

# Voice Assistant Traffic Sign Recognition Using Cnn

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**Abstract**—This paper centers on developing a software-based recognition module that integrates with a vehicle’s onboard camera system. using openCV, the system preprocesses images through resizing, color normalization, and edge detection. A Convolutional Neural Network (CNN), trained with TensorFlow, Keras & Image Data Generator, enhances classification accuracy by augmenting and preprocessing traffic sign datasets. Once a traffic sign is identified, real-time voice feedback is provided using text-to-speech conversion, allowing drivers to receive alerts without distractions. The backend, built with Django, manages the entire pipeline, ensuring seamless processing, model execution, and user interaction. The results show that the system accurately recognizes traffic signs even in different lighting and weather conditions and it correctly identifies and announces the traffic sign in real-time. By combining CNN-based image recognition with voice feedback, this system greatly improves driver assistance, making driving safer.

**Index Terms**—Traffic Sign Recognition, Convolutional Neural Networks (CNN), Image Data Generator, OpenCV, Deep Learning, Real-Time Detection, Voice Assistance, Computer Vision, Machine Learning, Django, TensorFlow, Keras, Driver Assistance, Road Safety.

## I. INTRODUCTION

Traffic signs are essential for road safety, guiding drivers, and preventing accidents. However, poor visibility, distractions, and varying weather conditions can cause drivers to miss critical signs. So, we are proposing a software-based traffic sign recognition module that integrates with a vehicle’s onboard camera system. Using Convolutional Neural Networks (CNN), the system processes images in real time, classifies traffic signs, and provides voice-assisted alerts to enhance driver awareness without additional hardware modifications.

The system employs OpenCV for image preprocessing, including resizing, color normalization, and edge detection, ensuring optimal input for classification. A CNN model

trained with TensorFlow and Keras, utilizing an Image Data Generator, enhances accuracy by improving dataset variability. Upon identifying a traffic sign, the system provides real-time voice feedback through text-to-speech conversion, ensuring drivers receive alerts without distractions. The Django backend efficiently manages image input, model execution, and user interaction. By combining computer vision, deep learning, and voice assistance, this system offers a lightweight, scalable, and hardware-independent solution for real-time traffic sign recognition, improving road safety and driver assistance.

Figure 1

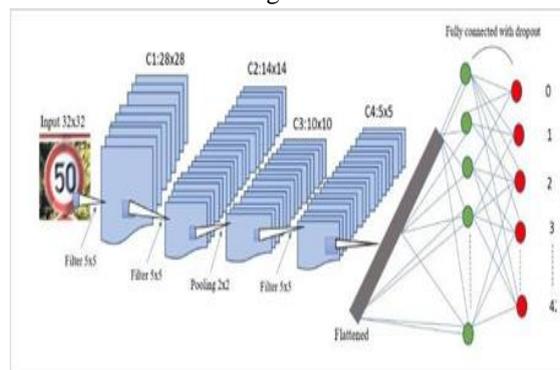
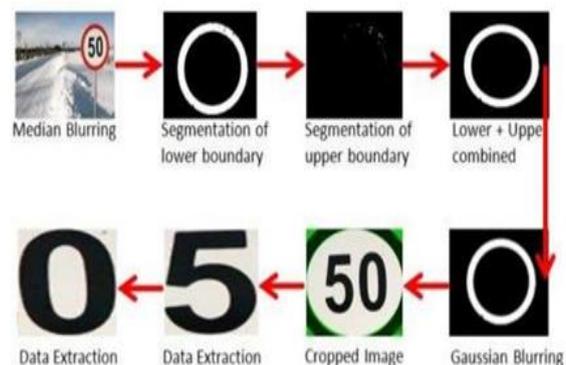


Figure 2



Convolutional Neural Networks (CNNs) recognize images by extracting important features through multiple layers. First, the input image undergoes preprocessing, such as blurring and segmentation, to enhance relevant details. The CNN then

processes the image through convolutional layers, where filters detect patterns like edges, shapes, and textures. Pooling layers reduce the spatial size, making the model more efficient while preserving essential features. After multiple convolution and pooling steps, the extracted features are flattened and passed through fully connected layers, where the network learns to associate patterns with specific traffic signs. Finally, the model classifies the image into a predefined category and provides real-time voice feedback to the driver for enhanced road safety.

## II. LITERATURE SURVEY

1. This Study talks about a convolutional neural network-based traffic sign recognition system with voice alerts that enhances road safety by providing real-time sign detection and auditory feedback. The system follows a modular approach, including data collection, preprocessing, model training, recognition, and voice alerts. A deep learning model, trained on a comprehensive dataset, ensures accurate classification of traffic signs while maintaining computational efficiency. Experimental results demonstrate high reliability across various conditions, highlighting its potential to improve traffic management and reduce accidents. This integration of CNN-based recognition with voice assistance offers a practical solution for driver support systems.

