A VOICE ASSISTED TRAFFIC SIGN BOARD RECOGNISATION SYSTEM: A SURVEY

Richa Saxena[1], Prateek Singh[2], Ishita Gupta[3], Ajhar Ali[4], Dikshant Kumar[5], Vaibhav Yadav[6]

[1,2,3,4,5,6] Department of Computer Science and Engineering, Moradabad Institute of Technology, Moradabad

[1]richasaxena2006@gmail.com, [2]prateeksingh0809@gmail.com, [3]ishitagupta781@gmail.com, [4]ajharalimbd@gmail.com, [5]dikshantk266@gmail.com, [6]yadavvaibhav109@gmail.com

Abstract

The aim of this research project is to explore the development of a voice-activated traffic sign board identification system using convolutional neural networks (CNN). The audio instructions and traffic sign recognition feature of the system are meant to assist drivers. The CNN model is used to correctly classify traffic signs based on images captured by an onboard camera. The technology also includes a voice assistant that gives the driver real-time feedback. The system's effectiveness is evaluated through a number of studies, and the results indicate that the recommended approach may increase traffic safety.

Keywords

TSR (Traffic Sign Recognition), Driver Assistance Systems (DAS), Automated Driving, Convolutional Neural Networks (CNN), Pre-Processing Techniques, Image Classification

I. INTRODUCTION

Traffic accidents are a major contributor to deaths and injuries in the country. India's accident rate remains high even if conditions are improving in many other parts of the world. The number of road accidents in 2022 increased by 11.9 percent over 2021. Similarly, highway crashes increased the number of fatalities by 9.4% and injuries by 15.3%, respectively (Figure 1.1) (Ministry of Road Transport and Highways, 2022).

In the entire country, these figures translate to an average of 1,264 accidents and 462 fatalities every day, or 53 accidents and 19 fatalities every hour. According to the Ministry of Road Transport and Highways (2022), the country had an unprecedented decrease in accidents and fatalities in 2020–21 (Figure 1.1). This was mostly caused by the unusual Covid-19 pandemic outbreak and the rigorous nationwide lockdown that followed, particularly in March and April of 2020 before the containment restrictions were progressively lifted and discontinued.

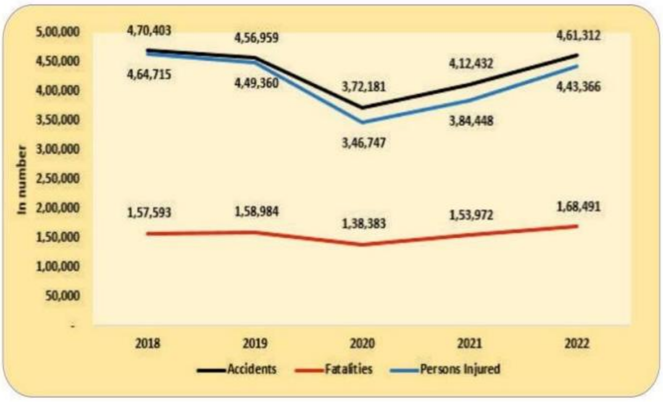

Figure 1.1. Trends in the quantity of collisions, fatalities, and injuries from 2018 to 2022

An accident is considered lethal if one or more persons die in it. From 1,42,163 in 2021 to 1,55,781 in 2022, the overall number of fatal traffic accidents increased by 9.6% as compared to the same period the previous year (Figure 1.2) (Ministry of Road Transport and Highways, 2022). 33.8 percent of all accidents in 2022 will be fatalities.

Traffic sign recognition is an integral part of a modern autonomous driving system. Accurate and efficient recognition of road signs can significantly improve road safety and reduce the frequency of accidents. Traditional road sign recognition techniques are based on manually generated features and machine learning algorithms. However, these techniques often falter in difficult and unpredictable real world situations.

