**Bangladeshi Road Sign Detection Using Deep Learning Technique for Driver Assistance System**

**Background:**

Traffic signs have been designed so that they are easily distinct from the driving environment. The colors for traffic signs are chosen in such a way that they serve different purposes and are also distinguishable for the driver while driving. The signs are characterized by fixed shapes like triangle, circle, octagon, and rectangle. The combined features of shape and color are used by the driver to distinguish a traffic sign. Hence an autonomous system also uses the same principle of the color and shape of the traffic signs. With respect to the road the traffic signs are positioned at well-defined locations so that the drivers can expect the position of the sign. The road sign may contain text as a string of characters, picture or both to represent the meaning of the sign. They are characterized by using fixed text fonts and character heights. There are a large number of traffic signs in India???? categorized as WARNING, COMPULSORY, REGULATORY and INFORMATORY. These signs are mainly characterized by color and shape [ref].



Figure 01. ??????

An automatic driver assistance system (ADAS) is a technology that is designed to assist the driver of a vehicle by automatically performing certain tasks, such as braking, steering, or acceleration. These systems are designed to improve the safety of the vehicle and its occupants by reducing the likelihood of accidents caused by human error. Some ADAS include lane departure warning systems, adaptive cruise control, and automatic emergency braking. These systems use a combination of cameras, radar, and other sensors to detect the environment around the vehicle and respond accordingly [ref].

Different traffic sign recognition systems have been developed as reported in the literature review section. In this project we will develop a traffic sign recognition system as discussed in the problem statements, objectives, and planned methodology sections.

**Literature Review:**

**1. TRAFFIC-SIGN RECOGNITION FOR AN INTELLIGENT VEHICLE/DRIVER ASSISTANT SYSTEM USING HOG**

The work is on an intelligent transport system. The project works with different traffic sign conditions. There are 4 kinds of signs. Warning Signs, Compulsory Signs, Regular signs, and Informatory signs. The proposed approach of the project was first to train the data set and then work with the testing stage. At the training stage, the RCB color-based threshold will help to analyze the shape and then extract the features. These features will be saved in the database. From this classification of traffic signs will be done and test data will be categorized at that classification and a better result will be found. Normalized RGB color space is used for RGB-Based color thresholding. Shape Analysis is used in this project to clean the binary image from noise and small objects and apply connected components labeling algorithm to identify the traffic sign. This project uses HOG(Histogram of Oriented Gradients) to recognize pedestrians. KNN(K-Nearest Neighbor) algorithm is used to find the closest object sets similar to each other. r. The proposed project for traffic sign recognition attains a classification accuracy of 63% [1].

**2. TRAFFIC SIGN RECOGNITION WITH A SMALL CONVOLUTIONAL NEURAL NETWORK**

The project used Artificial Neural Network algorithm to recognize traffic signs which they called as CNN module. This study proposes a CNN TS-Module module for traffic sign recognition. Several trials on the traffic signs dataset show that the module's CNN is more suited for traffic sign identification than the classic CNN, because the typical convolution is done through a single layer. The 3\*3 convolution kernel conducts feature extraction, which has the problem of producing an excessive number of parameters. The gradient diminishes as the network deepens, resulting in poor network performance. The TS-Module module CNN employs many sets of convolutions in its implementation. A 3\*3 convolution kernel is created by connecting a 1\*3 convolution kernel and a 3\*1 convolution kernel via a 1\*1 convolution kernel. The experience field effectively deepens and broadens the network, while multi-channel convolution can not only extract a variety of information but also considerably lower the parameters, increasing the network's practicality. CNN also mentions the residuals. This module is 87% or more accurate than the GTSRB data set [2].

**3. REAL-TIME TRAFFIC SIGN RECOGNITION BASED ON EFFICIENT CNNS IN THE WILD**

The paper "Real-Time Traffic Sign Recognition Based on Efficient CNNs in the Wild" presents a method for recognizing traffic signs in real time using efficient convolutional neural networks (CNNs). The authors propose a new CNN architecture that is optimized for real-time traffic sign recognition, as well as a new dataset for training and testing the CNNs.

