# TRAFFIC MANAGEMENT SYSTEM

## TEAM MEMBERS


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# 1. ABSTRACT

The objective of the project is to develop and implement an intelligent system that utilizes artificial intelligence (AI) to recognize and interpret traffic signs accurately. The project aims to enhance road safety and improve driver assistance by leveraging advanced computer vision techniques and machine learning algorithms.

The proposed traffic management methodologies encompass the development of a real-time traffic sign detection system using computer vision algorithms and the enhancement of vehicle detection, specifically targeting emergency vehicles. The traffic sign detection aims to improve driver awareness and automate responses to signs, influencing traffic signal control and speed limit enforcement. On the other hand, the vehicle and emergency vehicle detection system seek to optimize traffic flow, reduce congestion, and prioritize emergency vehicles through adaptive traffic signal adjustments.

# 2. INTRODUCTION

## 2.1 INTRODUCTION

The Smart Traffic Management System using Machine Learning aims to revolutionize urban traffic control by leveraging advanced algorithms and realtime data analysis. The system integrates predictive modelling, anomaly detection, and optimized traffic light control to enhance overall traffic flow and responsiveness.

Traditional approaches have been developed by training on a restricted set of classes, possibly a smaller subset of traffic signs. In contrast, the described model stands out for its training on a more diverse dataset, encompassing 42 different classes of traffic signs. This diversity likely includes a broader range of sign types, allowing the model to better generalize and recognize a more extensive array of traffic signs in real-world scenarios.

Moreover, the training under various weather conditions and with blurred images indicates that the model has been exposed to a wide range of environmental challenges. This approach is beneficial for enhancing the model's robustness and adaptability, as it learns to identify traffic signs under different lighting, weather, and image quality conditions.

The project also incorporates dynamic route planning, utilizing real-time traffic information to suggest optimal routes for drivers. Supported by computer vision algorithms, enhances the system's ability to monitor and respond to traffic events, such as accidents or congestion.

## 2.2 OBJECTIVE OF THE PROJECT

The objective of the project is to develop an advanced system capable of recognizing, interpreting traffic signals and detecting emergency vehicles. By harnessing cutting-edge technology such as computer vision and machine learning algorithms, the aim is to enhance road safety and traffic management.

## 2.3 SCOPE OF THE PROJECT

The scope of the project encompasses the development and implementation of a comprehensive system for recognizing traffic signals and detecting emergency vehicles. This includes the design and integration of sophisticated machine learning algorithms capable of accurately identifying various types of traffic signals, such as stop signs, traffic lights, and yield signs, under diverse environmental conditions. Additionally, the system will be engineered to detect emergency vehicles, such as ambulances, fire trucks, and police cars, using machine learning techniques. The project will involve the collection and annotation of large datasets for training and testing these algorithms, as well as the deployment of the system in real-world settings for validation and performance evaluation.

# 3. Literature Survey

1.1 Traffic Management using Machine Learning Author: Ritu [1] Department of Computing Bournemouth University Poole United Kingdom

YEAR OF PUBLICATION: 2022

This study focused on applying machine learning algorithms, particularly YOLO, to traffic management, emphasizing prediction, data detection, and system efficiency. The study advocates for intelligent transport systems using machine learning for improved traffic data management and congestion handling, referencing related works in the field.

1.2 Traffic Management System using Machine Learning Algorithm Authors: A. Ravi,R. Nandhini, K. Bhuvaneshwari, J. Divya, K. Janani Professor [2], Department of EEE, A.V.C College of Engineering, Mannam pandal, Mayiladuthurai

YEAR OF PUBLICATION: 2021

Ravi, R. Nandhini, K. Bhuvaneshwari, J. Divya, and K. Janani proposed a "Machine Learning-based Traffic Management System". Their system aims to minimize traffic congestion and its negative effects by leveraging machine learning algorithms like YOLO and Convolutional Neural Networks.

1.3 MACHINE LEARNING-BASED INTELLIGENT TRAFFIC SYSTEM

Authors: Karishama Bisen, Rohini Shahare, Karishma Wasnik, Prof. P. Jaipurka[3] Department of Computer Engineering, SRPCE, College of Engineering, Nagpur, Maharashtra, India.

