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Smart Highway Road Side Symbol Detection

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Abstract: Automatic Discovery of road signs has lately entered attention from the computer vision exploration community. The main ideal of this system is to descry signs of a moving vehicle. Road Traffic subscribe Discovery is a technology by which a vehicle is suitable to fete the business signs put on the road e.g." speed limit" or" children" or " turn ahead". Consider a condition stoner is driving a auto at night or in stormy season also it is n't possible for motorists to keep watch on each and every road symbol or the communication plates like turn, speed swell, academy, diversion etc. This is veritably useful design in this condition Then we will use one signal transmitter on each and every symbol or communication plate on road side and whenever any vehicle passes from that symbol the transmitter positioned inside the vehicle will admit the signals and display proper communication or the symbol details on TV connected to auto. Now motorist can concentrate on driving. We're trying to apply the system with signal identification using the radio frequency technology. The business signal suggestion will inform the motorist of the current signal status inside the auto on the dashboard. The RF transmitter will transmit the RF signal and these transmitted signal will entered by RF Receiver fitted to the vehicle and will inform motorist about the current signal status of the business light to perform necessary action.

I. INTRODUCTION

Autonomous vehicles, capable of sensing their environment and navigating with minimal human input, have become a reality. These vehicles rely on advanced AI control systems to interpret sensory information for identifying navigation paths, obstacles, and road signs. This paper introduces an intelligent road signs classifier to assist autonomous vehicles in recognizing and understanding road signs. The classifier utilizes a deep learning model, specifically Convolutional Neural Networks (CNN), which are effective in solving pattern recognition problems like image classification and object detection. CNNs mimic human brain decision-making processes in handling visual data. The proposed pipeline was trained and tested on two different datasets, achieving high performance with a validation accuracy of 99.8% and a testing accuracy of 99.6%. The method demonstrates easy implementation for real-time applications [1].

Computer vision systems in autonomous vehicles must effectively detect objects and obstacles in various environments, particularly under challenging weather conditions like fog and rain, which can impair image quality and object detection (OD) performance. The primary navigation of autonomous vehicles relies on image processing techniques applied to data from visual sensors. To address these challenges, ensembling multiple baseline deep learning models with various voting strategies and utilizing data augmentation is proposed. Data augmentation is especially beneficial for OD applications with limited training data. Using baseline models accelerates the OD process compared to custom models due to transfer learning. The ensembling approach proves highly effective for resource-constrained devices used in autonomous vehicles in uncertain weather conditions. The applied techniques demonstrated improved accuracy over baseline models, with 32.75% mean average precision (mAP) and 52.56% average precision (AP) in detecting cars in foggy and rainy conditions. Multiple voting strategies for bounding box predictions further enhance the explainability and performance of the ensemble techniques [2].

Perception is crucial for autonomous driving systems, as it gathers all necessary information about the vehicle's environment. The decision-making system uses this data to make optimal decisions, ensuring passenger safety. This paper surveys recent literature on AVP, focusing on Semantic Segmentation and Object Detection, both vital for navigation. It provides a comprehensive overview of deep learning for perception and decision-making processes based on images and LiDAR point clouds. The paper discusses sensors, benchmark datasets, and simulation tools used in semantic segmentation and object detection tasks, specifically for autonomous driving. It serves as a roadmap for current and future research in AVP, highlighting models, assessments, and challenges in the field [3].

Accident Alert Light and Sound (AALS) System for Smart Roads increasing vehicular traffic elevates the risk of accidents, especially under poor weather conditions like heavy rainfall, strong winds, storms, and fog. To mitigate this risk and inform approaching vehicles of accidents, an Accident Alert Light and Sound (AALS) system is proposed. The AALS system, installed on the roadside, detects accidents and alerts all types of vehicles without requiring modifications to non-equipped vehicles (nEVs) or electric vehicles (EVs).