The authors proposed Faster R-CNN and MobileNets are combined and modified to make the detection process more efficient. A pretty good detection result of unique traffic signs is reported for the first time on the GTSDB database. An easy approach based on color and shape information for the localization refinement of small traffic signs is proposed, improving the detection quality and the classification accuracy of typical traffic signs. The traffic Sign Recognition (TSR) method used computer vision and machine learning methods. For the recognition of traffic signs, the benchmark dataset GTSRB. In Network Architecture they have used CNN architectures such as CNNs, VGGNets, ResNets, DenseNets, and LeNet-5. For Network Regularisation they have been used data argumentation, dropout, parameter norm penalty, and early stopping have. Then they optimize the network by using the training of CNNs, the training of CNNs, etc. Their proposed system has traffic sign detection (Faster R-CNN), ) base convolutional layers, Region Proposal Network (RPN), RoI Pooling Layer, Classifier, and Loss Functions. Convolutional neural networks have achieved state-of-the-art traffic sign classification

**4. Recognition of Traffic Signs with Artificial Neural Networks: A Novel Dataset and Algorithm**

This paper describes a novel dataset and algorithm for recognizing traffic signs using artificial neural networks. The authors collected a dataset of traffic sign images and used it to train and evaluate an artificial neural network for the task of traffic sign recognition. In this paper, they were starting their methodology by combining data sets GTSRB and TSRD by merging those data sets together. After merging two data sets they were we resized all of the cropped images to 32 x 32 pixels for preprocessing TSRD and GTSRB and they inspected all the 101 classes of the new dataset manually. They followed the rule of thumb by taking 80% for training, 10% for validation, and 10% for testing. Thirdly they were done data augmentation by increasing the number of observations. For data augmentation, they have been done par such as translation, rotation, noising, color, intensity jittering, and blurring. Following the application of the aforementioned data augmentation strategies. Feature extraction from images used a novel classification algorithm. In their paper, they used Hybrid-ANN Classification Models for their data set. As they had many predictions that’s why they used Hybrid-ANN Decision Model. In their proposal performed two sets of experiments to further validate our results such as experiments on GTSRB dataset and experiments on the Dataset Created. That applying HOG feature extraction algorithm with a cell size of 4 x 4 obtained the best accuracy around 80% and for experiment -2 their novel dataset achieve an 87% top-1 classification accuracy while a 95% was obtained for top-2 classification accuracy.

**5. Real-Time Traffic Sign Recognition Using YOLOv3 based Detector**

A traffic recognition system based on a CNN-based classifier and a YOLOv3-based detector is proposed in this paper. For the detector and classifier's training and evaluation, a PC equipped with an Nvidia GTX 1060 GPU and 6GB GPU RAM was employed. GTSDB and GTSRB databases were tested by the authors. The GTSRB dataset consists of more than 50000 traffic sign images of 43 classes with sizes ranging from 15×15 pixels to 222×193 pixels. The GTSDB dataset consists of 600 training images and 300 test images of 1360×800 pixels from urban, rural, and highway locations under various weather and lighting conditions. Positive detection is defined as Intersection over Union (IoU) > 0.5 between the ground truth box and the predicted bounding box. Utilizing the GTSDB test set, the detector's performance is compared against an R-CNN traffic sign detector implementation. On the GTSDB test set, the suggested YOLOv3-based detector demonstrated great accuracy with a mAP of 92.2% and a frame rate performance of almost 10 frames per second. The GTSRB test set, which contains 12630 photos, was used to evaluate the CNN-based customs traffic sign classifier. A model trained without the addition of new data might attain a 96.46% accuracy. Accuracy has increased with data augmentation to 99.6%.

**6. Traffic Sign Recognition and Classification Using YOLOv2, Faster RCNN and SSD**

A method for recognizing and classifying traffic signals is developed in this paper using You Only Look Once (YOLOv2), Faster Region Convolutional Neural Network (RCNN), Single Shot Detector (SSD). The authors constructed these three designs in the TensorFlow environment using the Anaconda 5.1.0 Windows platform and measured the performance using the mAP (mean average precision) and FPS (frames per second) benchmarks. The effectiveness of object detectors and classifiers is assessed using mAP. The German Traffic Sign dataset, which contains several traffic signs with distortions such sunshine reflections, wind effects, barricades, and occlusions, was used to evaluate their methods. In this methodology, 530 photos are utilized as the verification objective while 7832 images are used to train SSD, faster RCNN, and YOLOv2. These pictures were categorized by the authors into five categories: pedestrian crossing, no entrance, speed restriction, stop sign, and turn ahead. Using their mAP and FPS, SSD, Faster RCNN, and YOLOv2 are contrasted and evaluated. Their overall average mAP’s are 68.35, 74.68, and 77.89 for the five classes. In terms of overall accuracy performances, YOLOv2 is faster and more accurate than both Faster RCNN and SSD, but SSD is less accurate than Faster RCNN and SSD