YEAR OF PUBLICATION: 2023

This study emphasises integrating Intelligent Transportation Systems (ITS) with IoT, cloud computing, and machine learning for improved traffic management and emergency services. It demonstrates the efficacy of real-time data analytics and machine learning, including YOLO and AlexNet, in enhancing traffic flow optimization and emergency response, emphasizing road safety in smart traffic systems.

# 4. PROPOSED METHODOLOGY

## 4.1 DATASET DESCRIPTION:

The dataset used for traffic sign recognition consists of a comprehensive collection of images representing 42 classes of traffic signs commonly encountered on roads. This dataset encompasses a diverse range of traffic signs, including regulatory signs, warning signs, and informational signs, to ensure broad coverage of real-world scenarios. To enhance the robustness and reliability of the trained models, the dataset includes images captured under various challenging conditions, such as blur and fog. These adverse conditions mimic the environmental factors that may affect the visibility of traffic signs in real-world settings, thereby enabling the developed algorithms to effectively handle and recognize signs in less-than-ideal circumstances. Additionally, the dataset is carefully curated and annotated to provide accurate labels for each traffic sign image, facilitating the training and evaluation of machine learning models. By incorporating images with different levels of blur and fog, the dataset enables the development of more resilient and adaptable traffic sign recognition systems capable of performing effectively in diverse weather and visibility conditions.

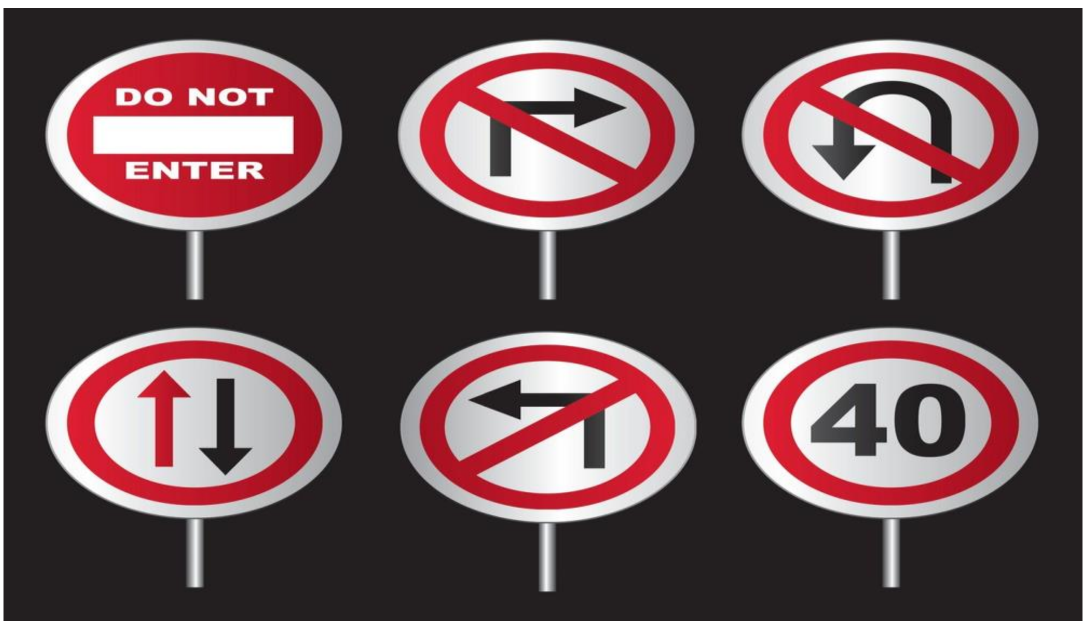
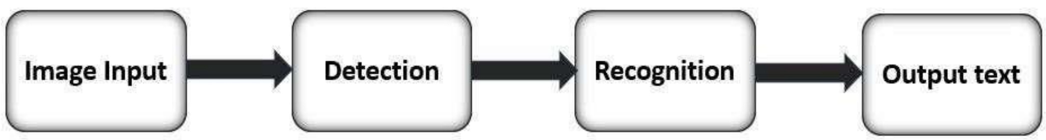



Figure 3.1: Example of traffic sign images as input

Our Proposed Methodology is categorized into two modules:

**1.Traffic Sign Recognition Module:**

The Traffic Sign Recognition (TSR) module is an integral component of intelligent transportation systems designed to enhance road safety and driver assistance. Leveraging advanced computer vision techniques, this module employs Convolutional Neural Networks (CNNs) to accurately detect and classify traffic signs present in a vehicle's field of view. Traditional methods focused on handcrafted features, but the advent of deep learning has significantly improved recognition accuracy.