This research focuses on creating smart roads (SRs) with various sensors to detect accidents, reducing the need for a global positioning system (GPS) to locate accidents quickly. The framework aims to reduce multiple-vehicle collisions (MVCs) and human fatalities by ensuring timely alerts and immediate first aid response. Wireless communication is utilized only when an accident is detected, enhancing the system's efficiency [4]. Traffic sign detection is crucial for self-driving cars and driver assistance systems. However, detecting small traffic signs, which cover only 1%-2% of the image area, poses significant challenges. To address this, we propose a YOLOv3 network with layer pruning and patch-wise training strategies for detecting small traffic signs. This approach improves recall percentage and mean Average Precision (mAP) [5].

Speed Sensor Detection System the Malaysian Police Force seeks technological advancements to combat highway thugs and illegal racers. The primary goal is to deter unethical road activities. This project designs a simple speed sensor detection system using an Infra-red (IR) sensor, NodeMCU ESP8266 microcontroller, and the Blynk application platform for control and monitoring via smartphone. The system detects vehicles or objects passing the IR sensor, displaying the vehicle's speed on both a Liquid Crystal Display (LCD) and the Blynk application. If a vehicle exceeds the speed limit, NodeMCU notifies the user's device, alerting them to the speeding vehicle. This innovative system offers authorities several advantages over traditional methods of addressing road rage incidents, enabling prompt action and resolution, ultimately contributing to safer road conditions and improved law enforcement capabilities [6].

II. LITERATURE REVIEW

Automatic Speed Control in Speed-Limited Zones ensuring the safety of pedestrians in speed-limited zones such as schools and hospital areas is a significant challenge due to drivers often exceeding speed limits. Traditional traffic policing methods are insufficient for constant monitoring and enforcement. To address this, a system utilizing Radio Frequency Identification (RFID) technology is proposed. An RFID reader, attached to the vehicle, interacts with RFID tags placed in speed-limited zones. These tags convey a coded message when the reader comes within range, triggering the vehicle's microcontroller unit to automatically control and reduce the vehicle's speed. The tags are strategically placed at the beginning and end of these zones. This innovative approach eliminates the need for driver intervention and ensures consistent speed regulation, enhancing public safety in critical areas [7].

Lightweight Convolutional Neural Networks for Traffic Sign Recognition traffic sign recognition and classification are vital for traffic safety, surveillance, artificial driver services, and self-driving cars. Recognizing traffic signs helps tackle traffic- related obstacles, and lightweight models are essential for portable devices. To address these challenges, a lightweight convolutional neural network (CNN) with residual blocks is proposed for traffic recognition systems. The proposed model demonstrates high efficiency and exceeds other well-known deep CNN architectures, achieving a remarkable 99.9% accuracy by F-score on the German Traffic Sign Recognition Benchmark. This paper highlights the model's effectiveness and general validity for traffic sign classification, showing its potential for real-world applications in traffic safety and autonomous driving [8].

Automatic Traffic Sign Detection and Recognition (TSDR) systems provide critical information to drivers and are essential for autonomous driving. Misclassifying traffic signs poses severe hazards to the environment, infrastructure, and human lives. Reliable TSDR mechanisms are necessary for safe vehicle circulation. Various Machine Learning (ML) algorithms have been proposed for Traffic Sign Recognition (TSR), but no consensus on a preferred algorithm or perfect classification capability has been achieved. This study employs ML-based classifiers to develop a TSR system that analyzes a sliding window of frames from vehicle sensors. The system utilizes Long Short-Term Memory (LSTM) networks and Stacking Meta- Learners to combine base-learning classification episodes into an improved meta-level classification. Experimental results using publicly available datasets demonstrate that Stacking Meta- Learners significantly reduce misclassifications and achieve perfect classification on all considered datasets. This novel approach based on sliding windows shows potential as an efficient solution for TSR [9].

