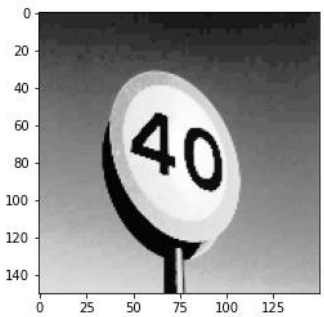
Brief Overview of CNN model:

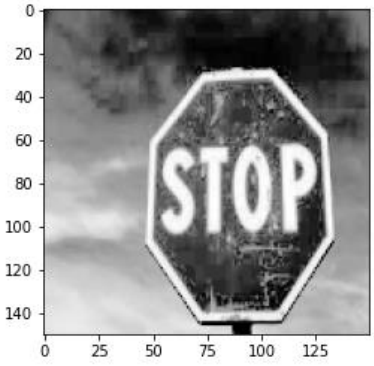
A sample image was taken outside of the data sets. Before we feed the image to the trained model it needs preprocessing. Firstly, a Image is loaded from directory for e.g. (275,183,3), then resized to the defined dimensions (150,150,3), Next it is converted to Grayscale (150,150,1). After it Histogram Equalization & Normalization was performed.

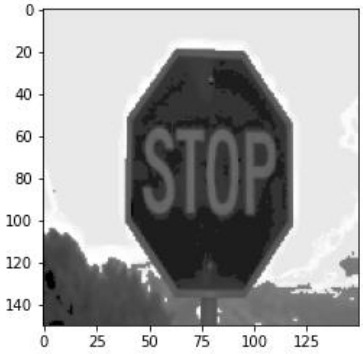
We need re-shaped the dimensions of the image, since the model accepts image as batches. Basically, here we create copies of the image in a single batch.

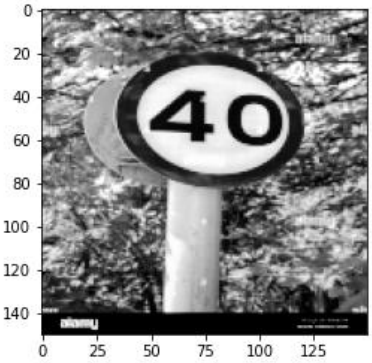
The threshold was testing phase was set at 50%. That implies if the results were >50 % it would print “Stop” with the prediction value and if the prediction value was <50% the result would print “Speed 40”.

Below are some of the sample images and preprocessed images which are fed into the trained CNN model.



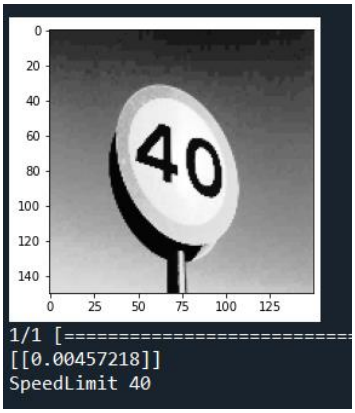


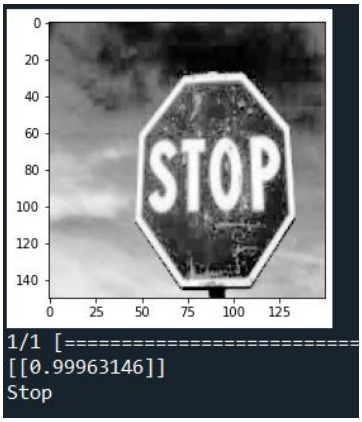


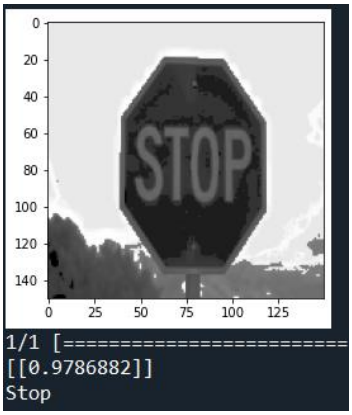


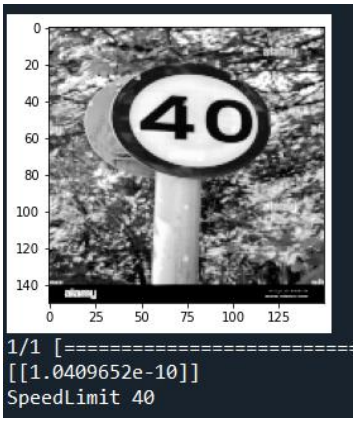
Results

After the above images are sent to the model, we have the output as shown below. Here we see the images are graded between 0 and 1. For example, the prediction value close to 0 signifies the image belongs to class 0 which is the Speed limit 40 class label and vice versa for the stop sign.









