabilities..

The capacity to locate and identify individual elements inside an image or video is made possible by this functionality. Object detection in the context of VIR can offer significant details on the location and dimensions of every vehicle in a scenario. An added capability included in many VIR systems is license plate recognition (LPR).

License plate information may be collected and understood from car photographs thanks to LPR technology [4]–[6]. Numerous businesses, such as automated toll collecting, parking management, or law enforcement, can benefit from this capability.

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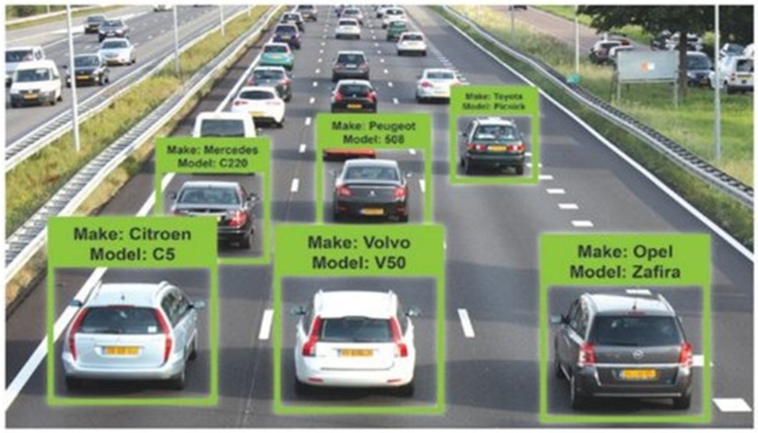


Figure 1 Vehicle recognition

A fast and accurate license plate reader is a lifesaver for many systems that rely on vehicle identification. Numerous sectors can benefit from vehicle image recognition technology. The transportation and traffic management industries rely heavily on VIR systems for traffic management, congestion control, and optimal signal timing. By making it easier to spot vehicles in crowded places and near critical infrastructure, the technology aids in security and monitoring. As a total, urban mobility is improved by VIR's promotion of smart city intelligent transportation network building. The retail and marketing sectors employ VIR to study consumer behavior and do market research by examining vehicle types and trends.Still, the VIR deployment isn't without its flaws. Environmental variability, such as changing lighting, weather, and occlusions, poses a substantial challenge for VIR systems. Meeting the processing demands of real-time applications, like autonomous vehicles, requires strong computational skills.Furthermore, there are privacy concerns related to the collection and processing of photos that could include personal details about people in the car.As technology like deep learning and edge computing progresses and more sensor modalities are integrated, Vehicle Image Recognition is expected to undergo significant evolution in the future [7]–[10]. Better, safer, and more efficient transportation networks are within reach, and VIR is a promising technology that might help make that a reality. Its potential to influence our future perception, understanding, and interaction with cars in the digital age is highlighted by its ongoing integration into numerous areas.

II. LITERATURE REVIEW

MeimeiH 2022 et.al Case studies are conducted for the recognition of the taxi and private vehicle paths, respectively. The influence of the number of missing nodes if AVI equipment on the model's accuracy as well as the validity of the path identification through empirical investigations are examined. The findings demonstrate that the suggested model's recognition of the journey path agrees with the real travel path. When the total number for missing nodes in the model is less than seven, the accuracy of the suggested model exceeds sixty percent. The suggested model considers the choice models for taxis and private autos, respectively, and offers a vehicle route detection method based on partial AVI data.[11].

Bathla 2022 et.al The application of artificial intelligence, machine learning, and the Internet of Things in autonomous vehicles is surveyed in this paper along with a comparative comparison of those modern approaches. An understanding of risk mitigation technology is necessary as the transition from human to automated processes occurs. As a result, this paper examines the safety requirements and difficulties related to autonomous cars in relation to object detection, cybersecurity, or V2X privacy. Furthermore, the hazards and benefits of hypothetical autonomous technology are enumerated in order to examine the significance of artificial intelligence in managing prospective cars. Effective frameworks and tools for self-driving cars are being developed by corporations and researchers. An extensive examination of the design methodologies for intelligent instruments and structures for AI or Internet of Things-based autonomous vehicles was carried out for this survey. Additionally, the functionality of autonomous electric vehicles is also explored.[12].

