A

Mini Project Report

On

Traffic Sign Detection and Recognition Based on Convolutional Neural Network

Submitted by

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Date of Submission: 15-05-2021

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2020-2021

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Abstract: In this modern time with the development, the rate of buying automobiles is also increasing. Due to this, the road traffic is becoming more complicated and also there is high probability that the driver can not identify the traffic sign properly. Being unable to identify the traffic sign there might a huge chance of getting a accident which cause loss of life and money. To identify traffic sign accurately and effectively there is need of an intelligent traffic sign detector and recognizer. To make it possible we have developed a convolutional neural network-based model for the traffic sign detection and recognition. This model is able to identify the traffic sign with great accuracy around 97%. For this is project I have used Germen traffic dataset.

Introduction: We are living in the modern world and with the rapid development in the area of social and economics, automobiles become one of the most easy and convenient way of the transportation. Some people have their own car and some people are travelling with the public transportation like bus. With the increase of the automobiles, the road traffic environment becomes more complicated and number of traffic rules violations are normal. If we see the past five years data then the numbers of accident have increased exponentially due to not following the traffic rules and sign system. In the current traffic system, there might be case that the drivers missing the traffic sign due to overcrowded traffic or even the drivers might ignore the traffic sign. To resolve these problems, we have to come up with the intelligent transportation system. Traffic sign recognition system is a part of the intelligent transportation system which helps to identify the traffic sign accurately. Due to being identify traffic signs effectively and accurately can improve the safe driving. A traffic sign detection and recognition system can be implemented in the vehicles which captures the traffic sign, detect them and recognizes the sign and take actions according to the traffic sign. Traffic sign is important security facilities on the road, which plays a very important role in regulating traffic behavior, ensuring the safety of the roads and guiding the smooth passage of vehicle. As part of the intelligent transportation system, the detection of traffic sign is significant for driving assistance system, traffic sign maintenance, autonomous driving and other spaces. There have a lot number of research works done only for traffic sign detection in the world. But the most of the works done are only for certain categories of traffic signs, for example, the speed limit sign. Traffic sign detection is generally regarded as challenging due to various complexities, for example, diversified backgrounds of traffic sign images.

Problem Definition: We know that the efficiency and accuracy of the traffic sign detection and recognition can depend on the following factors:

- **Colour fading:** If the traffic signs are installed very long time ago then there are a lot of chances that traffic sign got faded due to long exposure to sun and rain. It becomes one of the challenges to detect the traffic sign and recognize it effectively.
- **Vehicle Motion:** If we are travelling with a very high speed, there might be chances that camera can not capture the traffic sign in a proper way and end up having a blurred image. This leads to the decrease in the efficiency of the traffic sign detection and recognition system.
- **Weather Condition:** We know that the visibility in the rainy days and winter season is very low. Camera is not able to visualize the traffic sign very well that cause the problem of low efficiency and accuracy level of the traffic sign detection and recognition system.

We have to develop our Convolutional Neural Network in such a way that also in the above described condition, the accuracy and efficiency of the traffic sign detection and recognition system does not decrease significantly.

Literature Survey: Road Traffic is the major cause for the deaths taking place in major part of the India. The data shown below is the confirmation that how traffic is reason behind the increase in the accident.