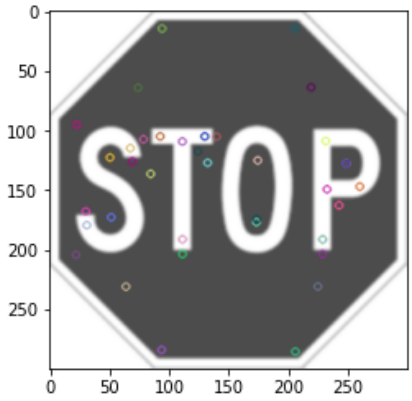
Comparison between the CNN model images with SIFT and ORB Feature Extraction Techniques

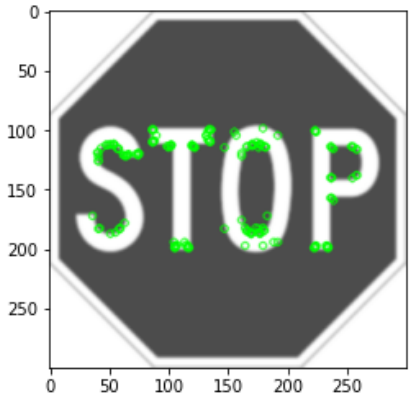
1. Stop Sign Comparison

Here we compare the stop traffic signs with the same images processed with our CNN model.

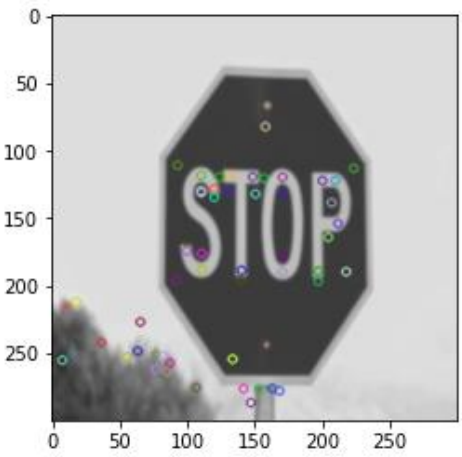
A reference image was selected for the comparison of the different images. The images are preprocessed to be resized to 200X300. Next, converted to grayscale and Gaussian blurr operation was performed.

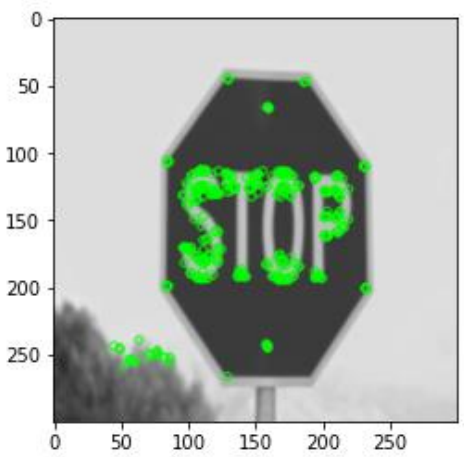
The figures below: reference image (left) for Stop sign along with the key-points computed by SIFT (middle) and ORB (right) technique.