Zhao 2022 et.al This paper begins with a summary of the vehicle multisensor data, the vehicle CAN bus data collecting system, and common feature extraction techniques.Next, a number of deep learning and machine learning-based models for recognizing driving behavior are examined.

The following conclusions are drawn from a thorough examination of the characteristics of the neural networks used to create driving behavior recognition models—random forests, support vector machines, convolutional neural networks, & recurrent neural networks: Although the driving behavior model built using a typical machine learning approach is fairly developed, the accuracy of the final driving behavior detection is heavily influenced by feature extraction, data scale, and model structure. A neural network-based deep learning model has demonstrated remarkable accuracy in recognizing driving behavior, and it may[13].

Deng 2022 et.al It is also essential for safe driving of automobiles. Malicious traffic accidents, such rear-end collisions, can be successfully avoided by using real-time vehicle detection and recognition. This work primarily examines the color space preprocessing of the image using the threshold segmentation approach or infrared image enhancement to segment the front vehicle or backdrop because the infrared image has several drawbacks, such as weak contrast, loud noise, and blurring edge. In other words, we apply a median filter to eliminate noise from the infrared picture that was collected, and then we use an enhanced histogram equalization to improve the contrast of the image. This is done by analyzing the infrared image that was obtained using an infrared CCD. To improve the image's vertical border, the vertical Sobel operator is chosen.[14].

Lv 2022 et.al Immersion, interactivity, gaming, teaching, and distribution are all integrated into the somatosensory interaction-based virtual reality system of smart tourism attractions. It can alter the situation of one-way passive reception of conventional smart tourist attractions, improve the interaction and interaction of tourists, and break down barriers of time and space for the creation and utilization of smart tourist attractions. It can also improve the extremely cold experience environment of smart tourist attractions. In order to support the advancement of teaching in smart tourist beautiful areas, it also offers innovative ways of instruction and design to those who create them. It modifies the conventional ice and snow industry business model and highlights the significance of ice and snow culture.[15].

TABLE NO. 1 LITERATURE SUMMARY

Author’s name	Methodology used	Problem statement	Research gap	Dataset used
Javaid 2024 et. al [16]	Graph Neural Networks model cyberattacks; GraphSAGE outperforms in accuracy.	Detecting cloud network attacks using Graph Neural Networks for improvement.	Current models underperform in detecting cloud network cyberattacks accurately.	CSE-CIC-IDS2018 dataset simulates cloud network attacks for model training.
Theivadas 2024 et. al [17]	Facial recognition, machine learning, and alerts detect driver fatigue effectively.	Driver fatigue detection is crucial for preventing road accidents and fatalities.	Existing systems insufficiently detect driver fatigue in diverse real-world scenarios.	Driver facial feature data analyzed for fatigue indicators using OpenCV, Dlib.
Muneeswari 2024 et. al [18]	Bi-LSTM-based VM load balancing enhances efficiency in cloud computing.	Improving VM load balancing efficiency in cloud computing systems.	Inadequate VM load balancing methods hinder cloud computing performance enhancements.	Dataset specifics were not detailed in the provided text.
Shang 2024 et. al [19]	DDoS attack detection and defense in cloud computing environments researched.	Improving DDoS attack detection and defense in cloud computing.	Inadequate methods for effective DDoS defense in cloud computing systems.	No specific dataset was mentioned in the provided text.
Rajagopalan 2024 et. al [20]	IoT-cloud integration enhances power system efficiency and sustainability significantly.	Enhancing power system efficiency and sustainability through IoT-cloud integration.	Limited research on optimal integration of IoT and cloud in power systems.	Smart meter data and grid performance metrics analyzed for integration.

