
Traffic Sign Classification

About the team

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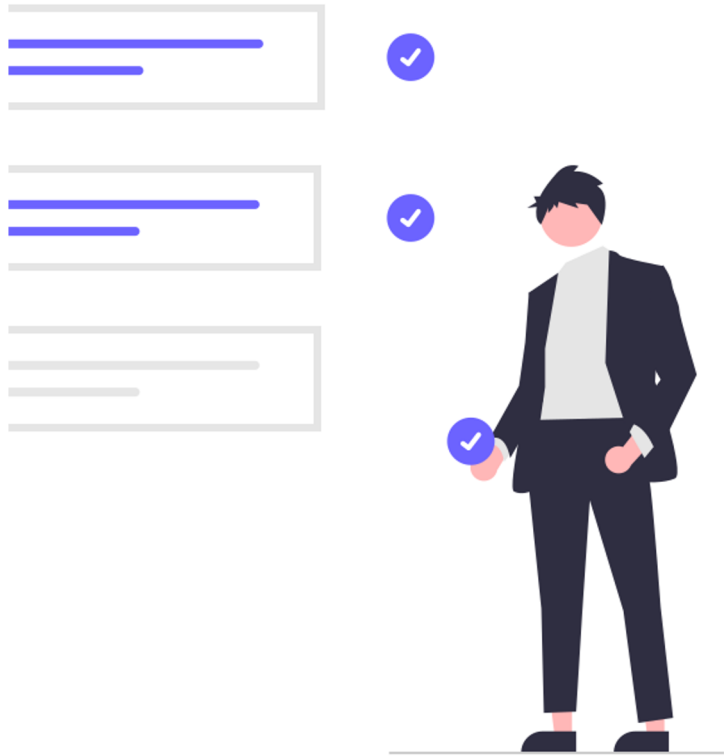
Problem Statement

Creation of an automatic, fast and lightweight system that is capable of real time detection, classification and interpretation of the traffic signs

Objectives

- Train a deep learning model on an industry standard database of traffic signs.
- Refine the model to detect traffic signs with large intra-category appearance variation.
- Provide real time detection, classification and interpretation of the traffic signs



Literature Survey

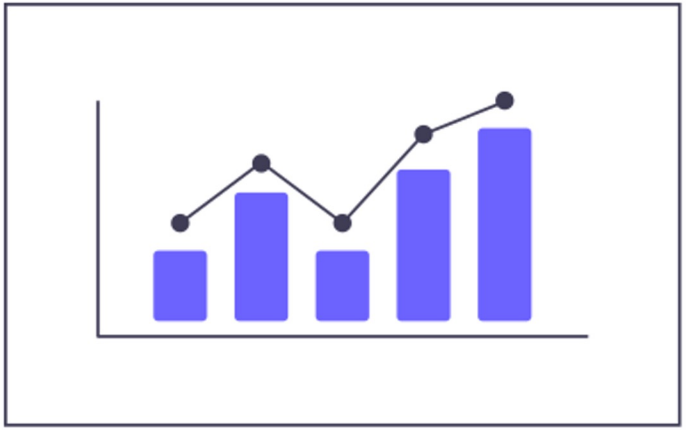
Paper Name	Abstract	Methods	Conclusion and Future work
Towards Reliable Traffic Sign Recognition -Benjamin H¨oferlin Intelligent Systems Group Universit¨at Stuttgart Stuttgart, Germany benjamin.höferlin@vis.uni-stuttgart.de -Klaus Zimmermann European Technology Center (EuTEC) Sony Deutschland GmbH Stuttgart, Germany klaus.zimmermann@sony.de	● System architecture for reliable detection of circular traffic signs. ● First research into computer aided traffic sign detection in the 80s. ● Usage of color segmentation, color thresholding and Bayesian classification of color in old research. ● Hough transform and its derivatives.	● Detection ○ Two fold detection stage ○ Shape based detection ○ Content based detection ● Refinement ○ Contracting Curve Density Algorithm ● Classification ○ Two Multi-Layered Perceptrons	● Conclusion ○ 30 minute long test yielded 96.4% correct detections. ● Future Work ○ Detection of non circular signs ○ Better methods for classification

