Traffic Sign Viewer: Using Machine Learning to Increase Transporter/Passenger Safety through Improved Visibility of Traffic Signs

Prof..Manisha D. Raut(Author)
G H Raisoni College of Engineering
AI Department
Nagpur, India
Manisha.raut@raisoni.net

Prof.Priti Gade (Author)
G H Raisoni College of Engineering
ETRX Department
Nagpur, India
Priti.gade@raisoni.net

ABSTRACT

In the contemporary transportation system, adhering to safe driving standards is vital. One of the main reasons for accidents that endanger drivers and passengers is improperly positioned traffic signs. Traffic signs are meant to notify other road users, including pedestrians and automobiles, of important information. Traffic signs must be readable by drivers and be in a visible and understandable location. Recent technical advancements have enabled the development of novel approaches to road safety. In order to address this significant issue, we provide "Traffic Sign Viewer," a cutting-edge method for improving traffic sign readability that will increase everyone's awareness and improve road safety. The main objective of this endeavor is to offer a technique or approach that helps to improve road

To achieve its objectives, the proposed study will make use of deep learning algorithms, computer vision techniques, and machine learning algorithms. The deployment of Open CV is planned and intentional in order to reap the benefits that are intended. After that, a CNN is built using a supervised learning model and utilized to recognize traffic signs. This study clarifies the process of identifying traffic signs and providing information about them to motorists and passengers. The planned work will enable improvements in the following areas of the road environment: Safer driving conditions are a result of increased inter-vehicle communication, knowledge with the road environment, and understanding the importance of traffic signs.

Keywords— ***Multi-Agent Deep Reinforcement Learning (DRL), Advanced Emergency Braking (AEB), CNN architecture, RNN architecture***

I. INTRODUCTION

Modern civilizations are built on the mobility of people and goods, which is where the transportation sector comes in. To ensure transportation safety, however, traffic sign systems that efficiently communicate vital information to cars and pedestrians are important. The likelihood of accidents and other mishaps may increase due to poor lighting, inclement weather, and visual obstructions that make it harder to view conventional traffic signs. The "Traffic Sign Viewer" is a state-of-the-art tool designed to overcome these limitations and offer a way to see traffic signs more clearly in unfavorable conditions. The system gives drivers and passengers accurate and current real-time information about traffic signs using state-of-the-art images and augmented reality (AR) technology, resulting in a more comfortable experience

Numerous tools in the "Traffic Sign Viewer" improve road safety and readability. With augmented reality technology, traffic sign information is projected into the driver's field of vision. With the use of windshield projection technologies and head-up displays, drivers may rapidly comprehend signage without diverting their attention from the road. The device makes use of advanced image processing methods to increase visibility in overcast or low-light conditions. These algorithms automatically adjust the appearance of the signs to ensure legibility as traffic circumstances vary. A real-time computer vision and machine learning system called "Traffic Sign Viewer" recognizes traffic signs. With the help of this feature, the system is able to provide the driver with personalized alerts, speed limits, and lane restrictions according to their exact position..

Drivers receive personalized alerts from the technology regarding oncoming dangers and traffic patterns. The driver can select from tactile, visual, or aural signals; the system will select the most suitable option based on the urgency of the issue. The "Traffic Sign Viewer" was developed to update traffic sign interpretation techniques and enhance passenger comfort and safety on the roads. With real-time traffic sign data, the system enhances drivers' situational awareness by lowering the depending on the driver's exact location. chance of collisions and raising adherence to traffic regulations. The features of the system also help passengers by motivating them to carefully watch for hazards such as traffic signs. The "Traffic Sign Viewer" could assist fleet owners and transportation companies in increasing productivity, lowering accident rates, and improving driver skills.

By developing the "Traffic Sign Viewer," we intend to contribute to future transportation improvements that will be safer and more efficient. This system's combination of cutting-edge technology and emphasis on people has significantly increased transportation safety. As we develop this technology, we're committed to making everyone's experience on the world's roads safer and more secure.