The TSR module preprocesses input images, extracts relevant features, and applies a trained CNN model to classify and interpret various traffic signs. Realtime processing capabilities enable timely responses to changing traffic conditions, providing critical information to the driver about speed limits, warnings, and regulatory instructions. This module is fundamental for enhancing driver awareness and supporting advanced driver assistance systems.

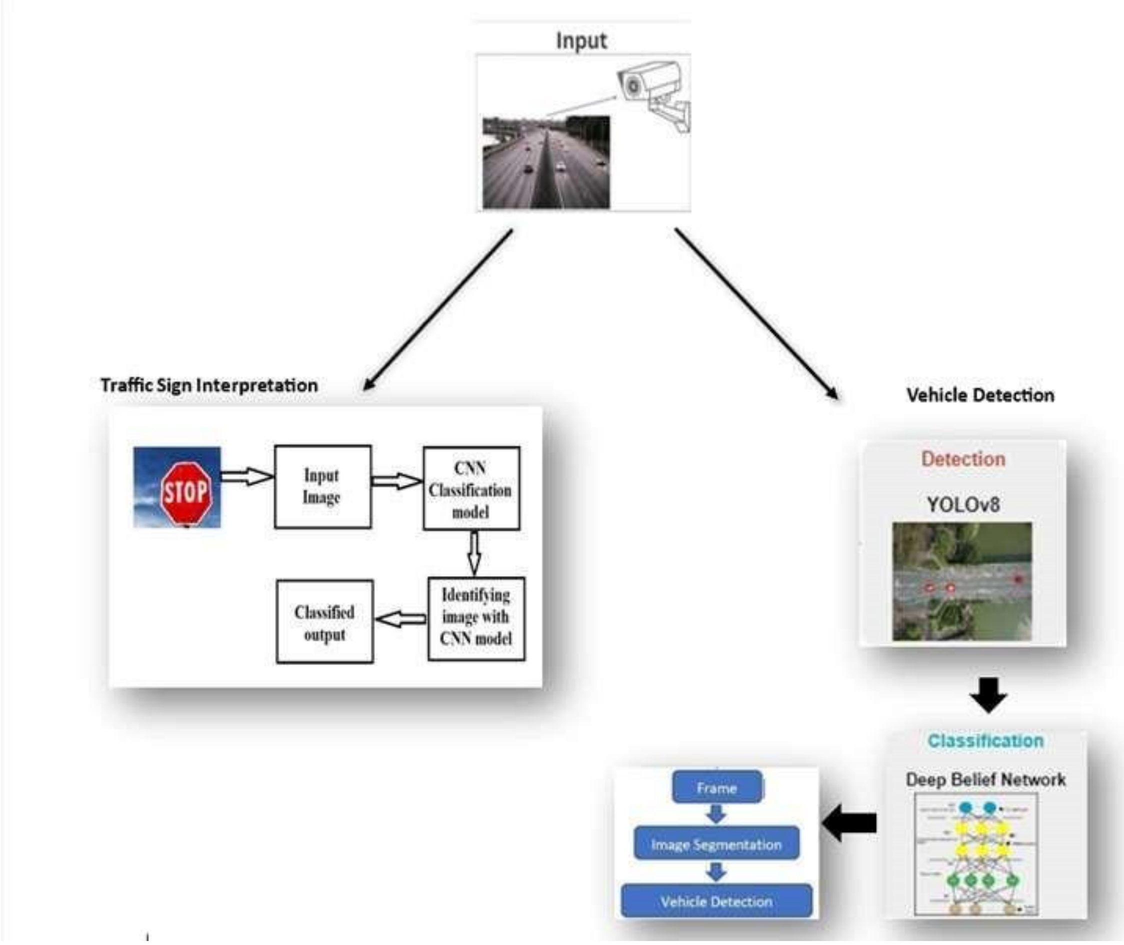
This project develops a robust computer vision algorithm to detect and locate traffic signs in real-time and utilize image processing techniques to preprocess input images and extract relevant features for detection.