III. VEHICLE RECOGNITION CLASSIFICATION

Vehicle recognition classification, that employs complex algorithms to classify & recognize cars based on visual input, is a crucial aspect of computer vision and artificial intelligence. This technology is now essential in many industries, including as retail, smart cities, security, & transportation. By utilizing an intricate sequence of image processing, feature extraction, and machine learning procedures, computers can accurately identify and grasp different types of vehicles.The foundation of vehicle recognition classification lies in image acquisition, where cameras, sensors, or other imaging devices capture visual data of vehicles. These images serve as the raw input for subsequent analysis. Preprocessing steps follow, involving the enhancement and optimization of acquired images. Tasks such as resizing, normalization, and noise reduction are performed to ensure that the images are suitable for detailed analysis in the classification pipeline. Feature extraction is a crucial phase in vehicle recognition classification. During this step, relevant information is distilled from the preprocessed images. This includes extracting features like color profiles, shape characteristics, texture details, and spatial arrangements. These features serve as distinctive markers that enable machine learning models to discern and classify vehicles accurately.Classification itself relies heavily on machine learning models, often trained on extensive datasets containing diverse images of vehicles. These models leverage the features extracted in the previous step to categorize vehicles into different classes. Common classifications include cars, trucks, motorcycles, bicycles, and more. The accuracy of the classification process is contingent on the robustness of the machine learning models and the quality of the features extracted. Object detection is an additional layer in vehicle recognition classification systems. This functionality goes beyond mere categorization and involves pinpointing the location and boundaries of vehicles within an image or video. Object detection provides valuable spatial information, allowing for a more detailed understanding of the distribution and arrangement of vehicles in a given scene.

License Plate Recognition (LPR) is often integrated into vehicle recognition classification systems, adding a layer of sophistication. LPR systems can extract and interpret license plate information from vehicle images, contributing to applications such as toll collection, parking management, and law enforcement. The ability to read and process license plates swiftly enhances the overall utility of these systems.

Vehicle recognition and categorization have a wide range of applications. This technology helps with congestion management, signal timing optimization, and traffic pattern monitoring in the transportation & traffic management domains. Accurate vehicle identification is beneficial for security and monitoring in public areas, airports, and vital infrastructure. Intelligent transportation systems are developed in smart cities through the use of vehicle recognition, which improves urban mobility. Technology is used by the retail and marketing sectors to study consumer behavior and do market research based on the kinds and movements of vehicles.

Despite its immense potential, vehicle recognition classification faces challenges. Variability in environmental conditions, such as different lighting and weather conditions, can impact the accuracy of classification. Real-time processing requirements, especially in applications like autonomous vehicles, necessitate high-speed computation. Privacy concerns also arise due to the capture and analysis of images that may contain sensitive information about vehicle occupants.

Looking ahead, vehicle recognition classification is poised for continued advancement. Innovations in deep learning, edge computing, and sensor technologies are expected to further enhance the accuracy and efficiency of these systems. As technology progresses, vehicle recognition classification is set to play an increasingly integral role in shaping safer, smarter, and more efficient transportation systems and urban environments.

IV. CLOUD COMPUTING CLASSIFICATION

Cloud computing classification is a systematic approach to categorizing the various services and deployment models that constitute the expansive realm of cloud computing. Cloud computing, a transformative technology, enables users to access and utilize computing resources, such as servers, storage, and applications, over the internet. The classification of cloud computing is essential for understanding its diverse offerings and choosing the right model based on specific needs and requirements.

A. Services Classification

1) infrasture as a service(Iaas): IaaS offers virtualized processing power, storage, & networking along with other essential computer resources via the cloud. Operating systems, apps, and development frameworks are all under user control.

2) Platform as a Service (PaaS): With the help of PaaS, users may create, execute, and maintain applications without having to worry about the intricate details of the supporting infrastructure. Development frameworks, middleware, and tools are all included.

3) Software as a Service (SaaS): SaaS provides software that is ready to use and is supplied via the internet. Users don't need to worry about underlying infrastructure, software upgrades, or maintenance in order to use these apps.