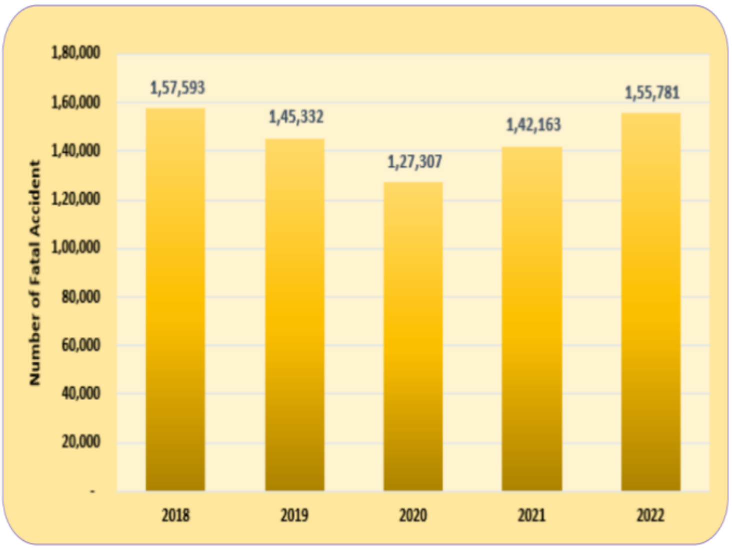

Figure 1.2. Development of the number of fatal accidents: 2018-2022.

One of the solutions suggested for Automated Driving (AD) and Driver Assistance Systems (DAS) is traffic sign recognition. However, due of variations in the surrounding environment, including shadows and lightning, this task is

not so simple for a computer to do. Sunny days are ideal for taking bright photos. There are two primary processes involved in identifying traffic symbols in an image: detection and classification.

During bright, wet days, the system's primary issue is accounting for numerous environmental changes. The Traffic Sign Recognition (TSR) technology encourages safe driving, maintains legal speed limits, and complies with traffic laws and instructions in addition to assisting in the decrease of traffic accidents.

Convolutional Neural Networks (CNNs) are an excellent choice for traffic sign identification because of their impressive performance in image recognition tasks. Deep learning models, such as CNNs, automatically extract hierarchical characteristics from unprocessed input data. Because of this, they are especially well-suited for applications like picture classification where the input data includes intricate spatial correlations.

The primary objective of this paper is to identify some of the trends and difficulties that researchers are currently facing. It then compares various approaches, reviews the ideas and tactics that have been looked into, and concludes with recommendations for more research in the areas of voice assisted systems and traffic sign board recognition using CNN in the hopes of developing a reliable system.

II. SIGN DATABASE

The traffic sign database is essentially a set of traffic signs that are arranged so that a computer program may rapidly choose necessary data points. The signs have accessible size and currency. All different kinds of traffic signs are included in a comprehensive traffic sign database, which aids users in becoming familiar with them all. The following are a few well-known and openly accessible traffic sign datasets:

- Swedish Traffic Signs Data set (STS Data set) [26],
- German TSR Benchmark (GTSRB) [27], [28];
- KUL Belgium Traffic Signs Data set (KUL Data set) [29];
- RUG Traffic Sign Image Database (RUG Data set) [30];
- Stereopolis Database [31].

III. CURRENT TRENDS AND CHALLENGES

A. CURRENT TRENDS

Several image classification approaches allow traffic signs to be classified into distinct k-sets. To make the driver's job easier and prevent numerous The technique of recognizing traffic signs is used in incidents that occur nationwide. Different researchers use different strategies to accomplish image recognition.

· **Pre-Processing Techniques:** Numerous research indicate that efficient and successful image pre processing methods should be used in order to improve TSR system performance [7,13,15,16-17]. Pre-processing is the process of modifying an input image to minimize noise, improve edges, and boost contrast to facilitate edge detection. The most popular preprocessing methods include the use of filters. In order to minimize noise and smooth the image, the Wiener filter or You can apply an averaging filter [15, 17].

· **Convolution Neural Network:** In several applications for recognizing traffic signs on roads, CNN is utilized as an image recognition technique. Within (H. Luo) et al., 2016) system is divided into three primary stages. Regions of Interest for traffic signs, followed by post-processing and ROI classification and refinement.

· **Traffic Sign Recognition:** In earlier research, HOG characteristics were combined with an SVM classifier. (Y. Jiang et al., 2011), (I. M. Creusen et al., 2010), MLP (Multi-Layer Perceptron) with radial features (S. Yin et al., 2015), and ANN (Artificial Neural Network) combined with RIBP (Rotation Invariant Binary Pattern).