**2.Vehicle Detection Module:**

This system will detect ambulance in the traffic along with other vehicles and make the traffic clear for emergency vehicle preemption. This system can contribute significantly to traffic management systems by improving emergency vehicle response times, reducing traffic congestion, and enhancing overall road safety.

The Ambulance Detection module is a key component in intelligent transportation and emergency response systems, aiming to swiftly identify and prioritize ambulances on roadways. Utilizing state-of-the-art object detection techniques, including deep learning architectures such as YOLO, this module is capable of accurately locating ambulances in complex traffic scenarios. This module plays a pivotal role in intelligent traffic management and contributes significantly to the overall effectiveness of emergency response systems.

## 4.2 WORKFLOW




The project workflow for traffic sign recognition through images and vehicle detection in a video begins with the acquisition of a diverse dataset containing images of various traffic signs under different environmental conditions. Preprocessing techniques such as grayscale conversion, histogram equalization, and normalization are applied to enhance image quality and prepare the data for training. Next, a convolutional neural network (CNN) model is trained using the dataset to recognize traffic signs accurately. Object detection techniques, such as YOLO (You Only Look Once), are employed to detect vehicles within each frame of the video. The detected vehicles are then tracked across consecutive frames using Deep Belief Networks.

### 4.3 ADVANTAGES OF THE PROPOSED SYSTEM

1. Enhanced road safety: By accurately recognizing traffic signals and swiftly detecting emergency vehicles, the project contributes to reducing accidents and improving overall road safety.

2. Efficient emergency response: Rapid identification of emergency vehicles amidst traffic facilitates quicker response times, potentially saving lives and minimizing property damage during critical situations.

## 4.4 MODULE DESCRIPTION

### MODULE 1: Traffic Sign Recognition

The project commenced with the collection of a diverse dataset comprising images featuring various types of traffic signs captured under different lighting and weather conditions, as well as perspectives, sourced from the Kaggle dataset "Traffic Sign Dataset Classification." Subsequently, preprocessing techniques were applied, including grayscale conversion using OpenCV's cv2.cvtColor function, histogram equalization via cv2.equalizeHist to enhance image contrast, and normalization by dividing by 255 to scale pixel values. Data augmentation was performed using the ImageDataGenerator class from Keras to increase the diversity of the training dataset, a common practice in deep learning for improving model generalization. The model architecture comprised convolutional layers with ReLU activation, max-pooling layers for spatial dimension reduction, additional convolutional layers with specified filters and kernel sizes, dropout layers to mitigate overfitting, a flatten layer for 3D to 1D transformation, and dense layers for multi-class classification using softmax activation. The model was compiled using the Adam optimizer with a learning rate of 0.001 and categorical cross entropy as the loss function. The training process iterated through epochs, with each epoch involving batches of augmented data generated by the ImageDataGenerator to enhance the model's ability to generalize to unseen data. Finally, testing and evaluation were conducted by visualizing training and validation loss, as well as training and validation accuracy over epochs.

### MODULE 2: Emergency Vehicle Detection

The script begins by importing essential libraries, including OpenCV for computer vision tasks, Pandas for data manipulation, and YOLO for object detection, specifically using the YOLOv8 model loaded from Ultralytics. A mouse event callback function ('RGB') is defined to print BGR values of pixels for interactive exploration during debugging. The video file is then opened for capture, and class names for object detection are loaded from a file ('coco.txt'). Each frame of the video is processed in a loop, where resizing is applied, and YOLOv8 predicts bounding boxes for vehicle detection. Detected bounding box data is converted into a Pandas DataFrame for easier manipulation, and detections below a confidence threshold are filtered out. The processed frame, including bounding boxes and class labels, is displayed to visualize the detected vehicles. Additionally, the script implements emergency vehicle detection using YOLO, OpenCV, EasyOCR, and Tesseract OCR, focusing on dynamically updating labels based on OCR results, particularly for identifying ambulances. The code initializes the YOLO model and sets up a window for video display. It captures video frames, reads a configuration file for recognized classes, performs object detection using YOLO, filters detections, applies OCR for label extraction, and updates labels accordingly. This approach enhances object detection by dynamically labeling vehicles, particularly ambulances, in real-time video streams.