2. This Study talks about Traffic Sign Board Recognition and Voice Alert Systems uses a CNN-based approach to identify traffic signs and provide real-time voice alerts to drivers. Trained on the German Traffic Sign Benchmarks Dataset with 43 categories and 51,900 images, the system achieves an accuracy of 98.52%. Upon detecting a traffic sign, a voice alert is issued to inform the driver, helping them make timely decisions. Additionally, the system provides alerts about nearby traffic signs to enhance road awareness. This solution aims to improve road safety by reducing human errors in traffic sign interpretation.

3. This Study talks about Traffic Sign Detection Using Convolutional Neural Network system leverages synthesized training data to address variations in traffic sign databases across different countries and regions. By generating a dataset that includes traffic signs under diverse

lighting and viewing conditions, the system enhances detection accuracy. A well-trained CNN model ensures high performance in both training and real-time recognition,

allowing drivers to focus on the road rather than manually observing signs. The proposed approach incorporates neural networks and feature extraction techniques to overcome existing limitations, improving efficiency in traffic sign detection and contributing to road safety in India.

4. This Study talks about a Voice-Based Traffic Sign Recognition Using a Deep Learning system enhances road safety by providing real-time audio cues for traffic signs, reducing driver distraction, and improving awareness. It processes traffic sign data and utilizes deep learning techniques for training and classification, ensuring accurate recognition under varying environmental conditions. This approach serves as an alternative or supplementary method to visual detection, particularly beneficial in cases of visual impairments or distractions. The system's effectiveness is evaluated based on accuracy, speed, and robustness, demonstrating its potential in intelligent transportation systems to improve compliance with traffic regulations.

5. This Study talks about a CNN-Powered Traffic Sign Detection and Voice Alerting **Solution** that utilizes deep learning and image processing techniques to enhance road safety by accurately detecting traffic signs. The system employs a Convolutional Neural Network (CNN) to process and classify traffic signs, helping drivers adhere to regulations and reduce accidents caused by negligence. By integrating intelligent recognition with a voice alerting mechanism, this approach ensures real-time assistance, making driving safer and more efficient. This solution plays a vital role in intelligent transportation systems by improving driver awareness and road rule compliance.

6. This Study talks about Traffic sign classification using Convolutional Neural Networks and explores the application of deep learning in traffic sign recognition, crucial for autonomous vehicles. The study highlights how Convolutional Neural Networks (CNNs) effectively extract features from traffic sign images and classify them into distinct categories. CNN-based models outperform traditional machine learning

techniques, enhancing accuracy and reliability in recognizing road signs. By simulating the human visual cortex, CNNs enable real-time classification, contributing to safer and more efficient intelligent transportation systems.

### III. EXISTING WORK

Existing traffic sign recognition systems predominantly utilize deep learning techniques, particularly Convolutional Neural Networks (CNNs), for accurate classification. This model is trained on a large dataset, such as the German Traffic Sign Benchmark (GTSB), to ensure high recognition accuracy. The process generally involves capturing images through vehicle-mounted cameras, applying preprocessing techniques like resizing, normalization, and edge detection, and then classifying signs using a trained CNN model. Some systems also integrate voice alerts, enhancing driver awareness by providing real-time notifications without requiring visual attention.

Certain approaches incorporate data augmentation techniques, such as synthesized image generation, to improve performance under different lighting and environmental conditions. Feature extraction methods have significantly improved recognition accuracy compared to traditional machine learning algorithms. Some research also explores voice-based recognition, offering an alternative for situations where visual detection may be impaired. Overall, these systems contribute to intelligent transportation by enhancing road safety and aiding both human and autonomous driving.

### IV. DISADVANTAGES

- **Dataset Dependency:** Most models are trained on specific datasets like GTSB, which may not generalize well to different countries, traffic conditions, and regional variations in road signs.
- **Environmental Challenges:** Poor lighting, adverse weather conditions, motion blur, and occlusions can reduce recognition accuracy.
- **High Computational Requirements:** Deep learning models demand significant processing power, making real-time execution difficult on embedded systems with limited hardware resources.
- **Limited Adaptability:** Many models require

retraining when deployed in new regions with different road signs, making them less flexible.

- **Noise Sensitivity in Voice-Based Systems:** Audio alerts may not be effective in noisy environments, reducing the efficiency of voice-assisted recognition methods.
- **Lack of Multi-Modal Integration:** Most approaches rely solely on image-based recognition, whereas integrating additional sensory inputs (such as LiDAR or radar) could enhance reliability.
- **Real-Time Performance Constraints:** While models achieve high accuracy in controlled environments, real-time deployment on moving vehicles remains challenging due to processing delays.