· **Ho Gi Jung, Avinash N., DevDuttYadav, Monica Singh, and 2009**: This suggested TSR algorithm can identify any traffic sign during daytime hours only. It is also a good speed controller.[1]

· **Changa, Paru D. Sindha, Ph.D. Scholar, and Dr. Dipti M. Shah**: "TSR using Translation of Images," IJARCSSE, 2014: It suggested there isn't an suitable technique that provides 100% accuracy. In order to classify the indications, this approach compares the photos with earlier ones. [2]

· **Traffic Sign Recognition for Intelligent DAS, URAI 2007: This** suggested TSR using neural network approaches, Auranuch Lorsakul1 and Jackrit Suthakorn. In first, a variety of pre processing methods, including the Gaussian filter, are applied to the pictures. The precision is only seen in photographs with intricate backgrounds [12].

· **Karla Brkic:** "A summary of techniques for detecting traffic signs," 2011: The techniques for detection are based on color, shape, and learning. It states that if every When a car includes a color camera with high resolution, a GPS receiver, an odometer, and other features, the difficulty of recognizing traffic signs is lessened.[18]

B. CHALLENGES

Safe driving requires the use of traffic signs. Without them, there would be far more catastrophic accidents since there would be no order, direction, or hazard alerts provided by traffic signs. Nevertheless, creating an effective TSR system is challenging since it needs to be trained to identify traffic signs that are partially obscured by objects, in poor condition from neglect, and in low visibility from severe weather. Anomalies in traffic signs have been demonstrated to be significant causes and obstacles for TSR systems.[3]

Nowadays, Intelligent Autonomous Vehicles together with Advanced Driver Assistance Systems (ADAS) deal with the problem of traffic sign recognition. It is a challenging real world computer vision problem due to the different and complex scenarios they are placed into it . The proposed system will help understand the problem and provide a systematic way of approaching the problem
For autonomous driving systems, classifying traffic signs is a critical problem because it affects everyone's safety, including the passenger. Traffic signs differ visually depending on the nation, which makes it more difficult for classification systems to work.

· **Variability in Traffic Sign Appearance:** There is a lot of variation in traffic signs' appearance, lighting, occlusions, and weather. It is still difficult to develop models that are resistant to these fluctuations.

· **Multiple sign appearances:** When multiple traffic signs appear at once and have a similar shape, a man- made object may overlap the signs, which could result in a false. Additional factors that may impact the detecting process include rotation, translation, scaling, and partial occlusion. In [4], Li et al. employed the HSI transform and a fuzzy shape recognizer, both of which are reliable and resistant to these issues. Its accuracy rate in various weather conditions is 94.66% in sunny conditions, 92.05% in cloudy conditions, and 90.72% in rainy conditions.

· **Impact on vision:** In a real-time application, visibility may be impacted by shadows and light from approaching cars' headlights. Moreover, visibility may be impacted by snow, fog, clouds, and rain. · **Image Quality-Related Issues:** Another issue facing TSR systems is the quality of the photos that are taken by the cameras. Motion blur in recorded pictures and video was noted as a significant obstacle to traffic sign identification in [9–10, 11]. Sharp edges in the recorded frame get softer due to motion blur. TSR systems find it challenging to recognize and categorize traffic indicators as a result.

· **Damaged and partially hidden sign:** If the system has a Recognizer of shapes. It lowers system efficiency and raises the false detection rate. The Soheilian et al. [5] 3D reconstruction algorithm can identify the damaged sign in a real-time setting.

· **Glory Reuben Maxwell et al**: This suggested a method for identifying traffic signs in 2020 [6]. The difficulties that influence the process of identifying and detecting traffic indicators have been emphasized by the author. The weather, color standards, obstacles, disorientation, motion blur and interlacing effects, variable lighting conditions, fading and blurring are some of these issues. impact, Visibility Affected, Motion Artifacts, and Public Database Not Available.

IV. COMPARATIVE ANALYSIS

The primary elements influencing the creation of an efficient TSDR system are those previously mentioned. Combining many techniques can enhance the system's effectiveness.

Various researchers utilize different combinations of machine learning methods that can solve many system- related challenges, such as the use of probabilistic neural networks by Escalera et al. [7] and

Sheng et al. [8], which are able to identify and recognize traffic signs in a variety of lighting conditions and with slightly distorted, noisy, or blurry backgrounds.

Support Vector Machine (SVM) is an additional well-liked technique for TSDR system development. SVM is used by Gil-Jimenez et al. [19] and Prisacariu et al. [20] to identify signage indicating the speed limit. Gil-Jimenez et al. [19] retrieved 134 blob pictures with a 90% success rate from an image database using SVM with a Gaussian Kernel to find and recognize speed limit signs.