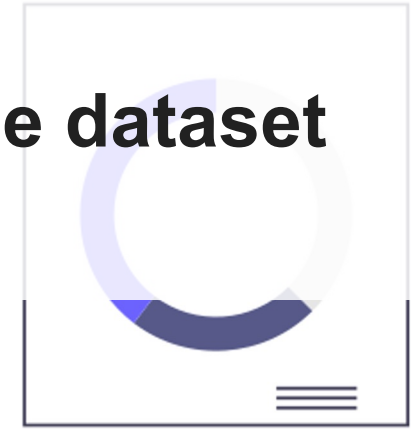
Paper Name	Abstract	Methods	Conclusion and Future work
Detection And Recognition of Indian Traffic Signs - Pritika Priya Dhara Modha, Mansi Agrawal Department Of Information Technology,Bharati Vidyapeeth College Of Engineering For Women, Pune-43	● An automatic system which would detect, recognize and interpret the meaning of the traffic signs for the driver. ● Use of several image processing techniques to enhance the efficiency and speed of the system. ● Disburden the drivers and reduce road accidents for a better and safe driving, thus implementing the concept of intelligent vehicle.	● Detection ○ Image blurring algorithm ○ Color filtering Blob detection ● Classification ○ Based on shapes: circle, rectangle and triangle. ● Recognition ○ Use of pattern matching algorithms to compare extracted ROI with standard templates. ○ If pattern is found, sound notification is given to the driver otherwise the image is discarded.	● Conclusion ○ Describes the system that is strictly used to differentiate Indian Traffic Signs that is subdivided in three classes according to the shapes. ● Future Work ○ Improve the robustness of the system. ○ Make the system work for highly tilted signs.

Paper Name	Abstract	Methods	Future work
Deep Learning for Large-Scale Traffic-Sign Detection and Recognition -Domen Tabernik and Danijel Skoˇcaj Faculty Computer and Information Science, University of Ljubljana Veˇcna pot 113,1000 Ljubljana {domen.tabernik,danijel.skocaj}@fri.uni-lj. si	● Use of Mask R-CNN for Traffic sign detection and recognition. ● Using deep learning method for detection of traffic signs with large intra-category appearance variation. ● This approach is used for detection of 200 traffic-sign categories.	● Detection and Recognition using Mask R-CNN ○ Online hard-example mining (OEHM) ○ Distribution of selected training sample ○ Sample weighting ○ Adjusting region pass-through during detection ● Data augmentation technique ○ This technique is used to generate several instances of traffic-signs and hence provide diverse data for the deep learning model.	● Conclusion ○ Average precision of 97.5% achieved in correct detections with an error rate of just 2%-3%. ● Future Work ○ Improving the system to achieve ideal performance.

Paper Name	Abstract	Methods	Conclusion and Future work
Traffic Sign Classification Using Deep Inception Based Convolutional Networks -Mrinal Haloi IIT Guwahati mrinal.haloi11@gmail.com	● Use of spatial transformer layers and a modified version of inception module specifically designed for capturing local and global features together. ● Classify precisely intraclass samples even under deformations. ● This approach addresses the concern of exploding parameters and augmentations.	● Transformation invariant ○ Localisation network ○ Grid generator ○ Sampling unit ● Proposed Pipeline ○ A modified version of GoogLeNet Inception module is used for classification task. ● GTSRB data set is used for training and testing.	● Conclusion ○ Achieves the state-of-the-art performance of 99.81% on GTSRB dataset. ● Future Work ○ Improving the system to achieve ideal performance.

Paper Name	Abstract	Methods	Conclusion and Future work
Indian Traffic Sign Detection and Classification Using Neural Networks -Arun Nandewal CSE Department arunnandewal@gmail.com Abhishek Tripathi IT Department abhishek.tripathi2421@gmail.com Satyam Chandrra EEE Department satyam9871@gmail.com NITK Surathkal	● This paper presents an automatic Indian Road Traffic Sign Detection and Classification system based on Multiple Neural Networks. ● Validated on a standard data set of Indian Traffic Signs. ● Proposed methodology works with real time images invariant to rotation, illumination and with partially distorted and occluded images.	The proposed system has 4 stages: ○ Image procurement and preprocessing ○ Color segmentation ○ Blob Detection using Binarization and Otsu Thresholding. Classification using Multiple Neural Networks to decide the type of sign.	● Conclusion ○ when the NN is trained over a standard database, the recognition of ROI has high accuracy. ● Future Work ○ Real time implementation requires more robust system which has reduced proceeding time.





About the dataset

General Information

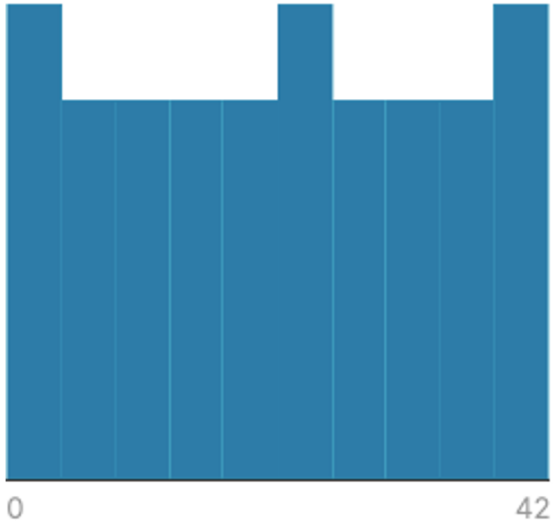
GTSRB - German Traffic Sign Recognition Benchmark

German Traffic Sign Recognition Dataset (GTSRB) is an image classification dataset. The images are photos of traffic signs. This benchmark has the following properties:

- Single-image, multi-class classification problem
- More than 40 classes
- More than 50,000 images in total
- Large, lifelike database

Data Set Values

ClassId



Valid	43	100%
Mismatched	0	0%
Missing	0	0%
Mean	21	
Std. Deviation	12.4	
Quantiles	0	Min
	10	25%
	21	50%
	32	75%
	42	Max

All the mismatched and missing values are removed

Data set analysis

34799 Images distributed over 42 Classes

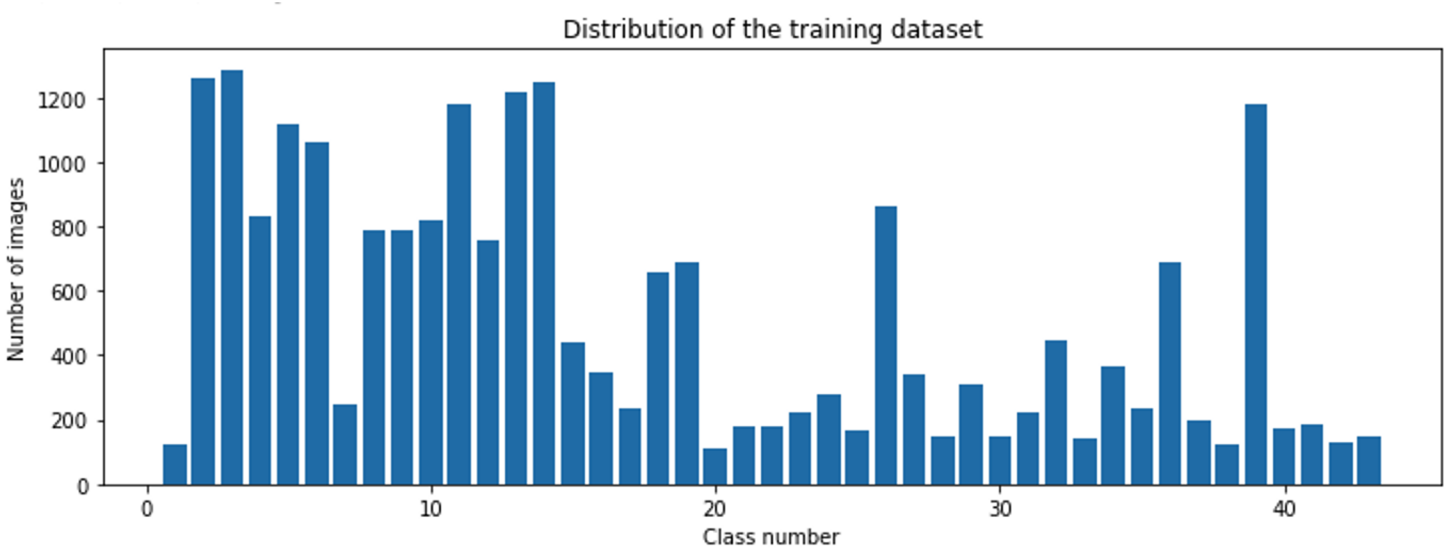
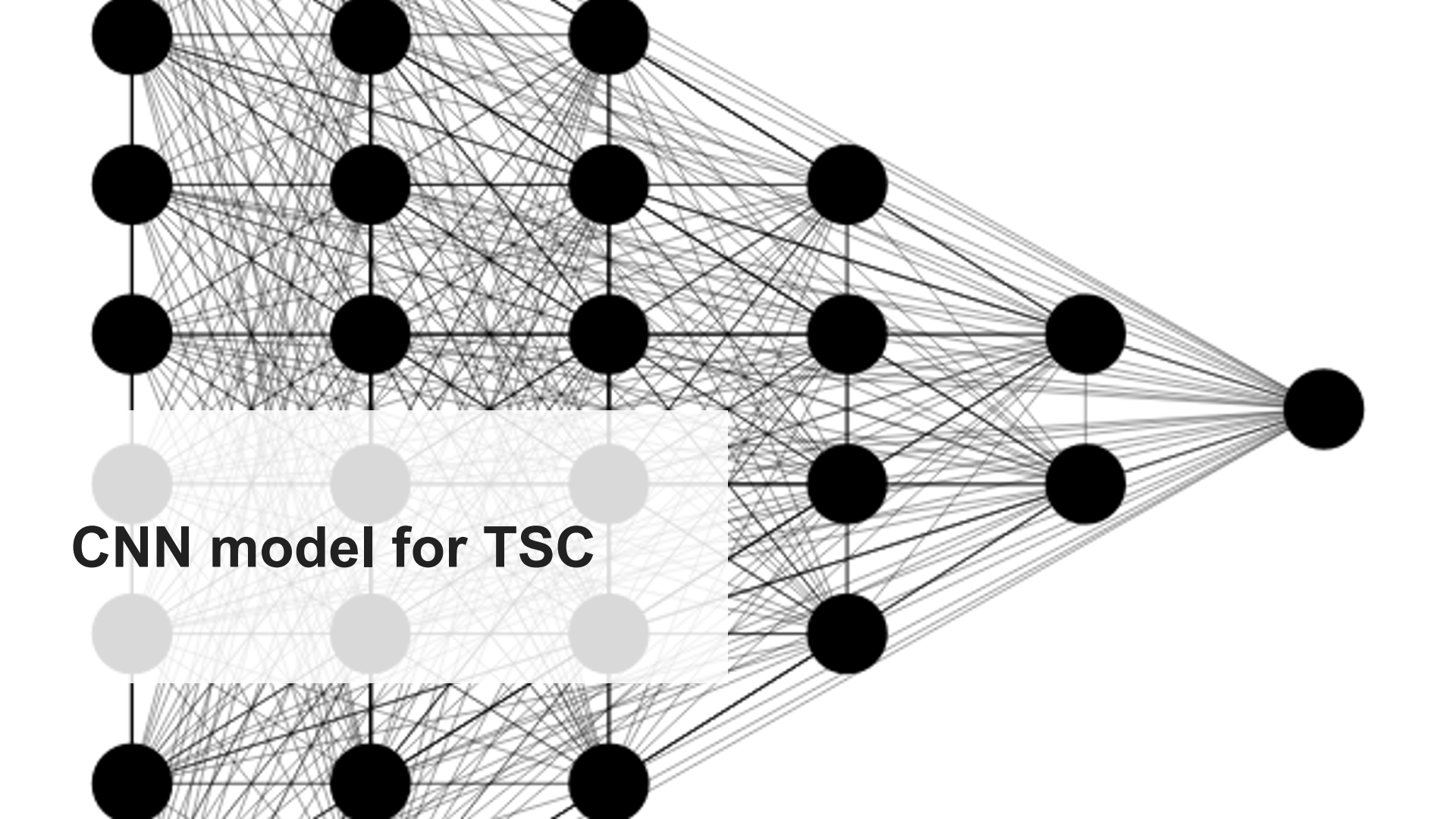