Lightweight Neural Networks for Traffic Sign Recognition traffic sign recognition significantly enhances road safety, with deep neural networks achieving impressive results in object identification. However, these systems can be limited by high computational and resource demands. To address this, a lightweight neural network for traffic sign recognition is proposed, offering high accuracy and precision with fewer trainable parameters. Trained on the German Traffic Sign Recognition Benchmark (GTSRB) and Belgium Traffic Sign (BelgiumTS) datasets, the proposed model achieved 98.41% and 92.06% accuracy, respectively. It outperformed several state-of-the-art models, including GoogleNet, AlexNet, VGG16, VGG19, MobileNetv2, and ResNetv2, with accuracy margins ranging from 0.1 to 4.20 percentage points on GTSRB and 9.33 to 33.18 percentage points on BelgiumTS [10].

Road-Type Detection Based on Traffic Sign and Lane Data the RTD system aims to help car drivers by determining the road type using onboard video and sensor data, without relying on GPS. It detects and evaluates traffic control devices (TCDs) along the road, using empirical statistics and heuristics for decision-making. Tested in various countries, the system achieved recognition precisions of 78.9% for European roads and 88.9% for UK roads [11].

III. RELATED WORK

This part presents many types of research on vehicle-to- infrastructure communication for the warning message. Below researchers have produced the most critical work in this field.

Targe, Pallavi A., and M. P. Satone, 2016 [18] propose a real time intelligent transportation system based on VANET to solve traffic congestion. RFID and an ARM controller are used in the proposed system. Every vehicle will be supplied with an RFID tag that will be read by a roadside unit equipped with an RFID reader. The roadside unit will collect information about the traffic strength on that signal node by sensing all vehicles present at that signal via their related RFID tags. Then, via RF transmission, traffic data will be sent to the central server and saved in our database. Then, via RF transmission, traffic data will be sent to the central server and saved in our database. The system can locate a path with the least amount of traffic, according to simulation results. For the system to be more effective, their system can be combined with traffic lights. Furthermore, in complex urban areas, they should consider positioning accuracy to assure path planning accuracy.

Salim A. Mohammed Ali, Emad H. Al-Hemairy [2] proposed communication modules inside vehicles that has OBDII to transmits and receive data for different function like vehicle security, and vehicles safety via Cellular V2X.

SRAIRI, Salim, and Arnaud GORIN, 2017 [17] created a traceability system to track the historical background of road infrastructure by including significant information generated during the construction, renovation, or operation phases. This can be accomplished by embedding passive tags in the road. They can be activated, read or written by sensors embedded in vehicles, and managed by intelligent control systems. First, the vehicle-infrastructure communication system is described, followed by an explanation of how it works. The developed communication software and the experimentation phase are then described in detail.

Huanjia Yang, Shuang-Hua Yang[12] proposed an RFID- based system that uses a UHF RFID reader in the vehicle, places an RFID tag on the road, and investigated automatic speed limit transmission using RFID technologies. He concludes that both passive and active RFID systems have potential in this scenario but at different scales of application. Identify and classify the problems and benefits for all types, and design a system to demonstrate the benefits of using RFID for speed limit purposes.

Isaac Perper[13] proposed low-cost software-defined radios to overcome RFID positioning systems limitation. The proposed platform is a low-cost, scalable, and portable RFID micro- location platform that can overcome real-world deployment issues such as RFID orientation.

Huanjia Yang, Shuang-Hua Yang in 2007 [14] investigated RFID-based automatic speed limit transmission. In this application, both passive and active RFID systems show promise. A passive RFID system has a low-cost yet dependable tag design, making it suitable for mass implementation in large- scale applications. Using a passive RFID system also has the advantage of being simple to maintain, as passive tags do not require batteries and can be re-programmed remotely. He has discussed and concluded that placing passive tags on the road surface can prevent passive tag confusion, ghost reading and reader conflicts.

Nash et al.[15] The impact RFID reader and tag placement, car velosity and RFID Tag Reading Count was examined. It was observed that in fast speed the lower the detection rate and RFID Tag Read Count. the reading count of tag and signal strength are both greater when the tag and reader are close.