B. Deployment Models

1) Public Cloud: Public cloud services are provided by third-party cloud service providers and are made available to the general public. Resources are shared among multiple users, offering scalability and cost efficiency.
2) Private Cloud: Private clouds are dedicated infrastructure exclusively used by a single organization. This model provides greater control, security, and customization options, making it suitable for businesses with specific regulatory or security requirements.
3) Hybrid Cloud: Hybrid clouds combine elements of both public and private clouds, allowing data and applications to be shared between them. This model provides flexibility, enabling organizations to leverage the benefits of both deployment models.

V. CLOUD COMPUTING FOR VEHICLE RECOGNITION

Cloud computing has become a crucial facilitator in the field of vehicle recognition, fundamentally transforming the domains of transportation, security, and urban planning. Vehicle recognition, a component of computer vision, entails the automatic detection and categorization of automobiles using visual information. The incorporation of cloud computing into vehicle identification systems has brought about increased efficiency, scalability, and collaboration, resulting in substantial impacts on many applications across industries.

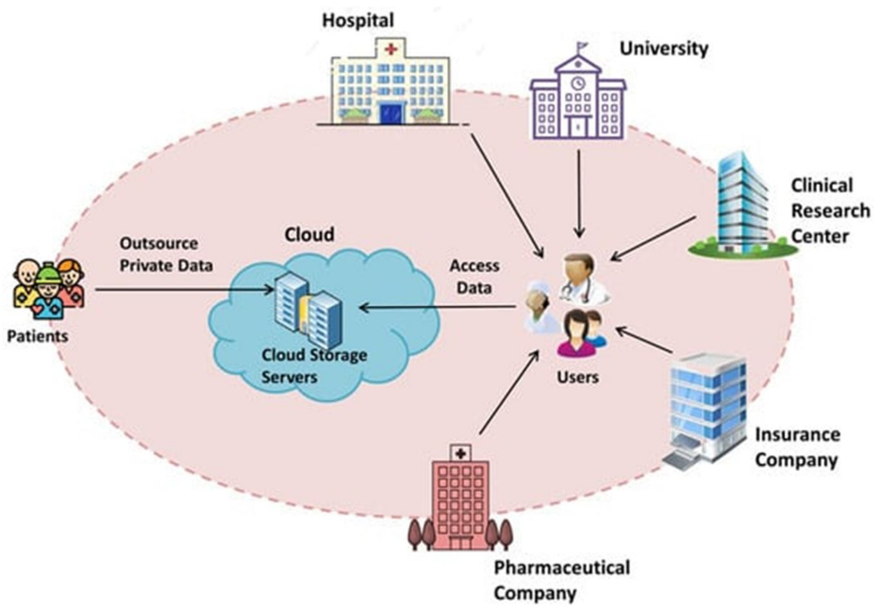


Figure 2 cloud computing vehicle recognition

An intrinsic advantage of utilizing cloud computing in vehicle recognition is its natural scalability. Cloud platforms offer immediate access to a large pool of computer resources, enabling recognition systems to adjust their processing capabilities in real-time according to the amount and complexity of incoming data. The capacity to scale efficiently is especially important in urban settings where traffic patterns constantly change. This allows recognition systems to adjust to different workloads effectively.Cloud-based storage is a significant determinant of the effectiveness of car identification systems. The extensive storage capacity of cloud services provide the efficient handling and storage of large databases of car photos. It is essential to enhance identification algorithms, train machine learning models, and categorize vehicles more accurately. In addition, cloud storage facilitates seamless collaboration and data sharing among different components of recognition systems, hence improving overall performance and generating valuable insights. Real-time processing is an essential necessity for various vehicle recognition applications, including traffic management and law enforcement. Cloud computing fulfills this requirement by offering significant computational capacity that can efficiently process real-time video streams. Real-time processing enables identification systems to quickly classify vehicles, detect objects, and recognize license plates. This improves situational awareness and reduces response times.

Efficient communication between different components of a vehicle recognition system is facilitated by cloud-based solutions, which ease collaboration. Edge devices, which are responsible for capturing photos, can effortlessly transmit pertinent data to central processing units located in the cloud. This collaborative approach enhances the efficiency and precision of the recognition process, resulting in a more cohesive and interconnected system.