Image Classification and Augmentation

Classification

Augmentation


CNN model for TSC

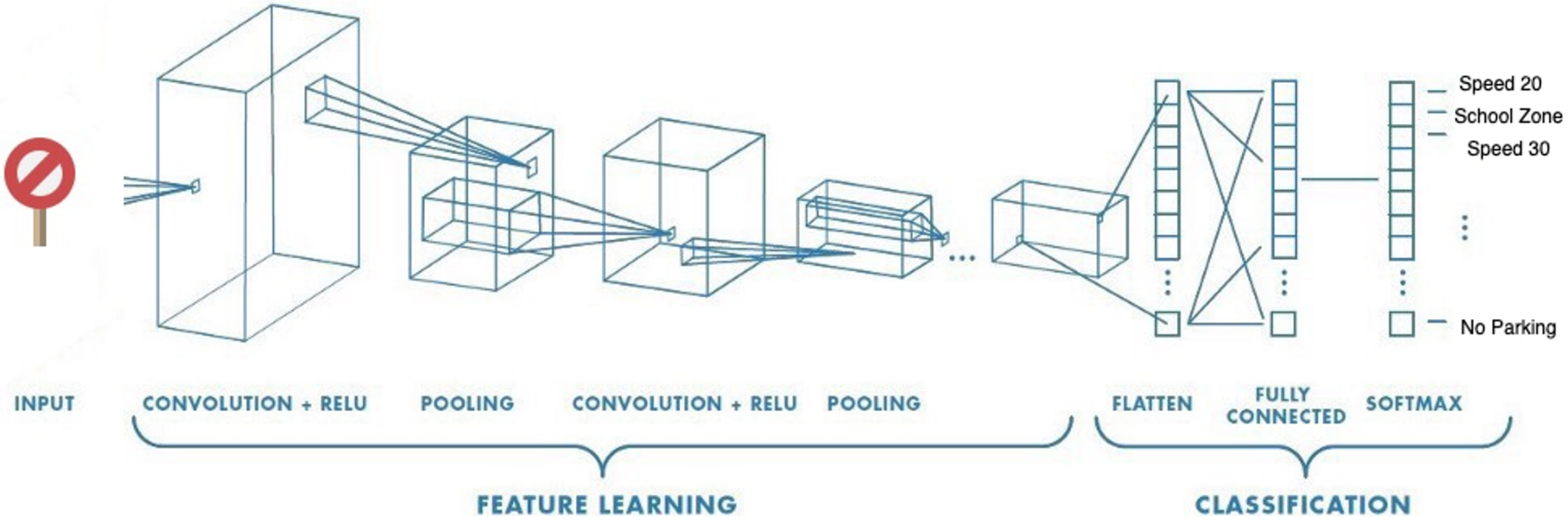
Convolution Neural Network

CNN is a machine learning algorithm that can take an input image, assign importance to various aspects or objects in the image, and be able to differentiate one from another.