Wang, Jianqiang, Daiheng Ni, and Keqiang Li, 2014 [16] proposed an RFID-based vehicle positioning approach. When a vehicle passes over an RFID tag, the precise position stored in the tag determines the vehicle's location. When there is no RFID coverage, the vehicle position is estimated using a kinematics integration algorithm from the most recent tag location until the next tag updates. RFID positioning accuracy is empirically validated in two independent ways, one using radar and the other a photoelectric switch. The proposed system is designed to verify whether the dynamic position obtained from RFID tags matches the accurate position measured by radar.

Wang, Zhan.[19] Proposed a new and timely vehicle positioning framework, named radio-frequency identification - driverless car positioning system (RFID-DCPS) This system is designed based on a local database of accurately geo-located Radio Frequency Identification (RFID) transponders on roadside furniture near roads and car-based interrogators. When the vehicle drives past the tagged roadside furniture, the interrogator mounted on the vehicle interrogates the location of the tagged roadside furniture within the reading range and determines the real-time positioning of the vehicle.

Wei Zhang, Bin Lin [20], proposed RFID-Integrated VANETs to monitor traffic flow, detect road accidents, and help avoiding chain crush. The deployment of Road Side Units (RSUs) at roadsides in VANETs, which send the accident information to the drivers timely on the city road, enhances the road safety. The paper investigates the placement of Base Stations (B.S.s) and RFID- reader.

Yunlei Zhang [21] Proposed Localization system contain UHF RFID tag is used as a electronic license plate (ELP) and placed on the vehicular front windshield. The RFID reader and antennas are installed on the sign gantry. The phase difference of arrival (PDOA) of RFID backscatter signal is utilized to estimate the distances between the Tag and antennas.

Jianqiang Wang [16] To assist connected vehicle applications, an RFID-based vehicle location technique was presented. When a vehicle passes over an RFID tag, the precise position contained in the Tag determines the car's location. RFID location accuracy is empirically validated in two different techniques, one utilizing radar and the other a photoelectric switch. From the above survey, we can conclude that there are many methods for send warning message from the Infrastructure to the vehicle and the position of the Tag that can be used to localize and monitor the users, the most famous are the GPS/GPRS and the RFID. The GPS/GPRS has some limitations in coverage and data bottleneck. While in the other hand, the RFID reader can act as a sink to collect all the information and send it to the cloud to be stored in the database. So our proposed work used the RFID technology.

IV. LITERATURE SURVEY

Reference	Title	Year	Key Focus	Methodology	Results/Findings
[7]	Automatic Speed Control in Speed-Limited Zones	2021	Ensuring pedestrian safety in speed- limited zones using RFID technology	RFID reader in vehicles interacts with RFID tags placed in speed-limited zones to control vehicle speed automatically	Ensures consistent speed regulation without driver intervention, enhancing public safety
[8]	Lightweight Convolutional Neural Networks for Traffic Sign Recognition	2022	Traffic sign recognition using lightweight CNN models	CNN with residual blocks for improved traffic sign classification efficiency	Achieved 99.9% accuracy on the German Traffic Sign Recognition Benchmark
[9]	Automatic Traffic Sign Detection and Recognition (TSDR)	2022	Reliable TSDR mechanisms using ML-based classifiers	LSTM networks and Stacking Meta-Learners analyze vehicle sensor data	Stacking Meta-Learners significantly reduce misclassifications and achieve perfect classification on all considered datasets
[10]	Lightweight Neural Networks for Traffic Sign Recognition	2023	High-accuracy, low-resource neural network for traffic sign recognition	Lightweight neural network trained on GTSRB and BelgiumTS datasets	Achieved 98.41% (GTSRB) and 92.06% (BelgiumTS), outperforming GoogleNet, AlexNet, VGG16, VGG19, MobileNetv2, and ResNetv2
[11]	Road-Type Detection Based on Traffic Sign and Lane Data	2022	Road type detection using onboard video and sensor data	Detection and evaluation of traffic control devices using empirical statistics and heuristics	Recognition precision: 78.9% (European roads) and 88.9% (UK roads)

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V. METHODOLOGY

The system consists of three main modules:

1) Transmitter Module (Installed on Traffic Signs)

- Each traffic sign is fitted with an RF transmitter that continuously broadcasts a signal containing a unique identifier (ID) for the specific traffic symbol.
- The transmitter operates on battery or solar power, ensuring uninterrupted functionality.
- It uses a predefined frequency channel to communicate with the receiver inside vehicles.

