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Use of Convolutional Neural Network and SVM Classifiers for Traffic Signals Detection

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Abstract-Road signals are crucial for preserving a safe and effective flow of traffic. They give directions to cars, warn them of potential dangers, and notify them of the conditions of the road ahead. Road signs make roadways safer for both vehicles and pedestrians by regulating traffic and reducing accidents. Failure to obey traffic signals can be harmful and result in collisions. Drivers must always be conscious of their surroundings and pay attention to traffic signs. If a driver misses a signal, they should proceed with caution and safety to prevent injuring themselves or others, and they should seek assistance to reroute themselves. Through the use of machine learning techniques, this project will create a traffic signal recognition system that will identify the traffic signals that are present on the road and inform the driver if the system determines that the motorist has missed a traffic signal or is thus violating traffic laws.

Keywords: Traffic Signals; Machine Learning; CNN; Driving Assistance; Road Safety

I. INTRODUCTION

Road safety contributes to a decrease in traffic-related accidents, fatalities, and property damage. Education and awareness about road safety can encourage cautious driving, lower risk-taking, and increase adherence to traffic regulations. Prioritizing road safety is essential to building stable communities, protecting vulnerable road users, and ensuring effective mobility. Making sure that drivers obey traffic laws and adhere to all traffic signal indications is a very fundamental step in ensuring road safety. Machine learning is used to solve many modern-day problems. It is used in healthcare to review medical records and create individualized treatment programs for individuals. It is applied in finance to automate financial analysis and detect fraud. Additionally, machine learning can be used to optimize transportation infrastructure, increase agricultural productivity, and increase energy efficiency. By forecasting weather patterns and simulating the environmental effects of emissions, it is also utilized to combat climate change. Thus, obviously, the use of machine learning tools to aid drivers in obeying traffic signals makes sense.

The intended model focuses on creating a model that can use the real-time image detection system to identify and alert the driver to traffic signals that are present on the side of the road. The model is trained on a range of data on traffic signals and tested on real life examples. The intended model may also be equipped with logic that can spot any traffic law violations and warn the driver about them.

II. PROBLEM STATEMENT

Drivers frequently disregard traffic signals and traffic laws, whether on purpose or accidentally, which can have extremely dangerous consequences. Drivers should have access to some sort of technology that can consistently alert them to the traffic signals nearby and to any potential violations of traffic regulations.

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III. RELATED WORK

[1] discusses yolov2, an automated system that would find two-wheelers driving without helmets and extract their license plates from films of traffic accidents. The registered phone number would then get a notification about the infraction, and a fine would subsequently be levied via an electronic system. The automated system for regulating traffic offences through electronic fines based on video surveillance is discussed in this paper.

[2] suggests an improved method for recognizing license plates using a dataset of object attributes that has been trained on neural networks and a blended algorithm for license plate recognition. Using 300 national and foreign motor vehicle LP photos, the system's three main modules—License Plate Localization, Plate Character Segmentation, and Plate Character Recognition—show enhanced accuracy.

[3] proposes a traffic sign detection algorithm based on deep Convolutional Neural Network (CNN) using Region Proposal Network (RPN) to detect all Chinese traffic signs. The model is trained and evaluated using a Chinese traffic sign dataset and tested on 33 video sequences. The proposed method achieves above 99% detection precision and real-time detection speed and can be used for data collection of traffic signs. Future work will focus on accurate ground truth and automatic sign classification.

[4] proposes an algorithm for identifying distorted and obscured triangular and circular traffic signs. The algorithm divides and binarizes the image, computes the convex hull, eliminates concave regions, and roughly converts contours to polygons. With a detection rate of 86.79%, the experimental results outperform the Hough and template approaches in terms of real-time performance and error detection rate. However, the error detection rate of circular traffic signs still has to be improved.

[5] proposes, a two-step approach for mobile LiDAR point clouds and images-based visibility assessment and traffic sign detection. The visibility estimation approach incorporates visual appearance and spatially associated features, while the detection algorithm uses retro-reflectivity and geo-referenced relationships. The system is tested on LiDAR point clouds and demonstrates efficiency and dependability, with the capability to assess the visibility of traffic signs.