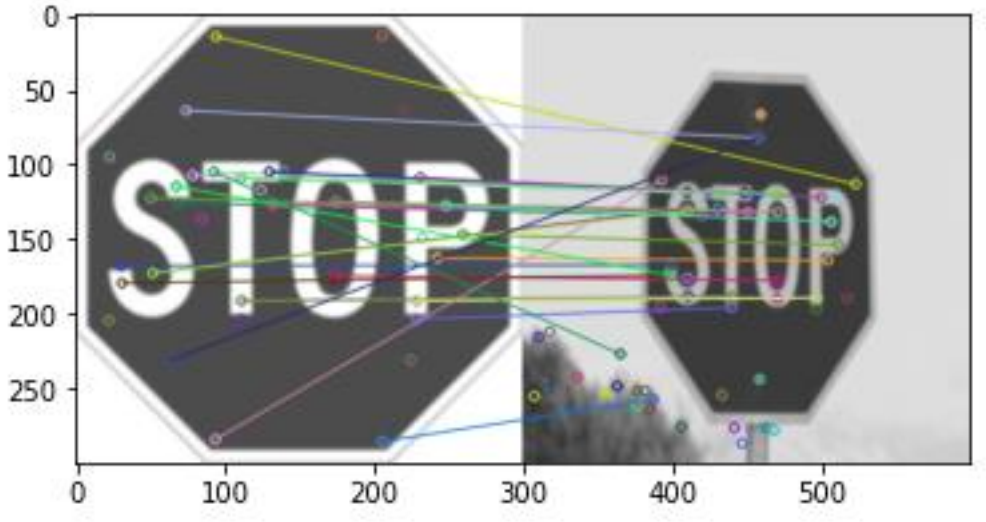


The image to be compared is shown below along with the key points is shown below:





Next the reference image is compared with the similar stop sign using SIFT technique and results are depicted below with parameters.

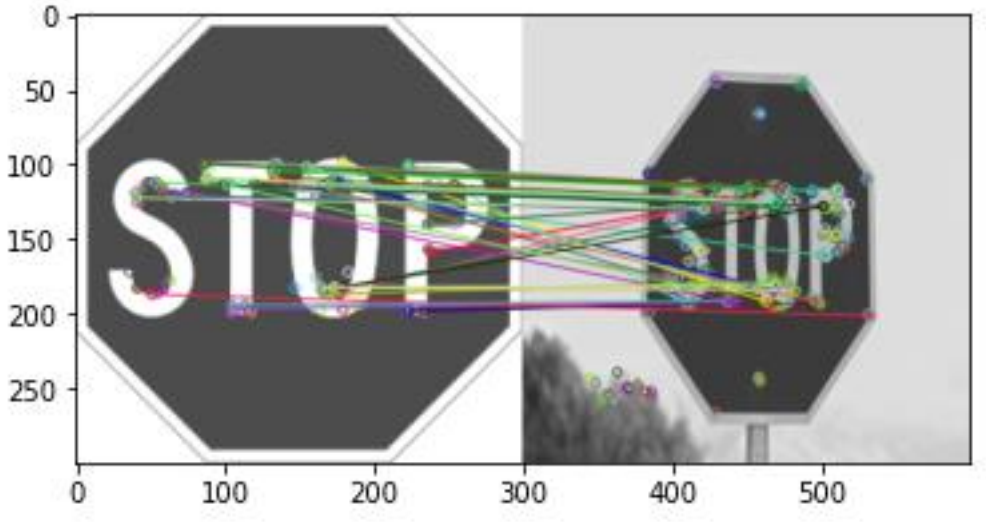


No. of key-points (Reference Image): 55

No. of key-points (Image to be compared): 70

No. of matching key-points: 30

Next the reference image is compared with the other similar stop sign using ORB technique and results are depicted below with parameters.



Here, No. of key-points (Reference Image): 183

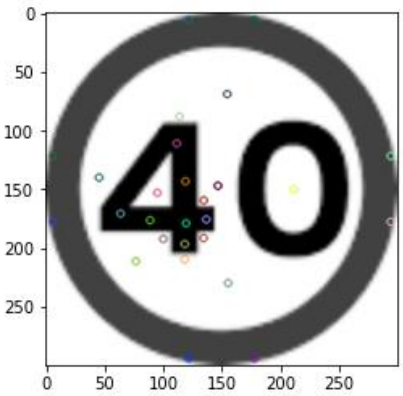
No. of key-points (Image to be compared): 359