When creating a successful TSDR system, all of the above mentioned concerns have to be taken into account. The researcher's preferred techniques have a variety of disadvantages, that lower the system's efficiency. The primary disadvantage of the Hough Transform, which is used by Greenhalgh et al. [21], is its reliance on input data and lengthy processing time.

Additionally, the assessment looks at how well voice-assisted traffic sign recognition systems work in a variety of settings, including bad weather, dim lighting, and intricate urban settings. In order to improve system flexibility and reliability, researchers have developed strong feature extraction methods, integrated multimodal sensor fusion techniques, and used cutting-edge machine learning models.

The poll also addresses the usability and user experience aspects of voice-assisted systems, emphasizing how crucial it is to create user-friendly interfaces and maximize speech recognition accuracy in order to guarantee smooth communication between drivers and the system. Studies on human factors have also looked into drivers' acceptance of and trust in voice-assisted technologies, which has helped to identify both opportunities and potential roadblocks to their wider adoption in practical driving situations.

On the other hand, voice assistance adds a new level of complexity to conventional visual recognition systems by giving drivers audio feedback, which improves situational awareness and lowers cognitive strain. Various methods of incorporating voice assistance have been investigated in this field of study. These methods include the use of natural language processing (NLP) techniques to interpret commands from drivers and provide speech output that sounds human.

This comparative analysis concludes by highlighting the various research initiatives working to improve voice-assisted traffic sign recognition systems and providing insights into the state-of-the-art approaches, technological obstacles, and future research directions in this quickly developing field.

Table 4.1. Comparative Analysis

Ref.	**Methods**	**Changing Lighting**	**Fading And Becoming Blurry**	**Multiple Instances Of The Symbol**	**Broken Sign**	**Sign Partially Concealed**	**Fast Algorithm for Real Time**	**Scaling, Translation, and Rotation**	**Noisy Background**	**Viewing Angle**
[8]	probabilistic neural network with adaptive shapeanalysis	Yes					yes		yes	

[22]	Orientation Gradient plus Karhunen Loeve change	Yes	yes	yes					yes	yes
[23]	YCbCr + Normalization of Image + NN	Yes	yes				yes		yes	
[5]	3D reconstruction technique				yes	yes	yes			
[24]	CIE XYZ transform in the FOSTS + LCH spacing model	Yes	yes	yes					yes	
[25]	SVM + SIFT matching	Yes							yes	
[7]	Genetic Algorithm + Probabilistic NN	Yes	yes				yes		yes	
[14]	Joint Transform Correlation + Gabor Filter			yes		yes		yes		yes

V. PROPOSED SYSTEM

A thorough summary of the state-of-the-art in traffic sign recognition systems is provided by the study done on the Traffic Sign Board Recognition and Voice Assisted System (TSBVAS) utilizing a Convolutional Neural Network (CNN). The research looks at a number of TSBVAS topics, such as the performance measures assessed, the CNN architectures utilized, and the datasets used. The analysis of previous studies emphasizes the difficulties encountered in real-world situations, including low resolution photos, obstruction, and weather.

Furthermore, a comparative study of several CNN models and architectures offers important insights into the advantages and disadvantages of each strategy. By combining voice-assisted driver feedback with a CNN-based TSBVAS architecture, the suggested solution expands on this study. By identifying traffic signs and giving drivers real-time directions, the technology seeks to improve road safety. The CNN model and voice-assisted feedback mechanism are designed and assessed using the analysis as a basis for the proposed approach.

A flowchart that depicts the essential phases of the TSBVAS, from the input video to the last voice assisted message sent to the driver, is also included in the study.

The reader's comprehension of the TSBVAS design is improved by this flowchart, which offers a visual depiction of the elements and operations of the suggested system.

All things considered, the analysis establishes the foundation for future study and advancement in this field and offers a thorough grasp of the state-of-the-art in TSBVAS.

In addition to traffic sign identification, the suggested approach may find use in autonomous cars and smart city infrastructure. The technology may also be combined with other smart city technologies to offer a complete traffic management and road safety solution.