**7. Traffic Sign Recognition with Convolutional Neural Network Based on Max Pooling Positions**

A method for recognizing traffic signals is developed in this paper using a convolutional neural network (CNN) and the "max pooling" technique. The authors propose a model approach to distinguishing traffic signs that combines the color and shape of the traffic signs. The suggested technique employs a CNN with a max pooling layer to extract features from the color and shape. In contrast to earlier techniques, which often used CNN as a feature extractor and multilayer perception (MLP) as a classifier, they proposed max pooling positions (MPPs) as a potent discriminative feature to predict category labels. The desirable traits of little inter-class variance and big intra-class variance are demonstrated by MPPs through extensive studies. Utilizing the max pooling layer, the most important characteristics from the CNN are selected, and the features are then used to recognize traffic signs. The German Traffic Sign Recognition Benchmark (GTSRB) dataset is used by the authors to compare their suggested strategy against a number of state-of-the-art methods for traffic sign recognition and show that it outperforms them. Their accuracy rate is 98.86%.

**8. Indian traffic sign detection and recognition using deep learning**

The authors provide a new deep learning-based traffic sign recognition method in India. In this paper, a viable deep-learning approach for the detection and recognition of Indian road traffic signs was developed. The proposed approach performed well under a variety of situations, including changes in scale, orientation, and illumination. The research introduces RMR-CNN, a modified version of Mask R-CNN with enhancements to its architecture, data augmentation, and parametric value refining. The suggested method extracts features from photos of Indian traffic signs using a deep convolutional neural network (CNN). The photos are first resized and normalized by the authors before being used to extract features using CNN. The recognition of traffic signs is subsequently done using the retrieved features. The authors test their methodology using the Indian Traffic Sign Dataset (ITSD) and demonstrate that it performs better than other cutting-edge techniques for identifying Indian traffic signs. High accuracy and a low false alarm rate have been attained. The research provides a new methodology for Indian traffic sign recognition utilizing deep learning techniques, specifically a deep convolutional neural network (CNN). Precision, recall, and F measures for all three models are for Fast RCNN 93%, 94%, 93.4% Mask R CNN 94.4%, 96.7%, 95.53%. RMR-CNN 97.08%, 96.75%, 96.87%.

**9. Road Sign Detection and Translation in Bangla Using Image Processing and Machine Learning**

The authors propose a system that uses a combination of image processing and machine learning techniques to detect and translate road signs in the Bengali language in real time. The authors use several image-processing techniques for road sign detection, such as color-based thresholding, morphological operations, and edge detection. These techniques are used to extract the region of the image that contains the road sign and to remove any unnecessary background information. For road sign recognition, the authors use a convolutional neural network (CNN), a type of deep learning algorithm commonly used for image classification tasks. The CNN is trained on a dataset of road sign images and their corresponding labels. The authors use a machine translation model for road sign translation to translate the recognized text from English to Bengali. Machine translation models use neural networks to learn the relationship between two languages and generate translations.

10. **Traffic Sign Detection and Recognition Model Using Support Vector Machine and Histogram of Oriented Gradient.**

This paper presents a model for detecting and recognizing traffic signs using a combination of Support Vector Machine (SVM) and Histogram of Oriented Gradient (HOG) feature descriptors.Pictures of traffic signs collected from streets of Bangladesh are categorized based on the type of traffic sign and stored on a data set. This data set will be used to train the classifier model. SVM(support vector machine) will be made using the OpenCV library of python, it will classify the data using the HOG (Histogram of Oriented Gradients)property. If the result is 96% correct it will be taken into consideration.Their Proposed Approach is the Identification of the traffic sign by playing a video and extracting frames. Match them with pre-processed frames, Generation of SVM Classifier Model using Hog, Detection, and recognition of traffic signs from video Input, After all of those have been done detection and recognition of traffic Signs from video input by using Similarity Measurement algorithm. For implementation, they used a dataset of Bangladeshi traffic signs with 1000 images of 6 different classes, each class containing approximately 170 images to train the model. The project was implemented with the help of JetBrains PyCharm, OpenCV, and Numpy. Final results were 𝑝𝑟𝑒𝑐𝑖𝑠𝑖𝑜𝑛 100%,𝑟𝑒𝑐𝑎𝑙𝑙 95.83%,𝑎𝑐𝑐𝑢𝑟𝑎𝑐𝑦 96.15%.