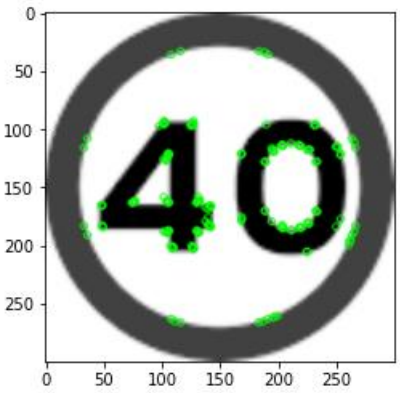
No. of matching key-points: 56

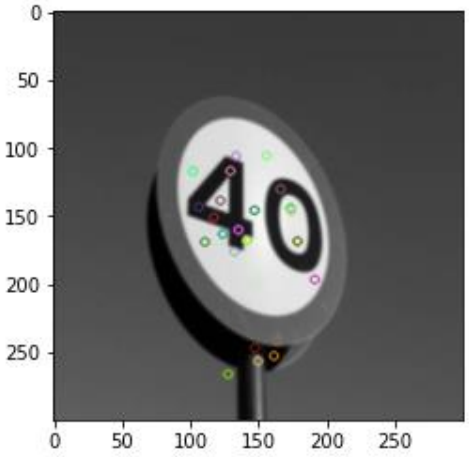
1. Speed Sign Comparison

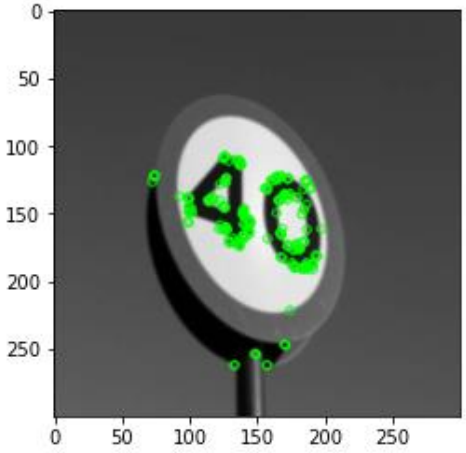
Similarly, we do the same process as mentioned ahead for the Speed 40 sign and the results are discussed here.

The figures below: reference image (left) for Speed sign along with the key-points computed by SIFT (middle) and ORB (right) techniques.

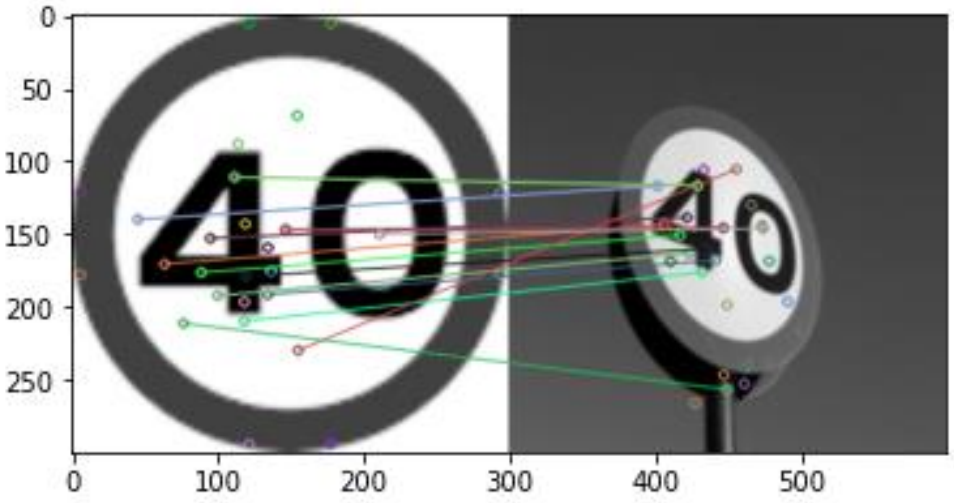








Next the reference image is compared with the similar stop sign using ORB technique and results are depicted below with parameters.