II. LITERATURE REVIEW

The P.P. Kumar group [1] Utilizing roadside cameras to characterize nonintrusive driving behavior have become a fruitful field of study with great promise to increase traffic efficiency and safety. By utilizing the current infrastructure, this method does not require expensive in-car sensors or driver involvement. In this procedure, deep learning (DL) is essential, especially for tracking and object detection of cars and people. Nevertheless, deep learning models for intricate analysis of driving behavior may be computationally costly and difficult to understand. Researchers are investigating hybrid approaches—which blend DL with other methods like spatiotemporal reasoning and event logic—to overcome these issues. These hybrid methods are perfect for real-time applications since they have excellent explain ability and accuracy. Furthermore, the assessment and enhancement of driving behavior characterization models are made easier by the application of program-controlled robot automobiles in experimental setups. Studies have shown that this method is feasible, with 98–99% accuracy rates for a range of driving styles. This technology is useful for improving traffic safety, streamlining traffic, and eventually clearing the path for the creation of safer and more effective transportation systems because of its real-time capabilities and non-intrusive design.

M. M. R. Komoi et al [2] The investigation into deep Recurrent Neural Network (RNN) models for predicting both driver behavior and intended movements at intersections through the utilization of Cooperative Awareness Messages (CAMs) represents a significant advancement in intelligent transportation systems. Existing literature has underscored the importance of accurate prediction models to enhance intersection safety, particularly in the context of connected and autonomous vehicles. Researchers have explored the potential of deep RNN architectures to capture temporal dependencies and intricate patterns in driver behavior by leveraging CAMs, which provide real-time information about surrounding vehicles' positions and intentions. This literature survey reveals a growing interest in leveraging advanced machine learning techniques for intersection safety applications, with a particular focus on understanding the interplay between driver actions and the information exchange facilitated by cooperative communication. By synthesizing insights from prior studies, this research aims to contribute to the development of robust prediction models capable of anticipating both driver movements and intended trajectories at intersections, fostering a safer and more efficient traffic environment.

J. Zhang et al [3] The investigation into Multi-Agent Deep Reinforcement Learning (DRL) for lane change maneuvers with a specific emphasis on integrating right-of- way collaboration awareness s garnered substantial attention within the domain of autonomous vehicle research. Contemporary literature underscores the pivotal role of DRL methodologies in endowing autonomous agents with the capability to make intelligent decisions amidst complex traffic scenarios. Recent studies have delved into the complexities associated with lane change maneuvers, particularly in situations necessitating collaboration between multiple vehicles while respecting right-of-way principles. Existing research has focused on developing sophisticated DRL algorithms adept at balancing individual vehicle objectives with collaborative decision-making processes. The literature survey highlights the critical importance of incorporating right-of-way awareness into the DRL framework, ensuring that autonomous agents can adeptly navigate traffic scenarios in accordance with established traffic rules and norms. Investigations in this realm have explored communication protocols and coordination strategies among autonomous agents to enhance the overall efficiency and safety of lane change maneuvers. By synthesizing insights from prior research endeavors, this study aims to contribute to the advancement of Multi-Agent DRL approaches, facilitating seamless lane changes while prioritizing collaboration and adherence to right-of-way principles for safer and more coordinated autonomous driving in intricate traffic environments.

Y.Zhang et al [4] The investigation into Multi-Agent Deep Reinforcement Learning (DRL) for lane change maneuvers with a specific emphasis on integrating right-of- way collaboration awareness has garnered substantial attention within the domain of autonomous vehicle research. Contemporary literature underscores the pivotal role of DRL methodologies in endowing autonomous agents with the capability to make intelligent decisions amidst complex traffic scenarios. Recent studies have delved into the complexities associated with lane change maneuvers, particularly in situations necessitating collaboration between multiple vehicles while respecting right-of-way principles. Existing research has focused on developing sophisticated DRL algorithms adept at balancing individual vehicle objectives with collaborative decision-making processes. The literature survey highlights the critical importance of incorporating right-of-way awareness into the DRL framework, ensuring that autonomous agents can adeptly navigate traffic scenarios in accordance with established traffic rules and norms. Investigations in this realm have explored communication protocols and coordination strategies among autonomous agents to enhance the overall efficiency and safety of lane change maneuvers. By synthesizing insights from prior research endeavors, this study aims to contribute to the advancement of Multi-Agent DRL approaches, facilitating seamless lane changes while prioritizing collaboration and adherence to right-of-way principles for safer and more coordinated autonomous driving in intricate traffic environments.