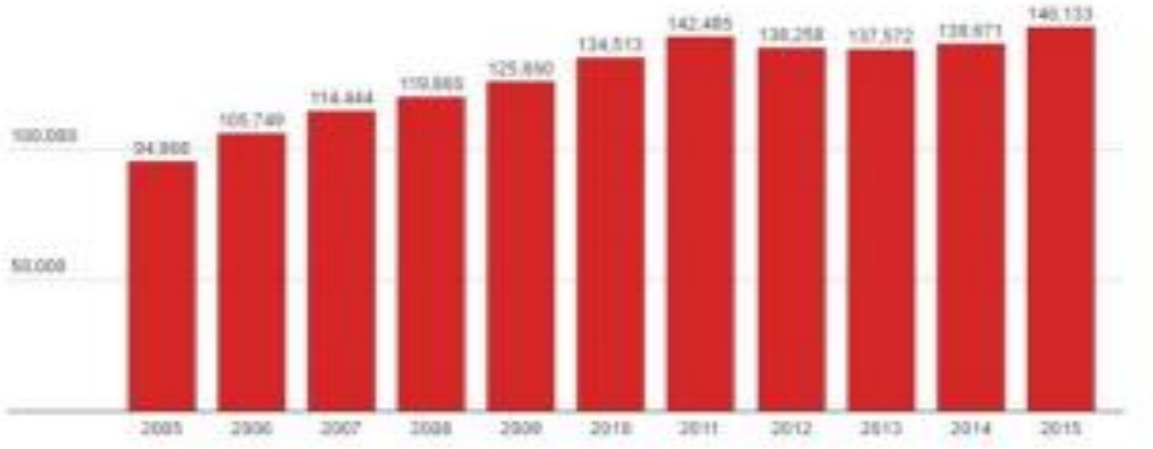


Fig: Statistics of annual year and no. of deaths due to road accidents

Ref: [Paper21104-108.pdf (inpressco.com)]

There is survey which shows that a lot of accident happens because of the misread of the traffic sign. Below is the statistical data is shown.

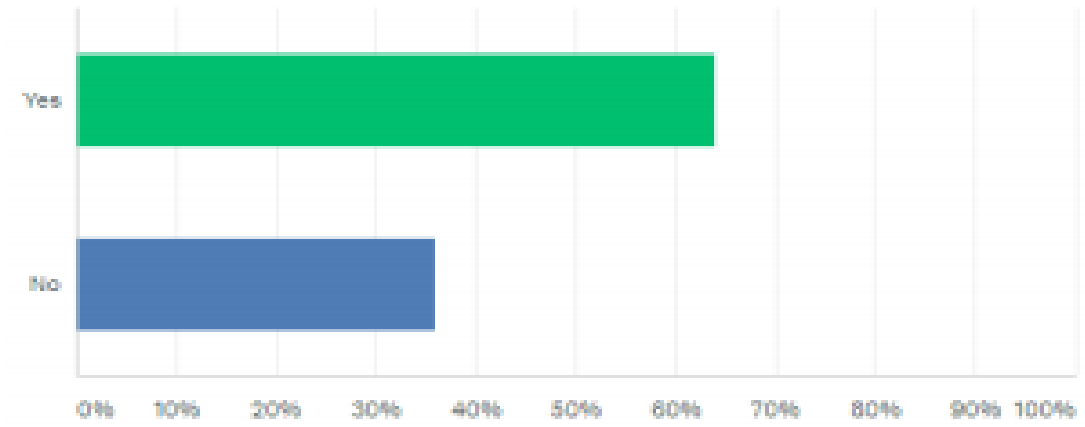


Fig: Statistics of regret caused among drivers due to missed road traffic signs

Ref: [Paper21104-108.pdf (inpressco.com)]

This above diagram represents the data percentage of drivers regretted, due to missing of road traffic sign boards.

By analysing all the survey, we come with one solution that there should be an efficient system for the traffic sign detection and recognition.

We have proposed the basic block of traffic sign detection using image processing.