Fig.1 RFID Tag

2) Receiver Module (Installed in Vehicles)

- An RF receiver inside the vehicle continuously scans for signals from road signs.
- When an RF signal is detected, the receiver extracts the unique ID from the signal.
- The system processes the received ID and matches it to a database of traffic symbols.
- The corresponding symbol and message are displayed on the in-car LCD screen, and an audio alert is played if necessary.

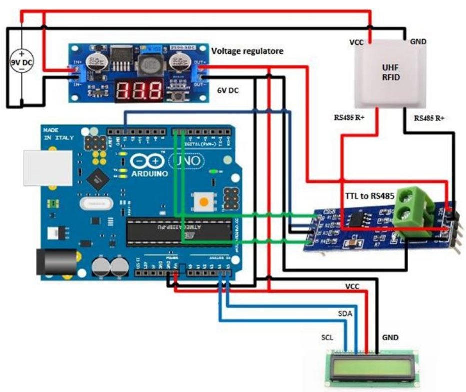


Fig.2 Receiver module in Vehicle

3) Processing Unit (Microcontroller-Based System)

- A microcontroller unit (MCU) is responsible for processing the received RF signals.
- The microcontroller decodes the signal, retrieves the associated symbol, and updates the display.
- It supports both text and graphical symbols for better user experience.

4) Prototype Development

- A scaled-down prototype of traffic signals and road signs is built with RF transmitters.
- Vehicles equipped with RF receivers and display modules are tested under different conditions to evaluate system performance.

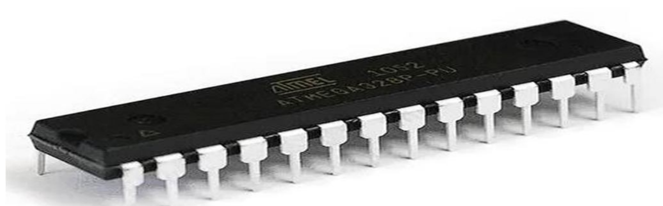


Fig.3 Microcontroller

VI. OBJECTIVES

In daily life every vehicle (car) driver while driving the car may have to face to face problems like they don't know the status of signal symbol, the nearest path, the status of his/her vehicle. To keep in mind all these problems in this project four modules are developed. They are as follows.

1) Symbol detection module: Whenever any vehicle passes away from any symbol its signal get detected by the signals detectors which are connected in car. This signal then converted in to proper symbol and displayed on the display panel connected in the car. This is how it show specific symbols to the driver which help driver in finding specific symbols and there meaning also.
2) Signal detection module: When any vehicle comes near square car detector will detect the car status and show it on the display. Now driver can decide what to do by speeding the car or by slow down car speed.