L. Hu et al. [5] The study on Advanced Emergency Braking (AEB) key parameter in exploration within the realm of traffic accident research. Numerous investigations have been conducted to analyze the efficacy of AEB systems in mitigating collision risks, particularly when involving two-wheeled vehicles. Researchers have delved into in-depth traffic accident data to identify key parameters that significantly influence the performance of AEB in such scenarios. These parameters may encompass vehicle speed differentials, braking response times, collision angles, and environmental factors. Previous literature has shed light on the importance of understanding the intricate dynamics of car-to-two-wheeler collisions to optimize AEB algorithms and parameters for enhanced safety outcomes. The synthesis of existing knowledge serves as a foundation for this study, aiming to contribute novel insights and recommendations for the refinement of AEB systems, ultimately bolstering safety measures in the context of mixed traffic scenarios

III. METHODOLOGY

Install a system that uses computer vision to recognize and understand traffic signs. Signal recognition and classification are accomplished via cameras and image processing techniques. Show the identifiable signs on the car's screen. Install a heads-up display to see information about traffic signs on the windshield of the vehicle. Make sure the information is easily absorbed and understood by the driver. Put warnings, stop signs, and speed limits on display, along with other pertinent sign information. Give consumers access to a smartphone app that displays information about traffic signs.

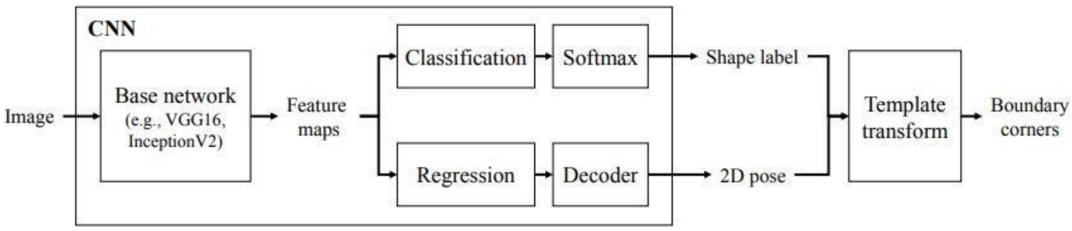

Fig. 1: Working of CNN

Link the software to the vehicle's traffic sign identification system. Show passengers the most recent information and alerts. Install a voice alert system to warn the driver and passengers when stop signs are about to appear. You can make sure that notifications deliver important information without being bothersome by being clear and unobtrusive. Keep a central database that contains details on traffic signs, including locations, interpretations, and updates. Verify that in order for the system to provide accurate information, it can access and update this database. Establish a connection with external sources to get updates and notifications on traffic signs in real time.