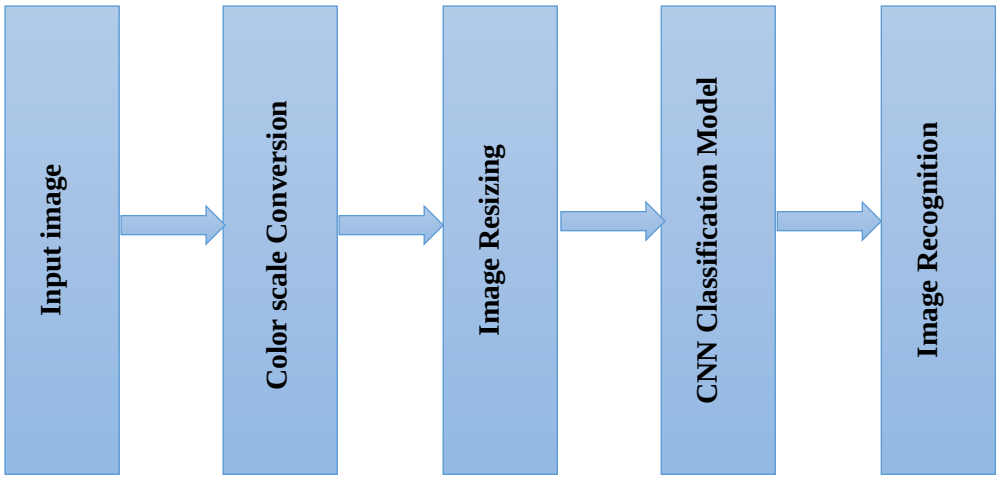


Fig.: Basic Block Diagram of traffic sign detection using Deep Learning

We will see development in a better way for traffic sign detection and recognition using deep learning and Convolutional Neural Network**.**

Implementation

Dataset: GTSRB - German Traffic Sign Recognition Benchmark dataset is used to develop and train the traffic sign detection and recognition system. This dataset is downloaded from the https://www.kaggle.com/meowmeowmeowmeowmeow/gtsrb-german-traffic-sign **.** This dataset has following properties: -

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

For any model development, dataset is important. There is also a importance of the dimensions of the dataset. In this dataset our main focus is on the images. Images can have the various dimensions.

Data Preprocessing: Data Preprocessing is very important in the deep learning and neural network. First check the dimension of all the images of the dataset is same or not. If not same we can pre-process the images into having similar dimensions. We also explore our dataset by plotting a distribution which provides us more insight of the data and number of classes and number of images per class.

- **Image Enhancement:** The main purpose of the data preprocessing is to eliminate the unused information in the images and get the useful information. A pre-processed dataset improves the accuracy of detection and classification of traffic sign and hence the overall performance is improved.

In this paper our main focus is on image enhancement and colour space conversion for image preprocessing.
Image enhancement is basic operation which is used to make unclear messages from the image clear so that important messages can be obtained from the image. The most common method of image enhancement are mean filtering and median filtering.

- **Image Resizing:** Since all the image available in the dataset is not of same size. To overcome this problem, we resized all available to 30 x 30 before giving it to the deep learning model

Model Used:

I have used the below model (figure) for the traffic sign classification and detection. In this model I have used 8 layers which consists of 4 convolutional layer, 2 max polling layer, 2 fully connected layer.

- Every intermediate layer uses Relu activation function.
- To overcome the problem of overfitting I have used dropout with the rate of 0.25 and 0.5.
- Since in the traffic sign dataset there are 43 difference classes because of that I have used softmax function in the last layer.
- Categorical_crossentropy is used as loss function.
- Adam is used as optimizer.