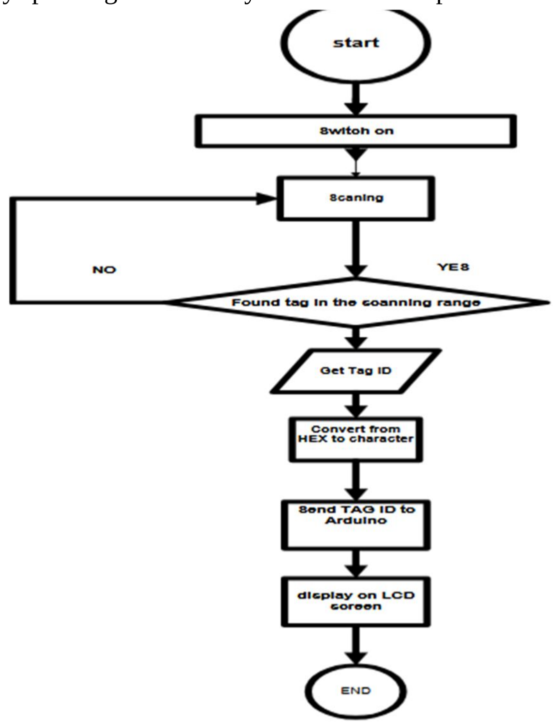


Fig.4 Block Diagram

VII. EXPECTED RESULTS

As the infrastructure to vehicle information passing is one of the important aspect in vehicular ad-hoc network and it gives a better assistance to driver so that driver can concentrate on driving. Here in proposed system we are designing the infrastructure to vehicle communication and sharing the road side symbols, sign and text boards' information with in-car system fixed at vehicle cockpit. Once the system is ready with all the functionality it is expected from the system that system should,

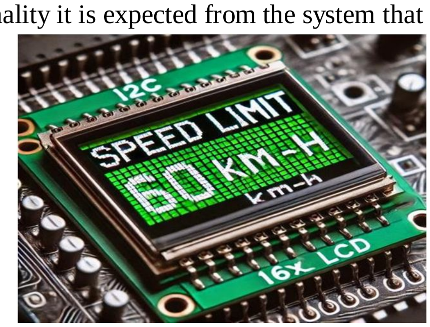


Fig. V Expected output

- System should detect the data from RFID tag and receiver show it on the in-car system.
- System should paly sound on the basis of detected symbol messages.
- System should take power advantages from different power source.

A. *Future Improvements*

1) Machine Learning Integration: AI models can be used to predict driver responses and optimize alerts.
2) Extended Range: Using advanced RF modules with increased range to cover larger areas.
3) Vehicle-to-Vehicle Communication: Enhancing system functionality by allowing vehicles to share detected sign information.

VIII. CONCLUSION

As the system is mainly designed for driver assistance on the way or in city it gives wide range of scope to the user or implementer.

1) *Helpful in Night traveling:* Much time it is not possible for driver to keep watch on each signal and board on the highways so the system will help drivers to understand the symbol or signals.
2) *No need to see board on road:* As system is capable of show the symbol details user can concentrate on driving only.
3) *Distance tower can show all spots:* If user misses the signal or can't see the signal or warning from long distance system can able to see the details of board from long distance.
4) *Viewing signal information:* It may possible that user can't read long messages on board so the system will also help the driver.