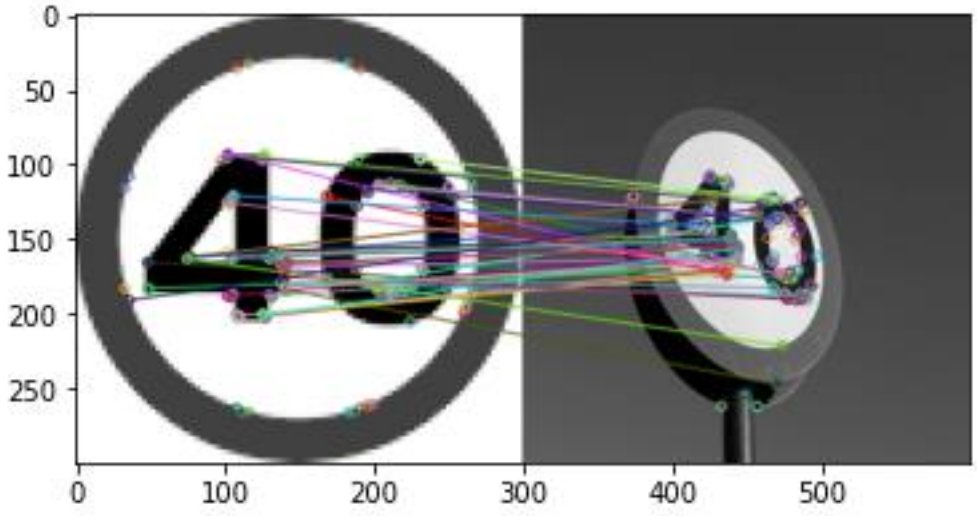


No. of key-points (Reference Image): 37

No. of key-points (Image to be compared): 36

No. of matching key-points: 18

Next the reference image is compared with the other similar speed sign using ORB technique and results are depicted below with parameters.



Here, No. of key-points (Reference Image): 193

No. of key-points (Image to be compared): 229

No. of matching key-points: 40

Discussion

The above results can be summarized in the table shown below:

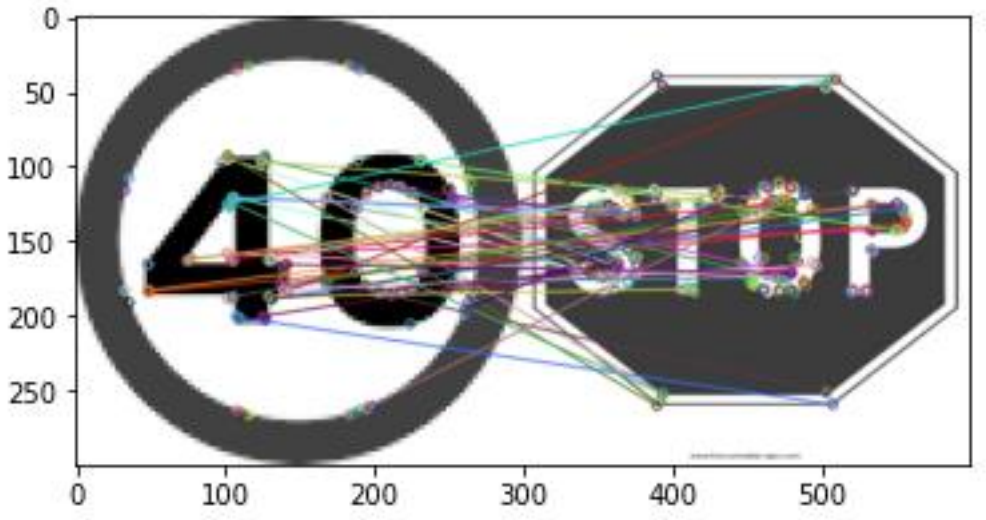
	STOP Sign			
	SIFT		**ORB**	
	Reference Image	Image 1	Reference Image	Image 1
No. of key-points	55	70	183	359
Matching Key-points	30		56	

	Speed Sign			
	SIFT		**ORB**	
	Reference Image	Image 1	Reference Image	Image 1
No. of key-points	37	36	193	229
Matching Key-points	18		40	

From the above results, we see that the ORB technique is more accurate compared to SIFT, in our case on basis of matching key-points.

In the real time application the algorithm should be able to differentiate the both signs according to the number of matching points.

To check the reliability of the ORB technique, we compared the both the signs with ORB with each other and observe the results as shown below:



Here, No. of key-points (Reference Image): 193

No. of key-points (Image to be compared): 333

No. of matching key-points: 42

Conclusion

Here, we see that comparing the stop sign and Speed 40 sign gives us the number of matching points (42) greater than the similar images compares together (40) as per previous results.

This creates ambiguity in the robot navigation command for the robot and hence, it is not reliable in our case. Additionally, on real time the processing is to be done for moving images, which may create further inaccuracy for the correct movement.