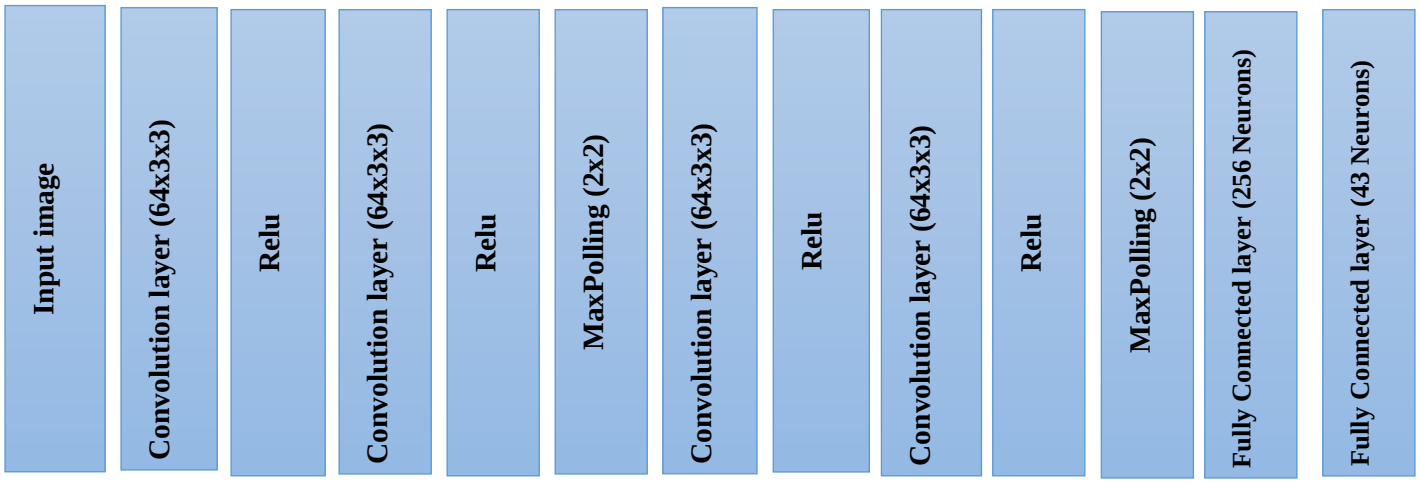
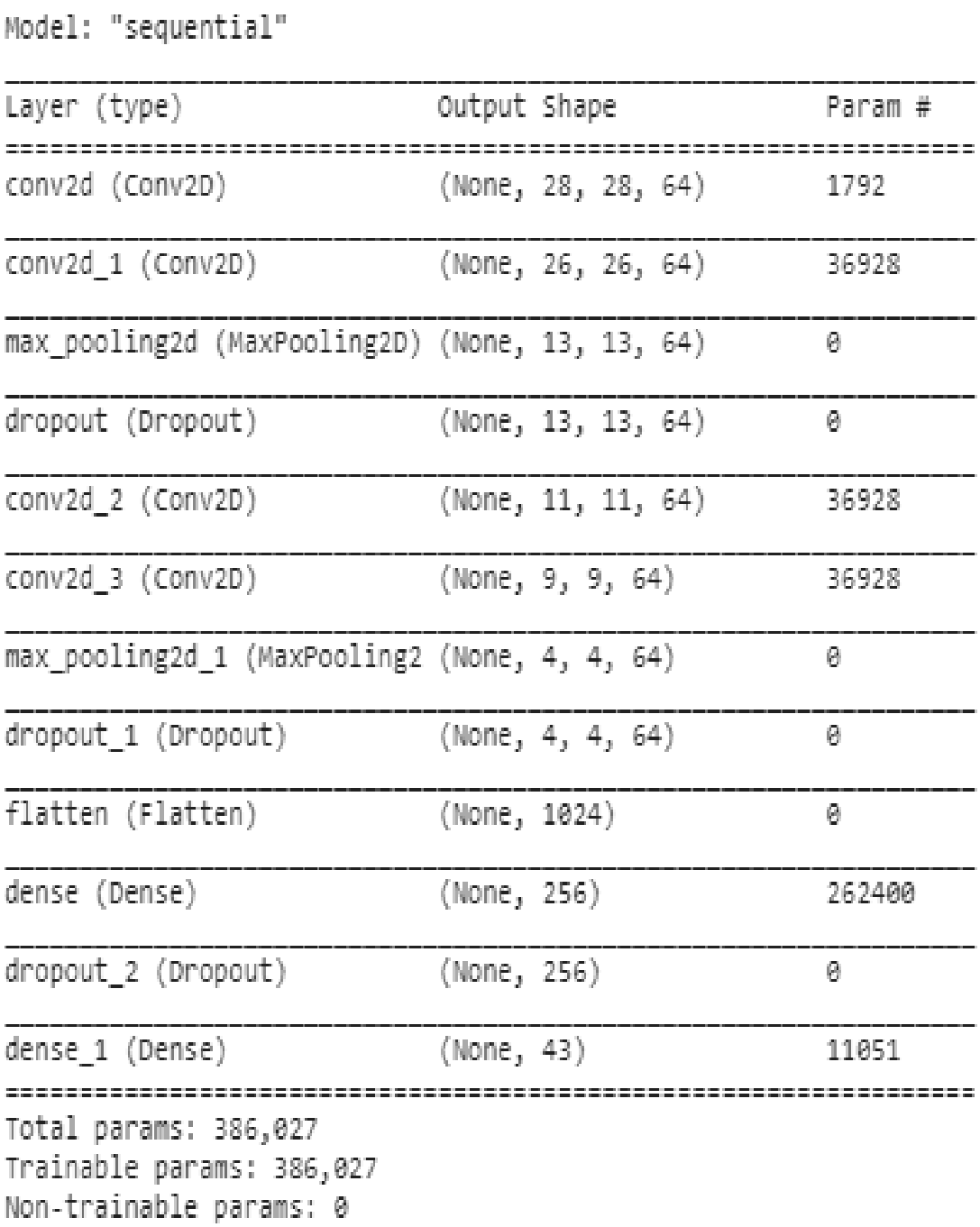