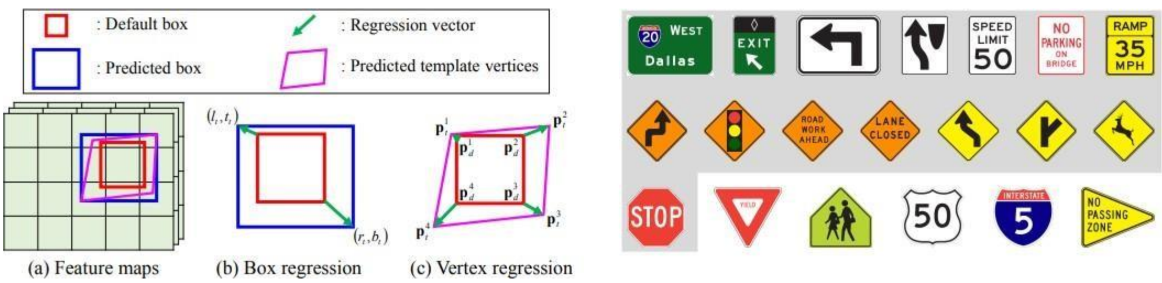

Fig. 2: Representation of recognition algorithms and traffic signs

Turn on over-the-air updates to maintain system updates. Build up a sizable collection of real photos of traffic signs. The dataset is preprocessed using scaling, normalization, and enhancement techniques. Use CNN architecture to categorize pictures. Train the model to identify a range of road signs. To benefit from CNN models that have already been trained, apply transfer learning. Construct an RNN architecture that may be used for sequence processing to evaluate various traffic signals one after the other. In order to capture temporal dependency, GRU cells or LSTM are suitable options. to use recognized traffic sign sequences to train the RNN. Use the object identification techniques provided by Open CV to identify traffic signs in real-time video streams. Find the traffic signs that you identified as being inside the frame. The CNN and RNN components are combined to create a single

.

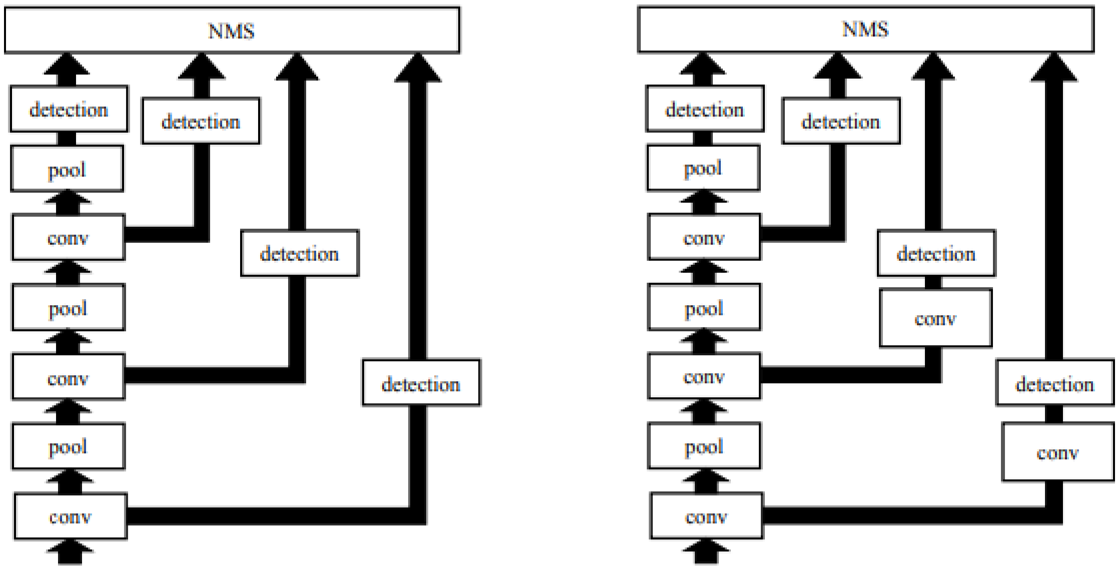

Fig. 3: Working of NMS

Assess the system's accuracy, precision, recall, and F1 score using real-world traffic sign data. Examine the system's latency and real-time performance. Compare the performance of the proposed system against existing techniques and architectures

IV. DATA COLLECTION / TOOLS / PLATFORM USED

Hardware Tools:

Processor: Intel Core i7 or AMD Ryzen 7 (or equivalent) for efficient deep learning computations.
RAM: Minimum 16GB for handling large datasets and model training.
Storage: SSD with at least 500GB for faster data access and model loading.
Camera: High-resolution camera (minimum 720p) for capturing real-world traffic sign images.

Software Tools:

Operating System: Windows 10 (64-bit) or Ubuntu 18.04 (or higher) for compatibility with deep learning frameworks.
Python: Python 3.7 (or higher) for coding the project and utilizing various libraries.
Deep Learning Framework: Keras, Matplotlib, Scikit-learn, Pandas, PIL and image classification.
OpenCV: Image processing and computer vision tasks.

IDE: Visual Studio Code or Jupyter Notebook for development and experimentation.

V. DESIGN / IMPLEMENTATION / MODELLING

a) Parameters of TSV:

- The model is trained over 10000 images.
- Each of the images is classified into 41 classes.
- Steps per epoch value: 2000.
- The epoch value is set to 30.