[6] suggests a color- and shape-based automatic approach for identifying and categorizing traffic signs in photos or videos. The system features cutting-edge components to enhance performance and is tested using photos from Portuguese highways. In the future, the authors intend to increase the STOP sign recognition step as well as the detection method for photographs with critical lighting circumstances. Under normal lighting conditions, the algorithm performs well overall in terms of detection and classification.
[7] presents the segmentation and detection stages of a quick and reliable traffic sign detection system. In order to effectively reduce computing load, the segmentation step is constructed with two segments, one with greater criterion and the other with lower criteria. The system can work in a variety of lighting conditions, on metropolitan roadways with distracting items, and with partially obscured targets, and it has been tested to have an accuracy rate of at least 86.7%. The technology uses color features to help with form detection and is a flexible solution for traffic sign detection.

[8] suggests a segment-based traffic sign recognition method that entails three steps: road scene segmentation, clustering, and traffic sign detection. The suggested technique is put to the test using a dataset that a Leader system has collected, and the results demonstrate that it performs well and produces accurate traffic sign detection from MLS point clouds.

[9] suggests a system that uses two neural networks for detection and recognition to identify and classify various kinds of traffic signs with widespread recognition. 40,000 photos are utilized for training, and a training and validation dataset is created via image augmentation. The region of interest is extracted from the processed photos and put into two CNN classifiers for classification. In contrast to prior works in this subject, which only employ a few signs, the suggested approach classifies objects using 28 signs.

IV. METHODOLOGY

The suggested system would be trained on 28 separate traffic lights using a data set with approximately 1400 photos total and 50 images per signal. In order to train our model for every conceivable scenario, a variety of data sources, including those found online and some actual photographs, were used to collect the dataset

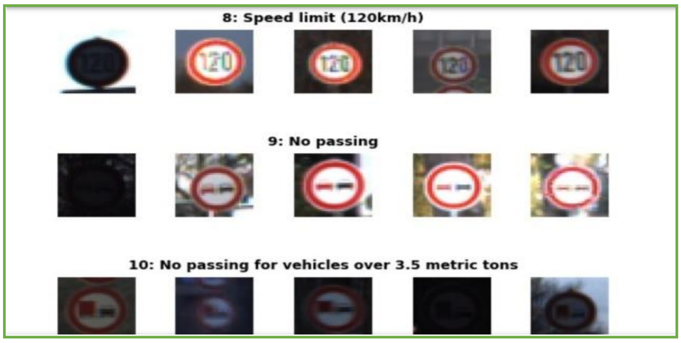

Fig. 1. Real life traffic signals

Fig. 1 shows real life traffic signals while fig. 2 shows a dataset used for training. Like with any other machine learning dataset, the dataset would be divided into the test-train set. We utilized a convolutional neural network for this example. Convolutional Neural Networks, or CNNs, are a subset of artificial neural networks used to process images for purposes like segmentation, object detection, and picture recognition. Through a technique called convolution, which entails applying a number of filters to the input image to extract pertinent charac-

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Fig. 2. Dataset of train model

teristics, it is intended to automatically learn features from images. Then, for jobs requiring classification or regression, these features are supplied into layers that are fully coupled. Convolutional, pooling, and fully connected layers are just a few of the layers that CNNs have, and they use backpropagation to learn their weights and biases as they train. CNNs have transformed image processing jobs and are widely employed in a variety of applications, including facial recognition, medical image analysis, and self-driving automobiles.

Fig. 3 shows dataflow diagram of a model. Input is in the form of video. For training, Preprocessing, feature extraction, working of CNN algorithm, Detection of traffic sign in text or voice format.