# 5. RESULTS

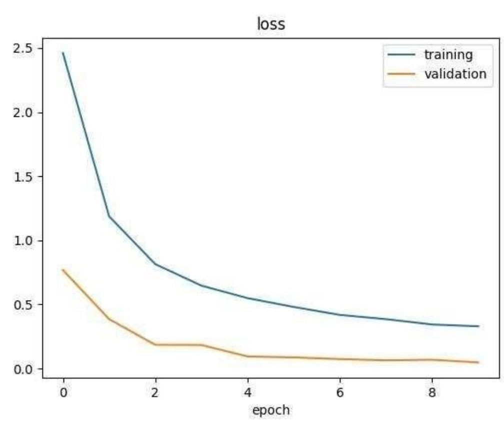
## 5.1 MODULE 1:

### Software results:

We have built CNN model with 89% of accuracy which includes various layers like convolution, dense, max pooling with appropriate activation functions.

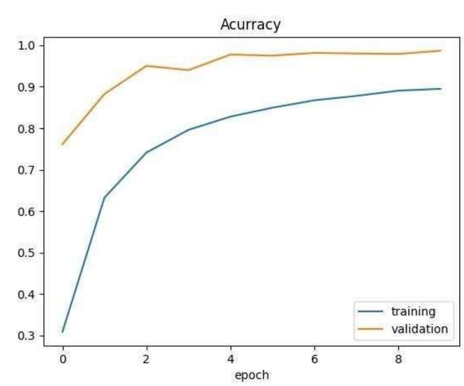
Through this model we got visualization of training and validation loss as well as the training and validation accuracy over epochs.