CNN works by extracting the features from the images. Any CNN consists of the following:

1. The input layer which is a grayscale image.
2. The output layer which is a binary or multi-class labels.
3. Hidden Layers consisting of convolution layers, ReLU (rectified linear unit) layers, the pooling layer, and a fully connected Neural Network.

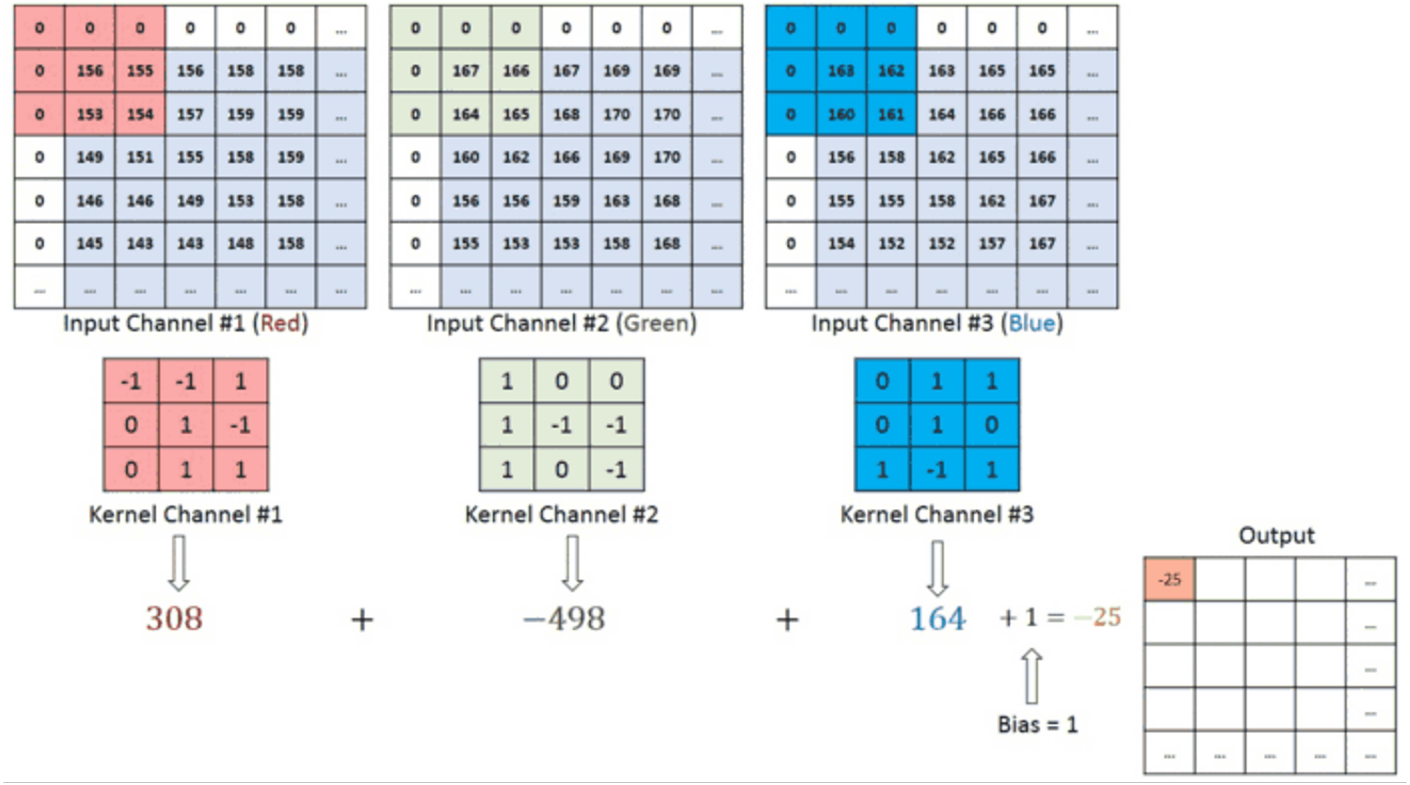
CNN Model for TSC



CNN Model Info

- Sequential Model
- 1st conv2d layer - 60 filters with 5x5 filter
- 2nd conv2d layer- 60 filters with 5x5 filter
- 3rd conv2d layer- 30 filters with 3x3 filter
- 4th conv2d layer- 30 filters with 3x3 filter
- Maxpooling with 2x2 filter
- Dropout of 0.5
- Flatten
- Dense layer with 500 nodes
- Dropout of 0.5
- Dense layer of 42 nodes with SoftMax activation.