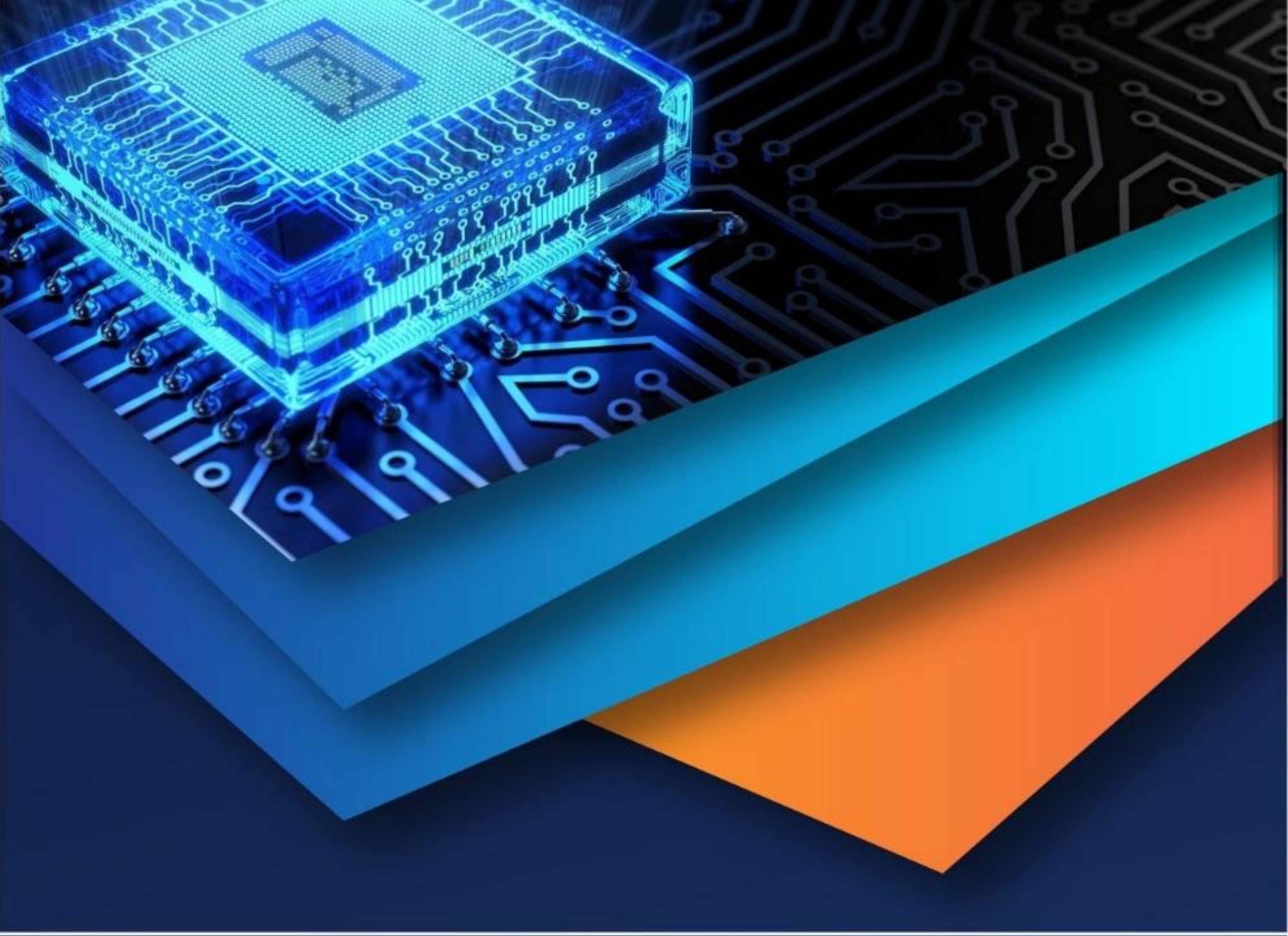
The Road Side Symbol Detection System offers a reliable and efficient method of assisting drivers by providing real- time traffic sign information using RF technology. Unlike traditional image-based systems, RF communication ensures accuracy even in adverse conditions such as nighttime driving or bad weather. The system effectively reduces driver distractions by eliminating the need to visually locate road signs.

Future advancements could integrate AI-based predictive alerts, extended RF range, and V2X (Vehicle-to-Everything) communication for enhanced road safety. This technology has the potential to be adopted in modern smart transportation systems, significantly improving driving efficiency and road safety.