### Graphs:




Loss curve

Accuracy curve

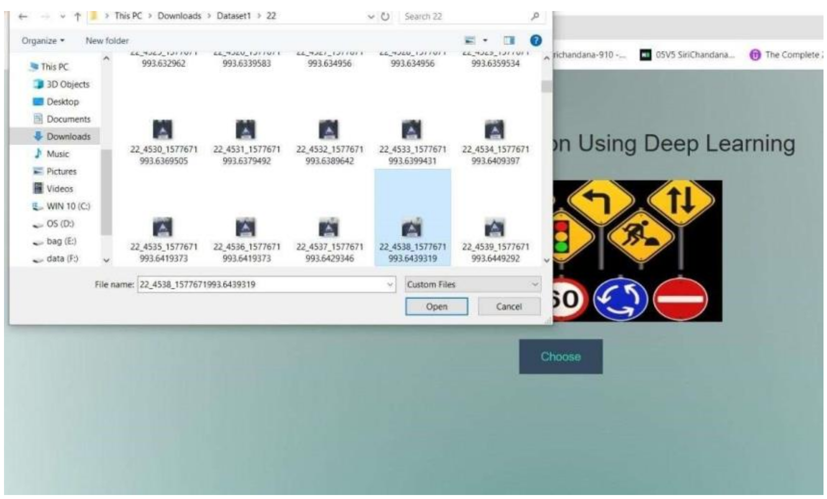


**Deployment Results:**

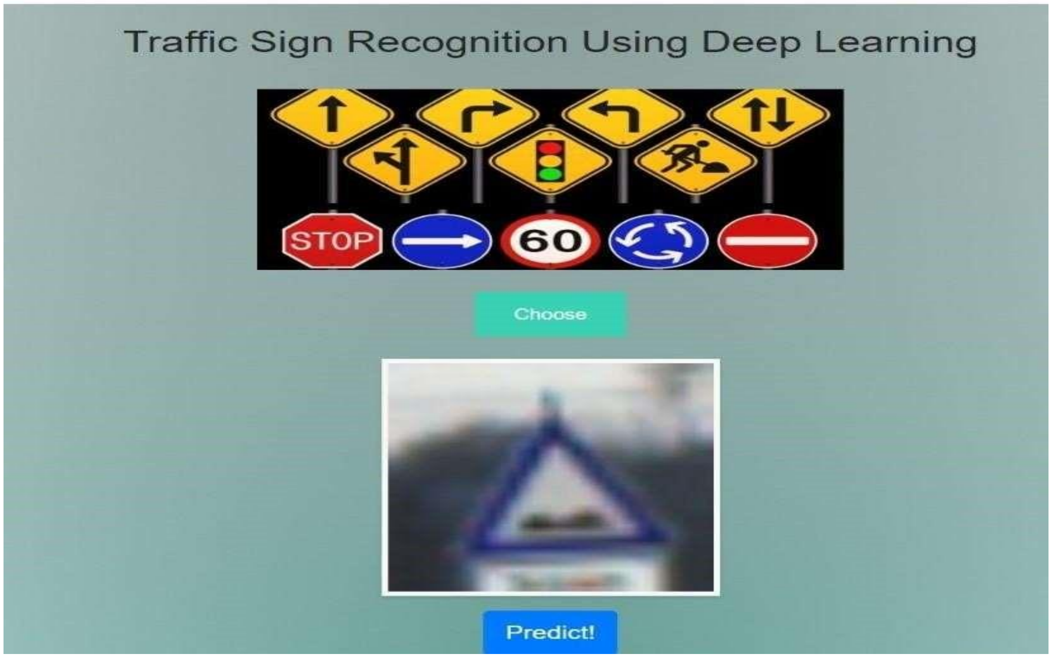
We deploy it for integration into a website using Flask. The website is designed to facilitate the upload of images depicting traffic signs, after which it autonomously provides detailed descriptions pertaining to the recognized signs.

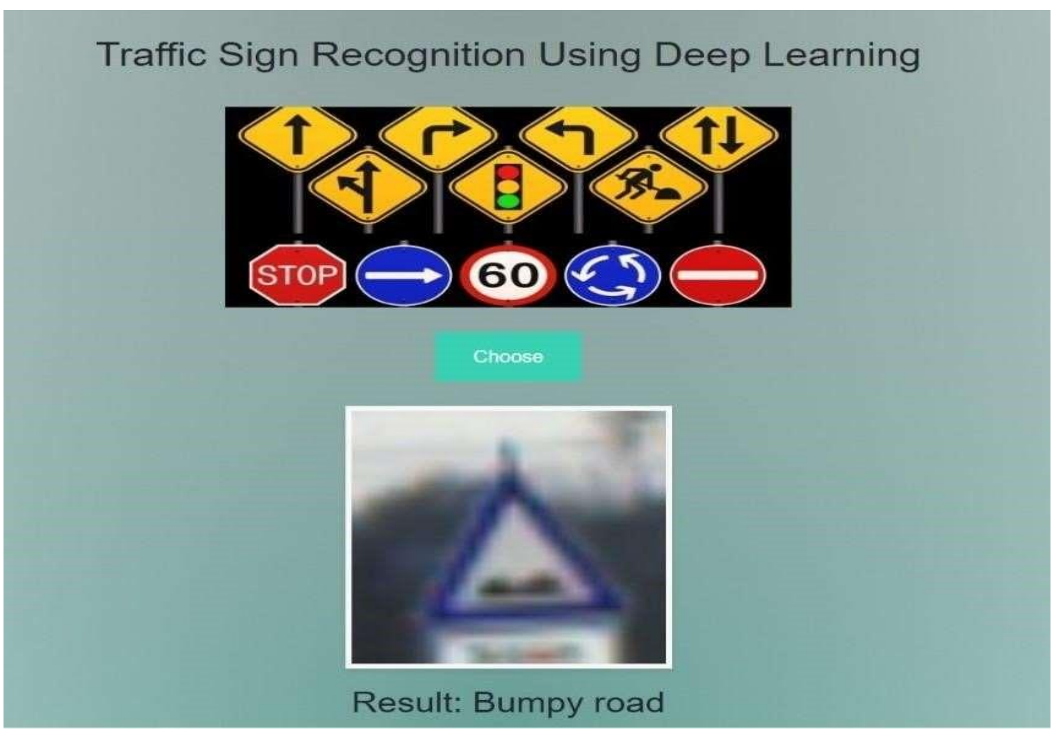
Step1: Home page to upload traffic sign images to recognise them.