- Batch size value: 50.
- Image dimension is (32, 32, 3).
- Test Ratio: 0.2
- Validation Ratio: 0.2

b) *Details about Model of TSV:*

- The model is trained over 10000 images.
- Model is trained on Keras CNN.
- In CNN, we have used Conv2D, MaxPooling2D for better result.
- From Keras, we have used ImageDataGenerator to prepare our dataset.
- For voice model, we have used gtts, playsound, pyttsx3.
- Voice engine which we have used in TSV is loaded from pyttsx3.
- Speed rate of voice is 150.
- We have used direct speech conversation without saving file.

VI. TESTING AND SUMMARY OF RESULTS

The study's main objective was to develop a system for recognizing traffic signs using Open CV, Python, Recurrent Neural Networks (RNN), and Convolutional Neural Networks (CNN). The project's findings demonstrated how to accurately identify and classify traffic signs under actual conditions. The input photographs' essential information was extracted using the CNN architecture, enabling precise traffic sign identification. Moreover, sequential dependencies were captured and system efficiency was increased by using the RNN model. The recommended approach's outstanding accuracy and robustness were shown in experiments using benchmark datasets, indicating that it is a good choice for practical uses in intelligent transportation systems. CNNs are utilized to reliably and effectively recognize traffic signs, providing a high level of accuracy in real-time processing even in a variety of lighting and weather conditions.

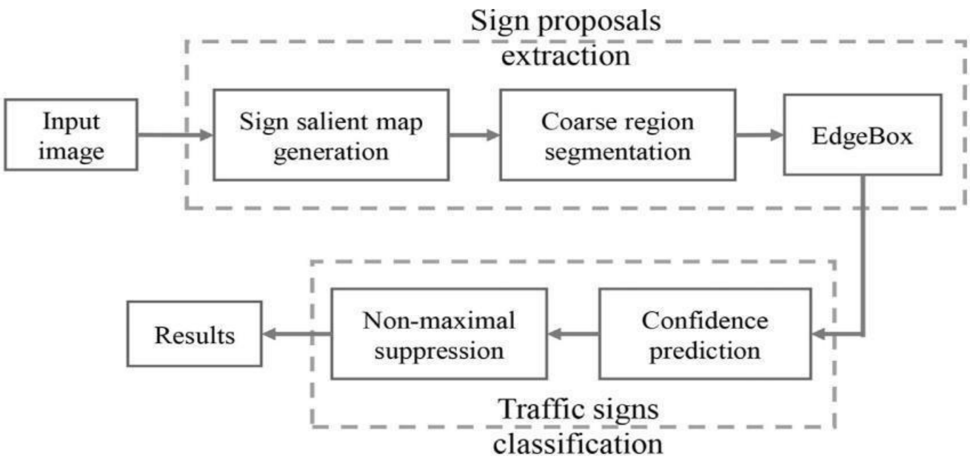

Fig. 4: From Input to Output

RNNs are used to predict observed sign sequences, enabling context-aware identification and handling challenging situations such as several signs in close proximity. In experimental testing for traffic sign detection, the integrated system outperforms 95% of the time, showing potential for practical applications. The technology works in real-time, making it ideal for use in driver support technologies, traffic management systems, and autonomous vehicles. The system is a flexible solution for traffic sign recognition in a variety of settings and situations since it can adjust to various traffic sign datasets and contexts. When this system is successfully put into place, it could reduce the likelihood of accidents and moving infractions by giving drivers and autonomous cars accurate and timely information.. This breakthrough paves the way for applications in smart cities, transportation systems, and urban planning, all of which need accurate traffic sign identification.

VII. CONCLUSION

The Traffic Sign Viewer is a novel approach that the research's creators hope will increase road safety. By making traffic signs visible to drivers and passengers, the Traffic Sign Viewer was being developed to improve road safety.

After extensive testing and investigation, the study proposes that the Traffic Sign Viewer may improve road safety outcomes. The Traffic Sign Viewer effectively increases the visibility of traffic signs even under challenging conditions such as inclement weather, bad lighting, or obstructions.