Cloud-based collaboration facilitates the gathering of information from various sources, thereby improving the comprehension of traffic patterns, vehicle behavior, and other pertinent data. Cloud-based solutions enhance communication efficiency among various components of a vehicle recognition system by optimizing collaboration. Edge devices with image processing capabilities can seamlessly share relevant data with cloud-based central processing units. Through collaboration, we can optimize the accuracy and efficiency of the recognition process, leading to a more integrated and interconnected system. Furthermore, the utilization of cloud-based collaboration enables the amalgamation of information from various sources, thereby enhancing our comprehension of traffic patterns, vehicle conduct, and other relevant data points.

Ensuring security is of utmost importance in vehicle recognition, considering the high level of sensitivity of the data involved. Cloud computing solutions include robust security measures such as encryption, access controls, and threat detection to prevent unauthorized access and maintain the confidentiality and integrity of vehicle data. Cloud-based vehicle recognition systems are highly suitable for applications that prioritize data privacy and protection due to their strong security features.

Cloud computing's versatility enables the implementation of hybrid models that integrate edge computing and cloud-based processing. Edge devices, such as cameras and sensors, have the capability to locally record and preprocess data before transmitting pertinent information to the cloud for more rigorous analysis. This hybrid solution utilizes the advantages of both local and centralized processing, enhancing the identification system for different situations and guaranteeing flexibility for unique applications.

Cloud deployment enables effortless and smooth execution of regular software upgrades and maintenance. Cloud-based vehicle identification systems can effortlessly get updates, guaranteeing that recognition models remain up-to-date with the most recent breakthroughs in machine learning and computer vision. The ability to adapt is essential for tackling new issues and consistently enhancing the efficiency of recognition systems, which in turn ensures the durability and applicability of the technology.

VI. CONCLUSION

This review underscores the profound impact of advanced technology on intelligent transportation systems, specifically focusing on leveraging cloud computing for vehicle image recognition. By deploying sophisticated deep learning algorithms on cloud platforms, the study aims to achieve real-time, scalable, and precise vehicle detection capabilities. The evaluation of system effectiveness is conducted through a comprehensive analysis of platform performance metrics and image recognition accuracy. Results indicate promising potential in enhancing traffic management, law enforcement operations, and the development of autonomous vehicles. This review significantly contributes to optimizing cloud-based solutions within these domains, highlighting the transformative role of cloud computing in revolutionizing transportation infrastructure. Furthermore, it acts as a catalyst for future advancements at the intersection of cloud computing and image recognition technologies. By bridging these fields, the study envisions a transportation landscape characterized by heightened intelligence, efficiency, and responsiveness. This vision not only enhances current practices but also paves the way for innovative applications and improvements in safety, reliability, and sustainability across transportation networks.

REFERENCES

[1] F. Qazi, D. Kwak, F. G. Khan, F. Ali, and S. U. Khan, “Service Level Agreement in cloud computing: Taxonomy, prospects, and challenges,” Internet of Things (Netherlands), vol. 25, no. October 2023, p. 101126, 2024, doi: 10.1016/j.iot.2024.101126.

[2] S. Sachdeva et al., “Unraveling the role of cloud computing in health care system and biomedical sciences,” Heliyon, vol. 10, no. 7, p. e29044, 2024, doi: 10.1016/j.heliyon.2024.e29044.

[3] W. Wei et al., “A lightweight network for traffic sign recognition based on multi-scale feature and attention mechanism,” Heliyon, vol. 10, no. 4, p. e26182, 2024, doi: 10.1016/j.heliyon.2024.e26182.