Step 2: Uploading image by clicking choose button.



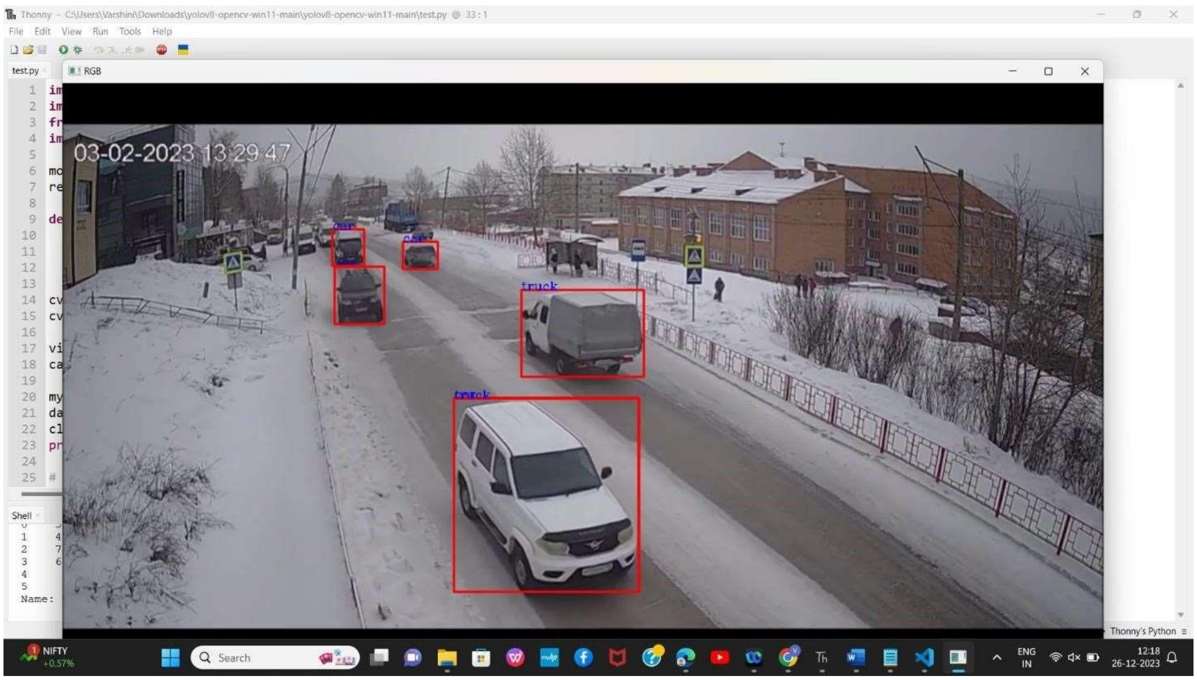
Step 3: By clicking the predict button, the interpretation of the traffic sign will be displayed.



### 5.2 MODULE 2:

Video 1:




Video 2:

# 6.CONCLUSION

In conclusion, the project's integration of traffic sign recognition through image analysis and vehicle detection in video streams offers a robust solution for enhancing road safety and traffic management. By leveraging advanced computer vision techniques and deep learning algorithms, the system can accurately identify various traffic signs under diverse environmental conditions and detect vehicles in real-time. This capability enables applications ranging from autonomous driving systems to traffic monitoring and law enforcement. The project's successful implementation underscores the potential of combining multiple vision-based technologies to address complex challenges in transportation infrastructure and urban mobility. Moving forward, further refinement and optimization of the algorithms, along with integration with other smart city technologies, could lead to even greater improvements in road safety, traffic efficiency, and overall quality of life in urban areas.

## 7. REFERENCES:

[1] Traffic Management using Machine Learning Author: Ritu Department of Computing Bournemouth University Poole United Kingdom
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[2] Traffic Management System using Machine Learning Algorithm Authors: A. Ravi, R. Nandhini, K. Bhuvaneshwari, J. Divya, K. Janani Professor, Department of EEE, A.V.C College of Engineering, Mannam pandal, Mayiladuthurai
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