Fig: This is the basic block diagram of the CNN Model used.



```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 28, 28, 64)        1792
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 26, 26, 64)        36928
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 13, 13, 64)        0
_________________________________________________________________
dropout (Dropout)            (None, 13, 13, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 11, 11, 64)        36928
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 9, 9, 64)          36928
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 4, 4, 64)          0
_________________________________________________________________
dropout_1 (Dropout)          (None, 4, 4, 64)          0
_________________________________________________________________
flatten (Flatten)            (None, 1024)              0
_________________________________________________________________
dense (Dense)                (None, 256)               262400
_________________________________________________________________
dropout_2 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_1 (Dense)              (None, 43)                11051
=================================================================
Total params: 386,027
Trainable params: 386,027
Non-trainable params: 0
```

Fig: This above figure shows the model summary

Result:

- We got a training accuracy around 97% with avg training error ranging between 10-12%.
- We got a validation accuracy around 99% with validation error ranging between 4-5%.
- We got testing accuracy 96.5% on the testing dataset.

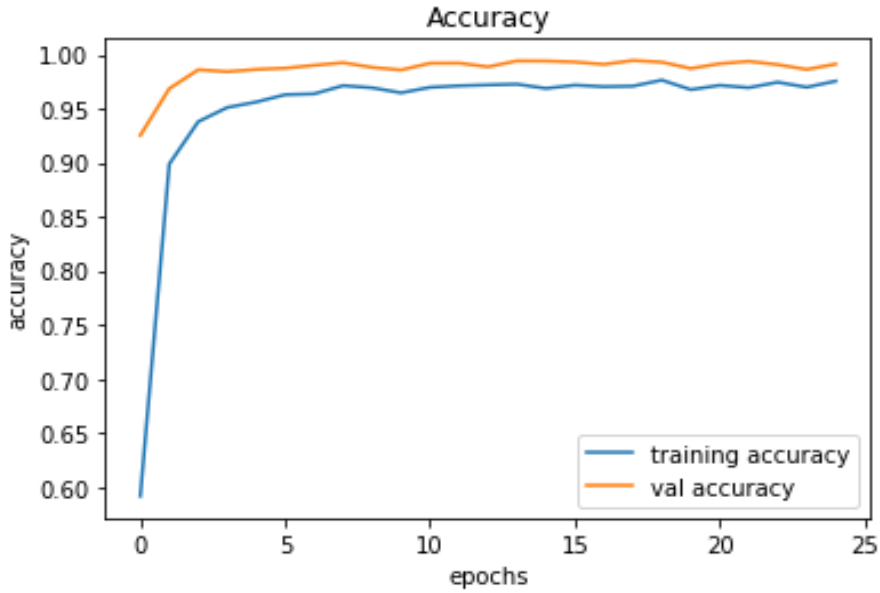


Fig: This above graph shows the training and testing accuracy on the training dataset