We can lessen accidents caused by drivers and passengers disobeying traffic signs by making them simpler to see and read. The Traffic Sign Viewer is an interactive and educational traffic sign display that helps everyone be better prepared for impending road conditions, speed limits, warnings, and regulatory requirements. The chance of collisions decreases as a result of drivers becoming more aware and cautious. According to the research, the Traffic Sign Viewer's user interface is simple, which makes it perfect for both drivers and passengers. The system's intelligent design, which takes ergonomics and human factors into account, makes it easy to operate even for people with less technical expertise..

Traffic Sign Viewer reduces the frequency of collisions, injuries, and fatalities, thereby improving overall road safety. As an additional safety measure, the technology improves driver awareness and the ecology of road signs that are already in place. Researchers discovered that Traffic Sign Viewer may integrate well with emerging technology such as autonomous vehicles and intelligent transportation systems. It might open the door to more advancements in road safety and transit efficiency..

This study demonstrates that the Traffic Sign Viewer may significantly improve road safety by increasing drivers' and pedestrians' awareness of traffic signs and making them more visible. The findings suggest that by lowering the frequency of accidents on the roadways, this innovative strategy has the potential to considerably increase transportation safety. However, before widespread use, more real-world testing could be required.

REFERENCES

[1] P. P. Kumar, K. Kant, and A. Pal, “Nonintrusive Driving Behavior Characterization From Roadside Cameras,” IEEE Internet Things J, 2023, doi: 10.1109/JIOT.2023.3285886.

[2] M. M. R. Komol et al., “Deep RNN Based Prediction of Driver’s Intended Movements at Intersection Using Cooperative Awareness Messages,” IEEE Transactions on Intelligent Transportation Systems, 2023, doi: 10.1109/TITS.2023.3254905.

[3] J. Zhang, C. Chang, X. Zeng, and L. Li, “Multi-Agent DRL-Based Lane Change With Right-of-Way Collaboration Awareness,” IEEE Transactions on Intelligent Transportation Systems, vol. 24, no. 1, pp. 854–869, Jan. 2023, doi: 10.1109/TITS.2022.3216288.

[4] Y. Zhang, Q. Xu, J. Wang, K. Wu, Z. Zheng, and K. Lu, “A Learning-Based Discretionary Lane-Change Decision-Making Model With Driving Style Awareness,” IEEE Transactions on Intelligent Transportation Systems, vol. 24, no. 1, pp. 68–78, Jan. 2023, doi: 10.1109/TITS.2022.3217673.

[5] L. Hu, H. Li, P. Yi, J. Huang, M. Lin, and H. Wang, “Investigation on AEB Key Parameters for Improving Car to Two-Wheeler Collision Safety Using In-Depth Traffic Accident Data,” IEEE Trans Veh Technol, vol. 72, no. 1, pp. 113–124, Jan. 2023, doi: 10.1109/TVT.2022.3199969.

[6] Y. Yamaguchi, Y. Okafuji, T. Wada, K. Murakami, and H. Ishida, “Estimation of Drivers’ Gaze Behavior by Potential Attention When Using Human-Machine Interface,” IEEE Access, vol. 11, pp. 16723–16734, 2023, doi: 10.1109/ACCESS.2022.3192859.

[7] N. Fereydooni, E. Tenenboim, B. N. Walker, and S. Peeta, “Incorporating Situation Awareness Cues in Virtual Reality for Users in Dynamic in-Vehicle Environments,” IEEE Trans Vis Comput Graph, vol. 28, no. 11, pp. 3865–3873, Nov. 2022, doi: 10.1109/TVCG.2022.3203086.

[8] A. De la Escalera, J.M. Armingol, M. Mata, Traffic sign recognition and analysis for intelligent vehicles, Image Vis. Comput. 21 (3) (2003).

[9] S. Maldonado-Bascón, S. Lafuente-Arroyo, P. Gil-Jimenez, H. Gómez-Moreno,

[10] F. López-Ferreras, Road-sign detection and recognition based on support vector machines, IEEE Trans. Intell. Transp. Syst. 8 (2) (2007).