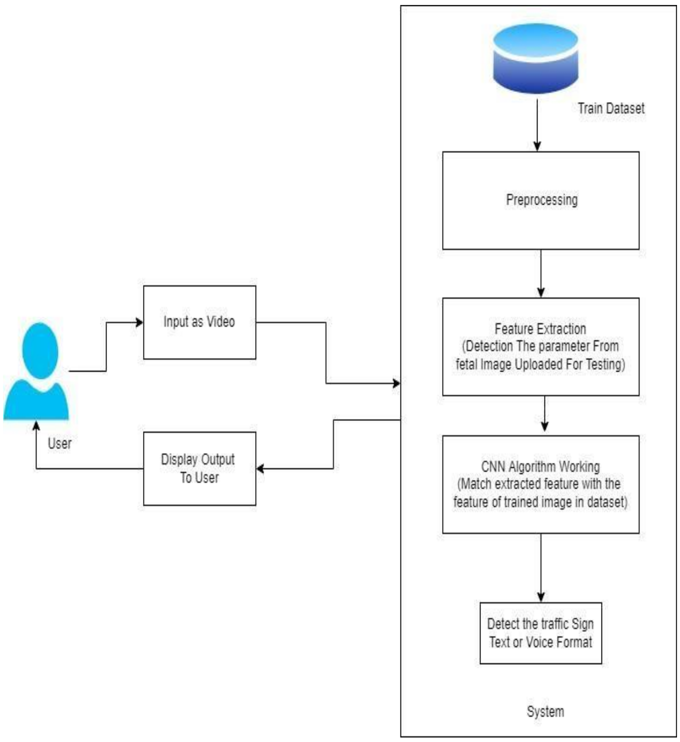

Fig. 3. Dataflow diagram of model

The suggested system would offer the ability for users to register with the system and then log in. Users would create an account, log in, and use the system. The device would connect to a live camera positioned on the dashboard of the car being driven and would display traffic signals for the driver on the screen so they could be seen easily.

Fig. 4. Registration form

The system would use Pytorch to obtain the images (so that the trained model could process them). PyTorch, created by Facebook's AI research team, provides dynamic computation graphs and enables efficient computation on tensors. It's widely used in academia and business for research and production purposes since it offers a straightforward, adaptable, and user-friendly interface for building and training deep neural networks. The model is implemented using the SVM technique to obtain images from live video because it is more accurate and quicker than other algorithms like regression or ANN.

V. RESULT

The end product is a functional system that can recognize traffic signals from live camera video and display them on a screen for the driver. If a traffic infraction takes place, such as the driver exceeding the posted speed limit, the system will also sound an alert to warn the driver. Fig. 4 shows registration form. Fig. 5 shows Login GUI and Fig. 6 shows result of trained model.

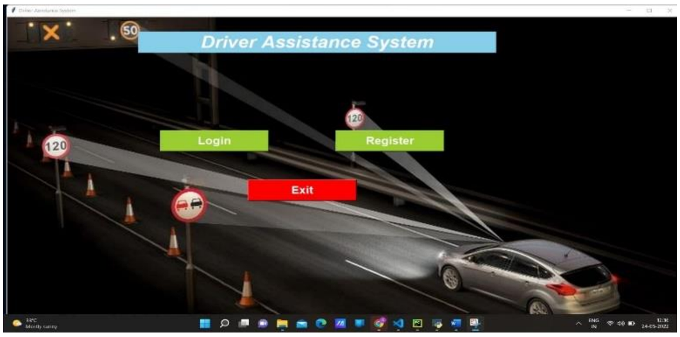

Fig. 5. Login GUI

VI. CONCLUSION AND FUTURE SCOPE

This system offers a system for extracting road and traffic signs from still photos of intricate settings with unpredictable lighting. The system uses two SVM classifiers to categorize the

Fig. 6. Result of Trained Model

signs and computer vision and pattern recognition techniques to segment and recognize signs based on color-shape combinations. In tests, the system proved to be quite resilient, providing a fresh perspective on traffic sign identification for further study.
Future scope of this project can be to solve these problems:

[1] Occluded Signs and Object Recognition: This situation is unpredictable and calls for characteristics that are clutter-free, transformation-invariant, and flexible enough to handle various variants. Though additional research is required, researchers are working on solutions.

[2] Detachment of Signs: Color segmentation of the image may lead to the labelling of several traffic signs as a single item when they are attached to the same pole and share the same space. This poses a challenge because they must be identified as distinct indications. To be recognized correctly, the indications must be separated from one another.

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