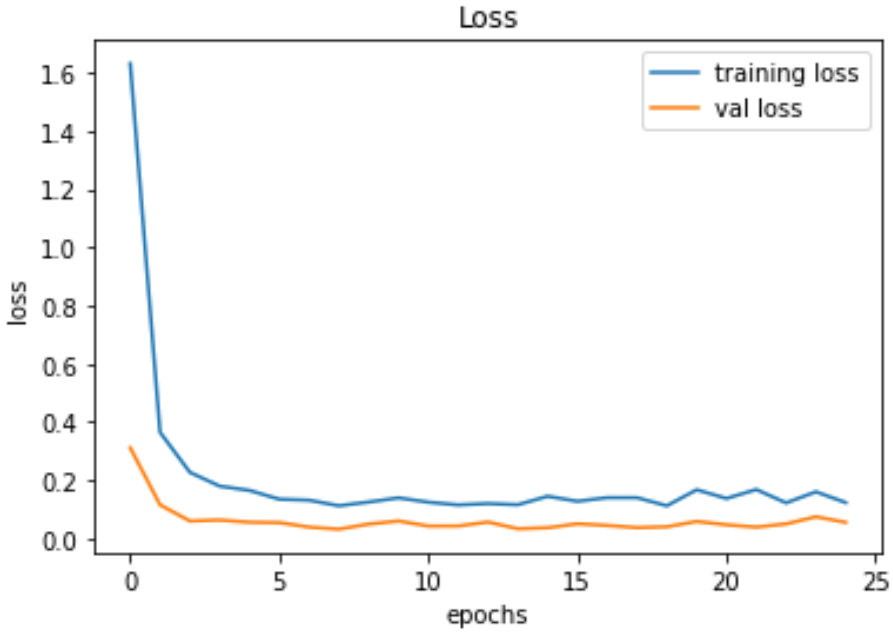


Fig- This above graph shows the training and validation error on the training dataset

	precision	recall	f1-score	support
0	0.984	1.000	0.992	60
1	0.960	0.994	0.977	720
2	0.964	0.995	0.979	750
3	0.933	0.962	0.947	450
4	0.992	0.973	0.982	660
5	0.936	0.946	0.941	630
6	1.000	0.833	0.909	150
7	0.987	0.984	0.986	450
8	0.972	0.933	0.952	450
9	0.926	0.996	0.960	480
10	0.997	0.945	0.970	660
11	0.995	0.912	0.952	420
12	0.987	0.994	0.991	690
13	0.985	0.993	0.989	720
14	1.000	1.000	1.000	270
15	0.986	0.995	0.991	210
16	0.987	0.993	0.990	150
17	0.994	0.989	0.992	360
18	0.982	0.851	0.912	390
19	1.000	1.000	1.000	60
20	0.988	0.989	0.947	90
21	0.988	0.922	0.954	90
22	0.948	0.908	0.924	120
23	0.846	0.987	0.911	150
24	0.988	0.944	0.966	90
25	0.948	0.956	0.952	480
26	0.927	0.844	0.884	180
27	0.714	0.917	0.803	60
28	0.974	0.987	0.980	150
29	0.988	0.889	0.936	90
30	0.752	0.807	0.778	150
31	0.947	0.996	0.971	270
32	0.968	1.000	0.984	60
33	0.959	0.990	0.974	210
34	0.937	0.992	0.964	120
35	0.987	0.992	0.990	390
36	0.934	0.942	0.938	120
37	1.000	0.967	0.983	60
38	0.996	0.962	0.979	690
39	1.000	0.956	0.977	90
40	0.988	0.989	0.947	90
41	0.864	0.850	0.857	60
42	0.826	1.000	0.905	90
accuracy			0.963	12630
macro avg	0.950	0.955	0.951	12630
weighted avg	0.965	0.963	0.963	12630

Fig: This above diagram shows the Precision, Recall and F1 score for all the 43 classes.

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