REFERENCES

[1] Ayachi, R., Said, Y. E., & Atri, M. (2019). To perform road signs recognition for autonomous vehicles using cascaded deep learning pipeline. Artificial Intelligence Advances, 1(1), 1-10.
[2] Walambe, R., Marathe, A., Kotecha, K., & Ghinea, G. (2021). Lightweight object detection ensemble framework for autonomous vehicles in challenging weather conditions. Computational Intelligence and Neuroscience, 2021(1), 5278820.
[3] Jebamikyous, H. H., & Kashef, R. (2022). Autonomous vehicles perception (avp) using deep learning: Modeling, assessment, and challenges. IEEE Access, 10, 10523- 10535.
[4] Mateen, A., Hanif, M. Z., Khatri, N., Lee, S., & Nam, S. Y. (2022). Smart roads for autonomous accident detection and warnings. Sensors, 22(6), 2077.
[5] Rehman, Y., Amanullah, H., Shirazi, M. A., & Kim, M. Y. (2022). Small traffic sign detection in big images: Searching needle in a hay. IEEE Access, 10, 18667-18680.
[6] Azidin, F. A., Zamri, M. S. A., & Zainudin, Z. (2023). Enhancing Road Safety: A Smart Speed Detection System Using IoT Technology. Journal of Telecommunication, Electronic and Computer Engineering (JTEC), 15(4), 27- 32.
[7] Dhote, D. R., Lakde, P. R., Pachare, A. S., Meharkure, M. A., & Dongare, M. (2021). Automatic Speed Control of Vehicle by using RFID Technology. International Journal of Research in Engineering, Science and Management, 4(7), 268-270.
[8] Mamatkulovich, B. B. (2022). Lightweight residual layers based convolutional neural networks for traffic sign recognition. European International Journal of Multidisciplinary Research and Management Studies, 2(05), 88-94.
[9] Fazekas, Z., Balázs, G., Gyulai, C., Potyondi, P., & Gáspár, P. (2022). Road-Type Detection Based on Traffic Sign and Lane Data. Journal of advanced transportation, 2022(1), 6766455.
[10] Atif, M., Zoppi, T., Gharib, M., & Bondavalli, A. (2022). Towards enhancing traffic sign recognition through sliding windows. Sensors, 22(7), 2683.
[11] Murthy, J. S., Siddesh, G. M., Lai, W. C., Parameshachari, B. D., Patil, S. N., & Hemalatha, K. L. (2022). ObjectDetect: A Real-Time Object Detection Framework for Advanced Driver Assistant Systems Using YOLOv5. Wireless Communications and Mobile Computing, 2022(1), 9444360.
[12] Khan, M. A., Park, H., & Chae, J. (2023). A lightweight convolutional neural network (CNN) architecture for traffic sign recognition in urban road networks. Electronics, 12(8), 1802.
[13] Dhawan, K., & RK, N. (2023). Identification of traffic signs for advanced driving assistance systems in smart cities using deep learning. Multimedia tools and applications, 82(17), 26465-26480.
[14] Nadeem, H., Javed, K., Nadeem, Z., Khan, M. J., Rubab, S., Yon, D. K., & Naqvi, R. A. (2023). Road feature detection for advance driver assistance system using deep learning. Sensors, 23(9), 4466.
[15] Padaria, A. A., Mehta, A. A., Jadav, N. K., Tanwar, S., Garg, D., Singh, A., ... & Sharma, G. (2023). Traffic sign classification for autonomous vehicles using split and federated learning underlying 5g. IEEE Open Journal of Vehicular Technology, 4, 877-892.
[16] C. Manchanda, R. Rathi, and N. Sharma, "Traffic density investigation & road accident analysis in India using deep learning," in 2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS), 2019: IEEE, pp. 501-506.
[17] A. Salim, M. Ali, and E. H. Al-Hemairy, "Communication Module for V2X Applications using Embedded Systems," in Journal of Physics: Conference Series, 2021, vol. 1933, no. 1: IOP Publishing, p. 012112.
[18] M. Altuijary, "An Overview of Vehicle-to-Infrastructure Communication Technology," Degree of Master, Faculty of The Graduate College, University of Nebraska 2020.
[19]

[20] W. A. Abdelkarim, "Vehicle to Infrastructure Communication for Adaptive Traffic Management," Sudan University of Science and Technology, 2016.
[21] O. Javaid, "Autonomous Vehicle Navigation and Communication by Radio Frequency Identity Tags," Master thesis, Electrical and Computer, Carleton University, Carleton University Ottawa, Ontario, 2021.
[22] J. F. Schnecker Sr, B. Byrtus, J. Yang-Tsui, B. Jaime, E. Leary, and K. Luo, "Satellite-based Positioning, Navigation, and Timing (PNT)," Naval Information Warfare Center Pacific, 2022.
[23] S. Dahal, J. Hernandez, and J. Roesler, "Infrastructure Enhancements for CAV Navigation," in "3," University of Michigan. Center for Connected and Automated Transportation, 2018.
[24] Y.-A. Bennai, S. Yessad, and L. Bouallouche-Medjkoune, "A flexible and adaptive medium access control protocol for improving quality of service in vehicular ad-hoc networks," International Journal of Computers and Applications, pp. 1- 10, 2021.



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