Convolution operation on a MxNx3 image matrix with a 3x3x3 Kernel



Training the model

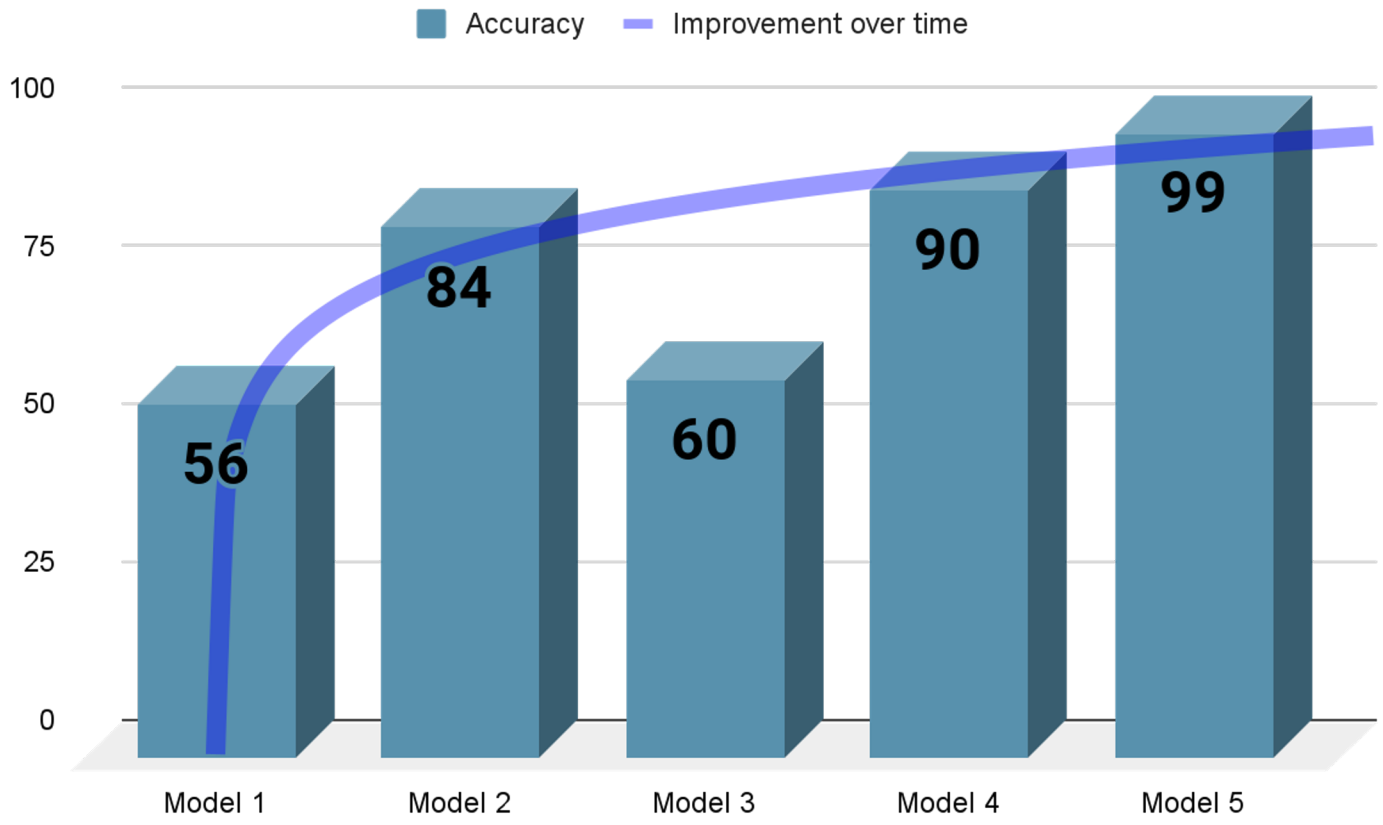
Most accurate model

- Batch Size = 500
- Steps per epoch = 400
- Epochs = 50
- Accuracy = 99%

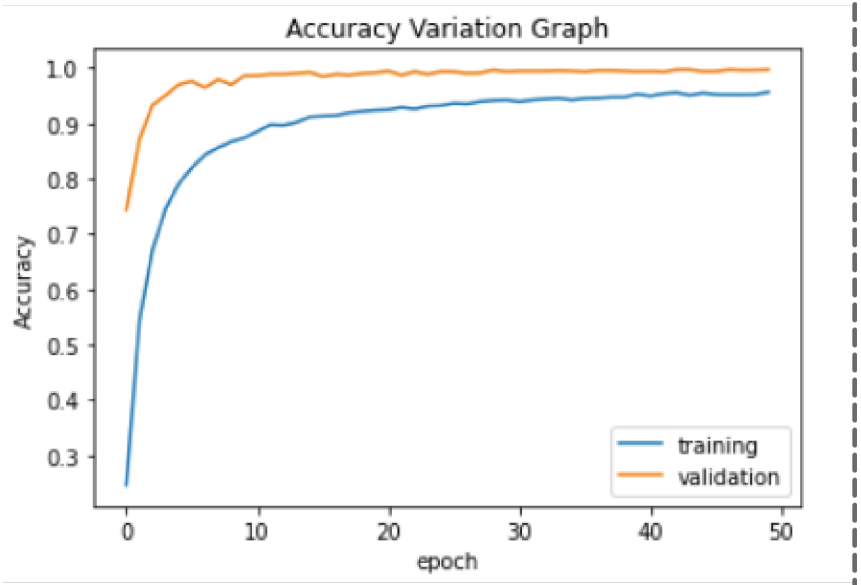
Resource Used

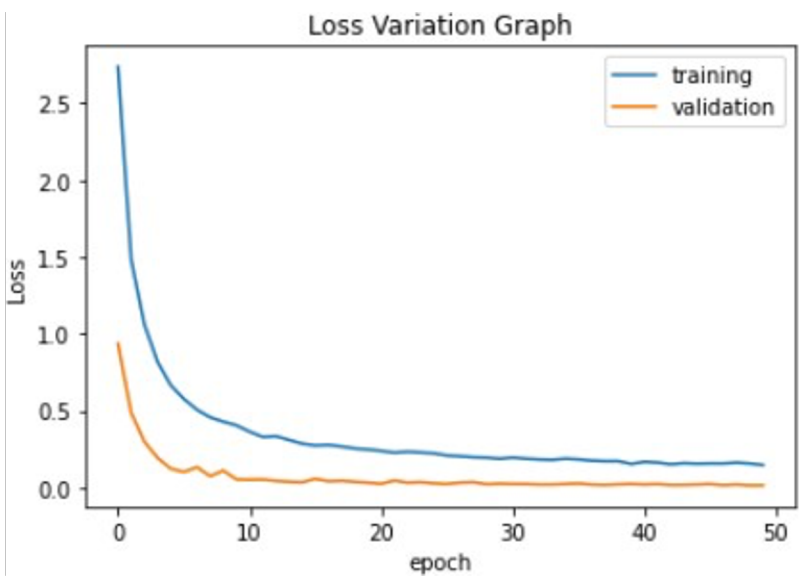
- CPU = 2 Core of Intel Xeon
- GPU = Tesla P100 16GB VRAM
- RAM = 13GB
- SSD = 10GB