### V. PROPOSED SYSTEM

The Voice Assistant Traffic Sign Recognition using CNN is designed to improve road safety by automating traffic sign recognition and providing real-time voice alerts to drivers. The system processes images captured by a vehicle's camera, classifies traffic signs using deep learning techniques, and conveys the recognized sign information through voice assistance.

#### A. Key Components of the Proposed System

- **Data Preprocessing and Augmentation**  
The system utilizes the German Traffic Sign Recognition Benchmark (GTSRB) dataset and also an optional custom dataset for local traffic signs. Preprocessing steps include resizing, normalization, and color filtering to enhance image quality. Data augmentation using Keras and TensorFlow applies transformations like rotation, flipping, scaling, and brightness adjustment to improve model generalization.

- **Traffic Sign Recognition Using CNN**  
A Convolutional Neural Network (CNN) is trained to classify traffic signs automatically, extracting meaningful features from images without requiring manual feature engineering.

The model uses tensor flow and keras, optimizing accuracy through transfer learning and fine-tuning techniques.

Image Data Generator helps adjust brightness, contrast, and augmentation for color and shape-based detection.

- **Real-Time Voice Assistance**

The system integrates a Text-to-Speech (TTS) library (Pyttsx3) to generate real-time voice alerts. This feature ensures that drivers receive hands-free notifications, improving response time and awareness.

- **Efficient Backend and Deployment**  
Implemented using the Django framework, allowing seamless communication between the CNN model and the voice assistant. Python is used for development due to its compatibility with deep learning libraries and faster deployment.
- **Robust Environmental Adaptability**  
Advanced image processing techniques improve system performance in varying lighting and weather conditions. The model is trained to recognize signs even under poor visibility, occlusions, and background clutter.

#### VI. ADVANTAGES

- **Higher Accuracy:** Achieves 95%+ accuracy by incorporating transfer learning and fine-tuning CNN models, improving classification performance.
- **Optimized Frameworks and Languages:** Uses TensorFlow, Keras, and Python, ensuring faster training, debugging, and deployment compared to traditional machine learning models.
- **Real-Time Voice Assistance:** Unlike existing systems that focus solely on visual recognition, this project provides audio alerts for enhanced driver awareness, particularly benefiting visually impaired users.
- **Better Data Handling:** Implements NumPy and Image Data Generator, optimizing preprocessing, augmentation, and dataset variability for improved robustness.
- **Environmental Adaptability:** Enhanced image processing techniques allow the system to function effectively under diverse conditions like poor lighting, weather changes, and motion blur, which many existing models struggle with.
- **Efficient System Deployment:** Uses Django as a backend framework, ensuring smooth integration and real-time processing of traffic sign recognition and voice output.
- **Scalable & Hardware-Independent:** Can be integrated with vehicle cameras without

requiring additional hardware, making it cost-effective and scalable for real-world applications.

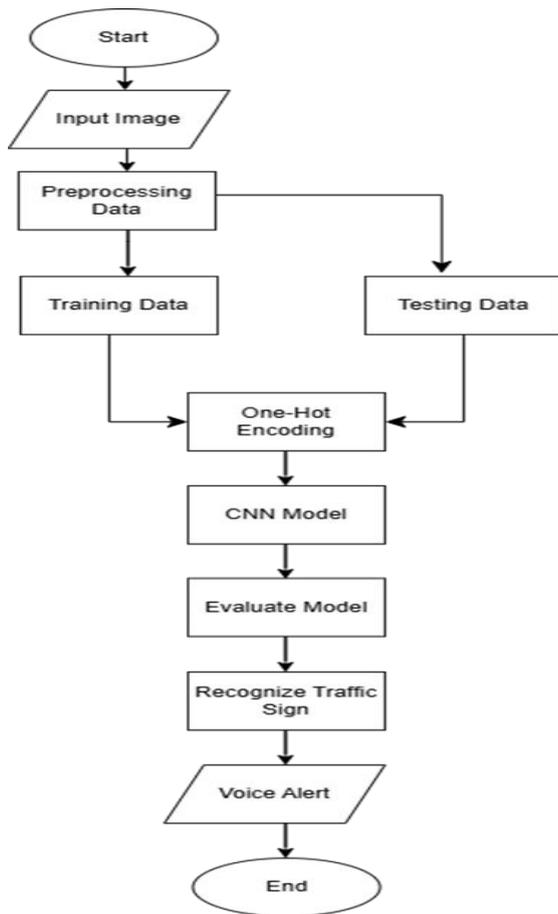
#### VII. DESIGN METHODOLOGY

The proposed voice assistant traffic sign recognition system is designed using a deep learning approach that combines computer vision, machine learning, and voice assistance. The process begins with capturing an image of a traffic sign using a camera. This image undergoes preprocessing, where it is resized, noise is reduced, and its pixel values are normalized to ensure consistency. Additionally, data augmentation techniques may be applied to enhance model generalization. Once the images are preprocessed, they are divided into training and testing datasets. The training data helps the model learn, while the testing data evaluates its performance on unseen images.