**11.Bangladeshi Road Sign Recognition Based on DtBs Vector and Artificial Neural Network.**

The project converts images from RGB to the YCbCr color model to extract candidate regions and to avoid the illumination sensitivity of color. The second part allows procedures for detecting ROI by using color segmentation in YCbCr color space. In YCbCr color space, any color is represented by the values of its intensity. Noises are eliminated using a morphological closing operation to recover the gaps smaller than 5 consecutive pixels. Eight connected components concept is used for labeling. After that geometrical features such as the area and aspect ratio of each region are extracted. **:** Distance to Borders (DtBs) vector is a robust method for rotated and scaled objects to recognize the shape. To calculate the DtBs we have calculated the Euclidean distance between the bounding box (BB) and perimeter position of the RSs. A BB has 4 sides so the DtBs will generate 4 vectors For every time the vector is calculated. The detected RS will be resized as 30X30 blobs that represent 900 pixels by ANN(Artificial Neural Network). These will be normalized into 60 outputs by averaging each column and row intensity values. Then these 60 values feed into the neural network. To recognize the content of road signs, ANN is used with three layers. The first layer consists of 60 inputs as the input layer. So, there are 3 layers Input, Output, and Hidden layer. The frame size of the image is resized as 448X336 pixels. Celeron Dual Core CPU 2.10GHz processor computer with 4GB ram has been used to execute the program to classify the BRS. The program has been developed under the MATLAB environment. Considering the above conditions, the successful road sign detection and recognition rate is about 94.87% and 92.79%.

**Problem Statements:**

A road sign detection method for the driver assistance system will be developed keeping the following questions in mind:

1. Can the system detect road signs from a sufficient distance?
2. Does the performance of the model change with different weather and lighting conditions?
3. How can road sign detection be integrated with other driver assistance systems to improve overall system performance and road safety?
4. How well does the proposed method perform on different types of traffic signs and under different lighting conditions?

**Objective:**

We will create a dataset by taking pictures of different road signs. Then for pre-processing the pictures, we will apply RGB to Grayscale. After that, we will train different pre-trained CNN models using the training data set. Based on the test results using the test data set, the best model will be selected. Finally, we will develop an app that will give Bangla text and audio alerts describing the detected road sign.

**Planned Methodology:**

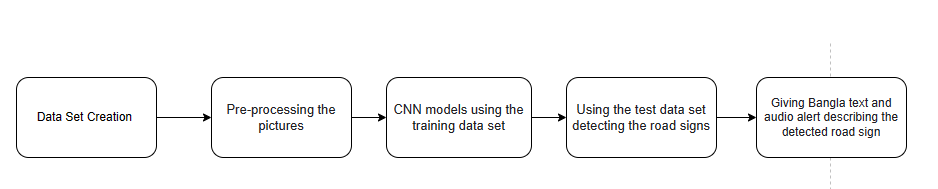


Figure 2. Planned methodology of the traffic sign recognition system

Data set creation for road sign detection using deep learning involves capturing images of different road signs, identifying the region of interest (ROI) in the images, cropping the images based on the ROI, resizing the images to the same size, and creating new images from existing images using image augmentation techniques. The process includes taking pictures of different road signs in various locations and under different lighting conditions, manually identifying the ROI in each image, cropping the image to only include the area of the image that contains the road sign, resizing the image to the same size, and creating new images from existing images to increase the diversity of the data set and to improve the robustness of the model. Creating a high-quality, diverse and balanced dataset is essential for training an accurate and robust model, and it's a time-consuming and labor-intensive process.

Pre-processing step of converting RGB images to grayscale is applied to improve the performance of the road sign detection model. It has several advantages, such as reducing computational requirements, improving robustness, and simplifying the feature extraction process. The grayscale images have fewer channels than RGB images, which reduces the computational requirements of the model, and make it less sensitive to changes in lighting conditions, making the model more robust to variations in lighting and simpler to process and analyze.