Accuracy Variation of Model Instances



Loss and Accuracy Graph

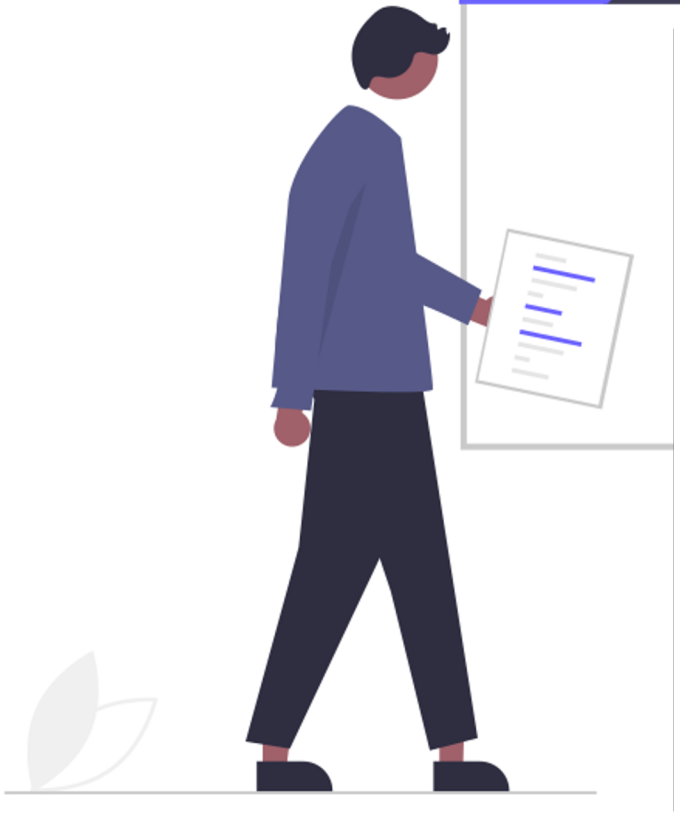




- The validation curve is above the training curve in accuracy variation graph, signifying that the model considered is not overfitting.
- Loss variation graph helps show the decline in bad predictions as the epoch count increases, further solidifying the parameters used in model 5