A Convolutional Neural Network (CNN) is the core of this system, as it is highly effective in recognizing patterns and features in images. The labels for different traffic signs are converted into a format known as one-hot encoding, making them suitable for neural network processing. The CNN model is then trained using the prepared dataset, where it learns to identify traffic signs based on distinctive visual features. After training, the model's accuracy and loss are analyzed to assess its performance.

Once the model is trained and fine-tuned, it is deployed for real-time traffic sign recognition. When a new image is provided, the model predicts the traffic sign's class based on what it has learned. To enhance driver safety, the system is integrated with a voice alert mechanism. Upon recognizing a traffic sign, the system provides an auditory notification to inform the driver about the sign's meaning, such as "Speed Limit 50" or "Stop Ahead." This feature ensures that drivers receive immediate and clear warnings, reducing the chances of missing important traffic signs.

VIII. FLOWCHART



IX. RESULT

Figure 3

```

global dataset

def loaddataset(request):
    global dataset
    dataset = "dataset"
    context = [{"id": "Traffic Sign Dataset loaded successfully..."}]
    return render(request, "admin/signs/dataset.html", context)

global training_set, test_set

def imagegenerate(request):
    global training_set, test_set
    train_datagen = ImageDataGenerator(rotation_range=30, zoom_range=0.1, horizontal_flip=True)
    test_datagen = ImageDataGenerator()
    training_set = train_datagen.flow_from_directory(dataset,
                                                    target_size=(64, 64),
                                                    batch_size=32,
                                                    save_format='png',
                                                    class_mode='categorical',
                                                    shuffle=True)
    test_set = test_datagen.flow_from_directory(dataset,
                                                target_size=(64, 64),
                                                batch_size=32,
                                                save_format='png',
                                                class_mode='categorical',
                                                shuffle=False)
  
```

Figure 4



Figure 5



Traffic Sign Recognized As : Dangerous curve right

The traffic sign recognition system successfully processes images from a dataset and classifies them using deep learning. Due to preprocessing, the images are enhanced for better accuracy, and the dataset is split into training and testing sets to ensure effective learning. A Convolutional Neural Network (CNN) is trained to recognize traffic signs by extracting key visual features, and its performance is evaluated to fine-tune the model for improved accuracy.

X. CONCLUSION

The proposed Voice Assistant Traffic Sign Recognition System successfully integrates deep learning, computer vision, and voice assistance to enhance road safety. By leveraging Convolutional Neural Networks (CNNs), the system efficiently detects and classifies traffic signs from images, ensuring high accuracy and real-time performance. The OpenCV used for preprocessing, TensorFlow and Keras for model training, and Pyttsx3 for voice alerts make the system robust, scalable, and hardware-independent.

REFERENCES

- [1] Shustanov, P. Yakimov, "CNN Design for Real-Time Traffic Sign Recognition," 3rd International Conference "Information Technology and Nanotechnology," ITNT-2017, 25-27 April 2017, Samara, Russia.
- [2] R. Biswas, H. Fleyeh, M. Mostakim, "Detection and Classification of Speed Limit Traffic Signs," IEEE World Congress on Computer Applications and Information System, pp. 1-6, January 2014.
- [3] Zhong LIU, Weihai CHEN, Yuhua ZOU and Cun HU "Regions of Interest Extraction Based on HSV Color Space," IEEE 10th International Conference on Industrial Informatics, July 2012.
- [4] Dept. Transp., London, U.K., Traffic Signs

Image Database, 2020

- [5] Jack Greenhalgh and Majid Mirmehdi “Real-Time Detection and Recognition of Road Traffic Signs,” Ieee Transactions on Intelligent Transportation Systems, Vol. 13, No. 4, December 2019.
- [6] Jung-Guk Park, Kyung-Joong Kim “A Method for Feature Extraction of Traffic Sign Detection and The System for Real World Scene,” Ieee International Conference on Emerging Signal Processing Applications, 12-14 Jan.2021.
- [7] Sungho Kim and Soon Kwon “Improvement of traffic sign recognition by accurate ROI refinement,” 15th International Conference on Control, Automation and Systems (ICCAS 2015) Oct. 13-16, 2020 in BEXCO.