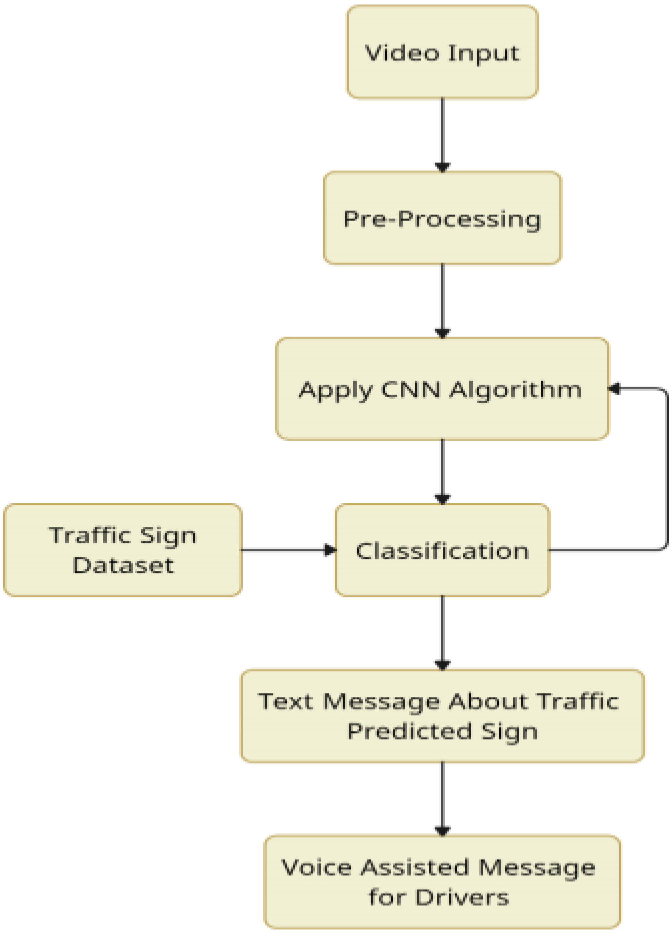

Figure 5.1 Flowchart of the process

VI. Conclusion

Finally, the Road Sign Recognition and Voice Assistance System (TSBVAS) offers a viable approach to improve driver awareness and road safety. The system uses convolutional neural networks (CNN) to accurately recognize traffic signs and provide real-time instructions to the driver. Through a thorough survey of the existing literature, we obtained important information about the obstacles and prospects in this field. The evaluated CNN architectures, datasets and performance metrics provided a strong foundation for the proposed system.Combining driver voice feedback with a CNN-based traffic sign recognition algorithm, the proposed TSBVAS extends this work. By eliminating the shortcomings of current systems, this new method aims to provide a more practical and user-friendly alternative.

Based on the comprehensive survey analysis and the proposed system, several conclusions can be drawn for future research and development activities in this field. First, studies have shown the importance of using high-quality data sets and evaluating performance metrics to ensure the accuracy and reliability of CNN models. Second, the proposed system shows how different technologies, such as computer vision and natural language processing, can be integrated to create more complex and interactive systems.The proposed approach also has real consequences for improving traffic safety and reducing the number of accidents. The technology helps reduce traffic congestion and prevent accidents by providing real-time feedback to drivers. The voice lab suggestion function also improves the usability of the system for a larger group of users, such as people with poor reading skills or visually impaired people.

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AUTHERS

Richa Saxena received her M.Tech degree in Computer Science & Engineering in 2013 from TMU She is currently persuing PhD and She is currently an Assistant Professor in CSE Department at MIT with 17 years of professional experience. She has wide expertise in Cloud Computing with a strong background in Networking, Ethical Hacking, Python, IOT, and has completed several FDP's along with STC’s from NITTTR, Chandigarh.

Prateek Singh is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr. A.P.J Abdul Kalam Technical University his research interest including Machine Learning, Artificial Intelligence and Natural Processing Language, Python and SQL.

Ishita Gupta is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr APJ Abdul Kalam Technical University her research interest including HTML, CSS, Javascript, and React and SQL.

Ajhar Ali is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr APJ Abdul Kalam Technical Universityher research interest including HTML, CSS, Javascript, and React and Python, Machine Learning, Artificial Inteligence.

Dikshant Kumar is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr APJ Abdul Kalam Technical University her research interest including Machine Learning, Artificial Intelligence and Natural Processing Language, Python and SQL.

Vaibhav Yadav is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr APJ Abdul Kalam Technical University her research interest including Cyber Security, Networking, CCNA, Web Development.