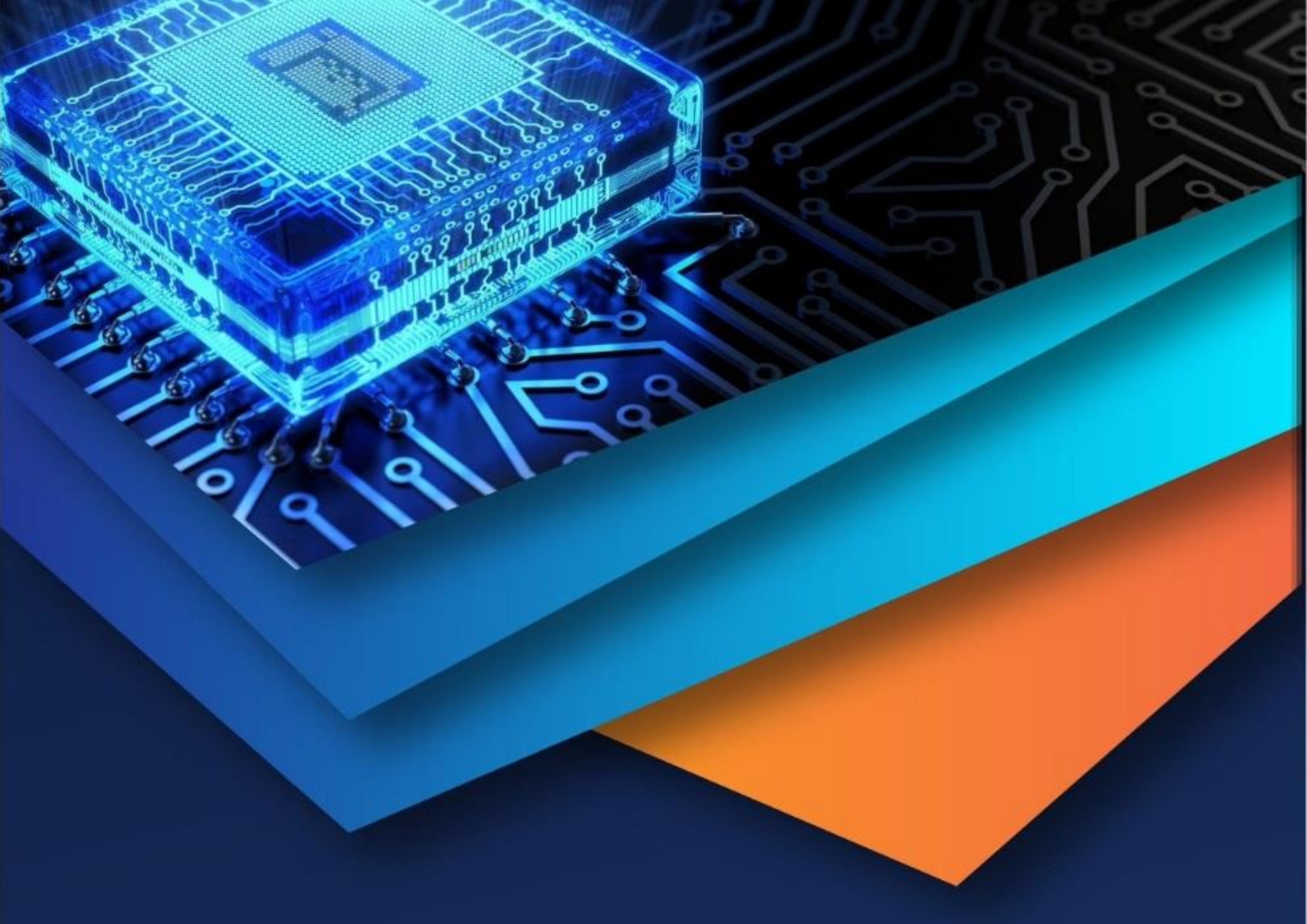
[4] N. E. Mustafa and F. Alizadeh, “Unmanned aerial vehicle (UAV) images of road vehicles dataset,” Data Br., vol. 54, p. 110264, 2024, doi: 10.1016/j.dib.2024.110264.

[5] N. Boonsirisumpun, E. Okafor, and O. Surinta, “Vehicle image datasets for image classification,” Data Br., vol. 53, p. 110133, 2024, doi: 10.1016/j.dib.2024.110133.