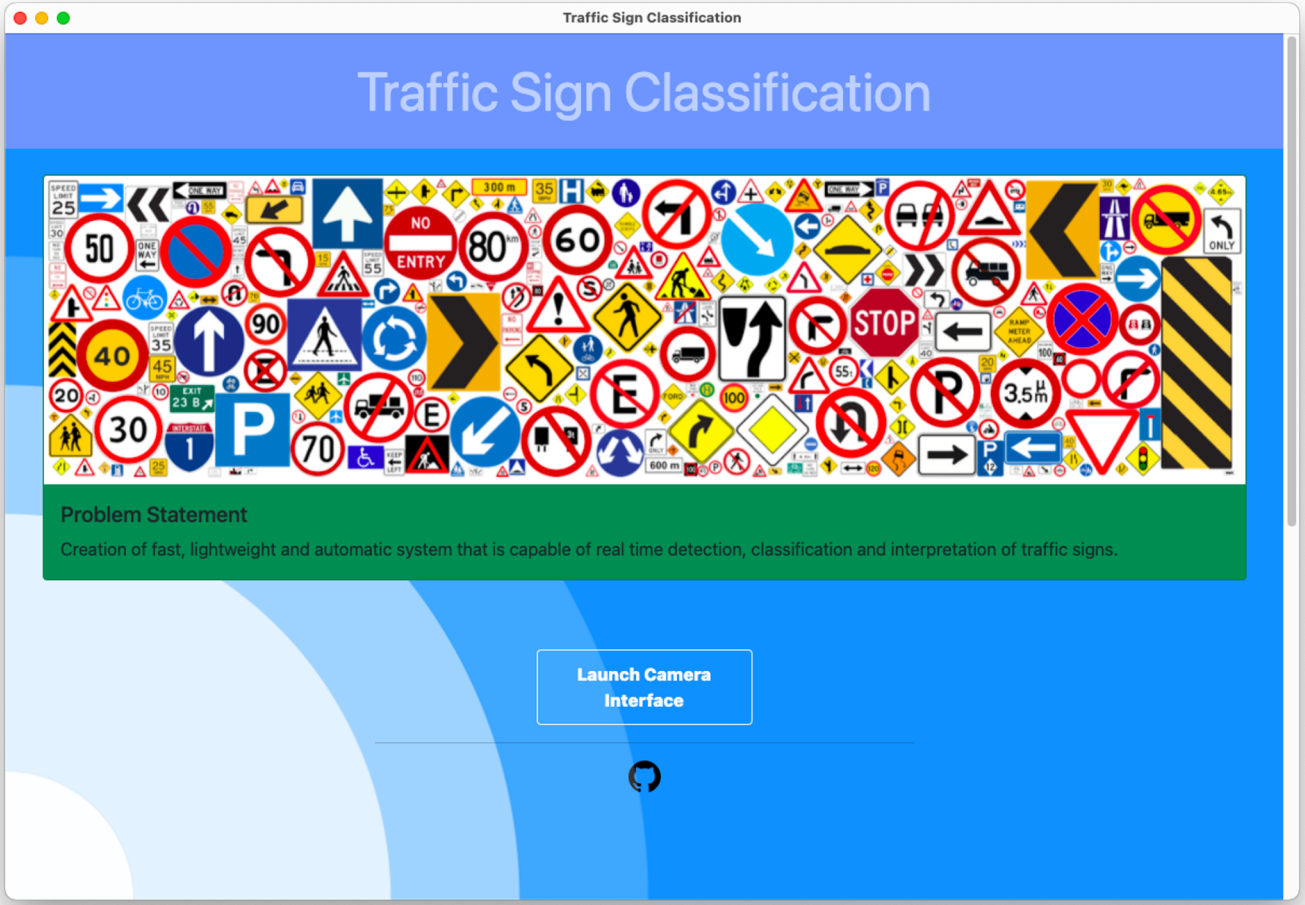
Features	System [1]	System [2]	System [3]	System [4]	System [5]	Proposed System
Signs recognition	Detects only circular signs	Doesn't detect octagonal signs	Detects all signs	Detects all signs	Detects all signs	Detects all signs
Training Time	Less	Less	Very high	High	Less	Less
Tilted Board recognition	No	No	Yes	Yes	Yes	Yes
Occluded Boards recognition	No	No	Yes	Yes	Yes	Yes
Colour Independent Recognition	No	No	Yes	Yes	No	Yes
Method	Contrast based detection	Pattern Matching	Mask R-CNN	CNN	ANN, Image Segmentation	CNN
Accuracy	96%	95%	97.5%	99%	97%	99.59 %

Outcome



- Model has achieved theoretical accuracy.
- The model was successfully serialized for future use.
- The practical use of the model yielded desirable results usable in real life scenario with minor modifications.

Practical Implementation



Project Welcome Page

Real Time Detection With Logging


```
manukashyap@Manukashyaps-MacBook-Air:~/Projects/TSC-GUI ⌥⌘1
→ TSC-GUI git:(main) ✗ cat tsc_log.txt
No: 1 Time: 20:48:01
[14] Stop 99.89%
------------------------------------------------
--
No: 2 Time: 20:48:02
[14] Stop 96.44%
------------------------------------------------
--
No: 3 Time: 20:48:03
[14] Stop 97.95%
------------------------------------------------
--
No: 4 Time: 20:48:03
[14] Stop 95.41%
------------------------------------------------
--
No: 5 Time: 20:48:03
[14] Stop 91.75%
------------------------------------------------
--
No: 6 Time: 20:48:03
[14] Stop 90.88%
```

Thank You