In the process of developing a road sign detection system using deep learning, training different pre-trained CNN models using the training data set and selecting the best model is an important step. Pretrained models are pre-trained on large datasets such as ImageNet, and fine-tuned on a smaller dataset to solve a specific problem. Using a pretrained model saves time and computational resources and improves the performance of the model. The best model is selected by evaluating the performance of each model using a validation dataset and selecting the one with the highest accuracy.

Road sign detection is the process of identifying and locating road signs in images or video streams using a trained model. The model is trained using a training dataset containing images of road signs and their labels. The test dataset is used to evaluate the performance of the model by comparing the model's output to the true labels of the road signs in the images. This allows us to evaluate the model's accuracy, precision and recall. It is an important component of driver assistance systems, providing important information to the driver and helping to improve road safety.

A Driver Assistance System (DAS) is designed to assist drivers in various tasks such as navigation, parking and traffic sign recognition. Giving Bangla text and audio alerts describing the detected road sign is an important component of DAS, which helps the driver to quickly understand the meaning of the sign and take appropriate action. Once the road sign is detected, the system can provide the driver with a text and audio description of the sign in the Bangla language. The DAS also provides other types of information to the driver, such as traffic conditions, navigation instructions, and parking availability, making the driving experience safer and more convenient.

**Data Analysis Plans:**

Firstly, creating the dataset by taking pictures of different road signs, and identifying regions of interest (ROI) based on three shapes or border colors, cropping the picture based on ROI, and resizing the picture to the same size. Creating new pictures in different rotations from existing pictures using image augmentation techniques. After creating the dataset, we will divide the data set into three parts such as training, validation, and testing. For training data, we will keep 70%, 15% for validation, and 15% for testing. For classification and accuracy testing of our dataset, we will follow some classifier models such as CNN, R-CNN, and augmentation models for image augmentation. In the augmentation model, we will do translation, rotation, and noise.

**Expected Results**:

Our expected result is making driver assistance systems. With this system, users will be able to see Bangla text and audio alerts which will describe the detected road sign.

**References:**

[1] ????K. PL, M. R. S.Md, and K. J, “Traffic-Sign Recognition For An Intelligent Vehicle/Driver Assistant System Using HOG,” *Computer Science & Engineering: An International Journal*, vol. 6, no. 1, pp. 15–23, Feb. 2016, doi: 10.5121/cseij.2016.6102.

[2] W. Li, D. Li, and S. Zeng, “Traffic Sign Recognition with a small convolutional neural network,” in *IOP Conference Series: Materials Science and Engineering*, Dec. 2019, vol. 688, no. 4. doi: 10.1088/1757-899X/688/4/044034.

[3] ????B. Venkatesu and S. F. Anwar, “REAL-TIME TRAFFIC SIGN RECOGNITION BASED ON EFFICIENT CNNS IN THE WILD.”

[4] A. Kerim and M. O. Efe, “Recognition of Traffic Signs with Artificial Neural Networks: A Novel Dataset and Algorithm,” in *3rd International Conference on Artificial Intelligence in Information and Communication, ICAIIC 2021*, Apr. 2021, pp. 171–176. doi: 10.1109/ICAIIC51459.2021.9415238.

[5] ????“10.1109@ICCCNT45670.2019.8944890(5)”.

[6] ?????“garg2019(6)”.

[7] ?????M. Li, Institute of Electrical and Electronics Engineers, and IEEE Circuits and Systems Society, *2016 12th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery : ICNC-FSKD 2016 : 13-15 August, Changsha, China*.

[8] R. K. Megalingam, K. Thanigundala, S. R. Musani, H. Nidamanuru, and L. Gadde, “Indian traffic sign detection and recognition using deep learning,” *International Journal of Transportation Science and Technology*, 2022, doi: 10.1016/j.ijtst.2022.06.002.

[9] ????K. A. Islam, “Road Sign Detection and Translation in Bangla Using Image Processing and Machine Learning,” 2019.

[10] N. Ahmed, S. Rabbi, T. Rahman, R. Mia, and M. Rahman, “Traffic Sign Detection and Recognition Model Using Support Vector Machine and Histogram of Oriented Gradient,” *International Journal of Information Technology and Computer Science*, vol. 13, no. 3, pp. 61–73, Jun. 2021, doi: 10.5815/ijitcs.2021.03.05.

[11] ?????S. Chakraborty, M. N. Uddin, and K. Deb, “Bangladeshi Road Sign Recognition Based on DtBs Vector and Artificial Neural Network.”