[6] N. Pessanha Santos, R. Moura, G. Sampaio Torgal, V. Lobo, and M. de C. Neto, “Side-scan sonar imaging data of underwater vehicles for mine detection,” Data Br., vol. 53, p. 110132, 2024, doi: 10.1016/j.dib.2024.110132.

[7] P. Tamilarasu and G. Singaravel, “Quality of service aware improved coati optimization algorithm for efficient task scheduling in cloud computing environment,” J. Eng. Res., no. September, 2024, doi: 10.1016/j.jer.2023.09.024.

[8] Y. T. HUANG and T. C. LEE, “A binomial distribution model for describing pedestrian-vehicle crashes in urban areas,” Asian Transp. Stud., vol. 10, no. August 2023, p. 100131, 2024, doi: 10.1016/j.eastsj.2024.100131.
[9] M. Guo et al., “Intelligent extraction of road cracks based on vehicle laser point cloud and panoramic sequence images,” J. Road Eng., vol. 4, no. 1, pp. 69–79, 2024, doi: 10.1016/j.jreng.2024.01.004.
[10] N. Alruwais et al., “Farmland fertility algorithm based resource scheduling for makespan optimization in cloud computing environment,” Ain Shams Eng. J., vol. 15, no. 6, p. 102738, 2024, doi: 10.1016/j.asej.2024.102738.
[11] M. E, X. Wu, Z. Zhan, and J. Guo, “Vehicle Path Recognition Approach Based on Incomplete Automatic Vehicle Identification,” J. Adv. Transp., vol. 2022, 2022, doi: 10.1155/2022/3462267.
[12] G. Bathla et al., “Autonomous Vehicles and Intelligent Automation: Applications, Challenges, and Opportunities,” Mob. Inf. Syst., vol. 2022, 2022, doi: 10.1155/2022/7632892.
[13] D. Zhao, Y. Zhong, Z. Fu, J. Hou, and M. Zhao, “A Review for the Driving Behavior Recognition Methods Based on Vehicle Multisensor Information,” J. Adv. Transp., vol. 2022, 2022, doi: 10.1155/2022/7287511.
[14] K. Li, R. Deng, Y. Cheng, R. Hu, and K. Shen, “Research on Vehicle Detection and Recognition Based on Infrared Image and Feature Extraction,” Mob. Inf. Syst., vol. 2022, 2022, doi: 10.1155/2022/6154614.
[15] H. Lv, “Construction of a Virtual Reality Model of Smart Tourism Scenic Spot Based on Cloud Computing,” Math. Probl. Eng., vol. 2022, 2022, doi: 10.1155/2022/5833861.
[16] M. Javaid, A. Haleem, and R. P. Singh, “Journal of Economy and Technology,” Researchgate.Net, vol. 2, no. May, pp. 190–199, 2024, doi: 10.1016/j.ject.2024.05.001.
[17] J. R. Theivadas and S. Ponnan, “VigilEye: Machine learning-powered driver fatigue recognition for safer roads,” Meas. Sensors, vol. 33, no. December 2023, p. 101186, 2024, doi: 10.1016/j.measen.2024.101186.
[18] G. Muneeswari, J. B. Madavarapu, R. Ramani, C. Rajeshkumar, and C. John Clement Singh, “GEP optimization for load balancing of virtual machines (LBVM) in cloud computing,” Meas. Sensors, vol. 33, no. August 2023, p. 101076, 2024, doi: 10.1016/j.measen.2024.101076.
[19] Y. Shang, “Prevention and detection of DDOS attack in virtual cloud computing environment using Naive Bayes algorithm of machine learning,” Meas. Sensors, vol. 31, no. December 2023, p. 100991, 2024, doi: 10.1016/j.measen.2023.100991.
[20] A. Rajagopalan et al., “Empowering power distribution: Unleashing the synergy of IoT and cloud computing for sustainable and efficient energy systems,” Results Eng., vol. 21, no. January, p. 101949, 2024, doi: 10.1016/j.rineng.2024.101949.



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