Classification of Traffic Signs using Convolutional Neural Network

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***Abstract*— Traffic signs are the important aspect of people's safety while driving. Though there are traffic signs at each corner of the road to indicate some instruction. We often find it difficult to understand what that traffic sign actually mean. There are in total 43 different traffic signs according to German Traffic Sign Recognition Benchmark. Our system approaches to solve this problem of classification and identification of these various traffic signs. Our system uses the German Traffic Sign Recognition Benchmark (GTSRB) dataset to identify and classify traffic signs using Convolutional Neural Network. As the pre-processing needed in CNN is less, We prefer using Convolutional Neural Network. The system captures the image of the traffic sign in real time and classify the image from the 43 classes to identify the traffic sign.**

***Index Terms*— Convolutional Neural Network, German Traffic Sign Recognition Benchmark, Traffic Signs.**

I. INTRODUCTION

Convolutional Neural Network has gained importance nowadays. In traffic areas, Traffic Signs Identification as well as classification can be used to classify various traffic signs.

Our system help drivers to identify the traffic sign without any time lapse and can avoid confusions of identification which can cause an accident. This allows the driver to control their speed, to stay focused and to follow all the traffic rules with comfort.

Traffic signs provide us information and help us accordingly so that we can travel safely while travelling. This system of Identification and classification can be very useful in Automatic Driver Assistance Systems.

In Today's world, the advancement in technology has improved significantly which makes the system sustainable for the upcoming technology-driven world.

II. PROJECT WORKFLOW

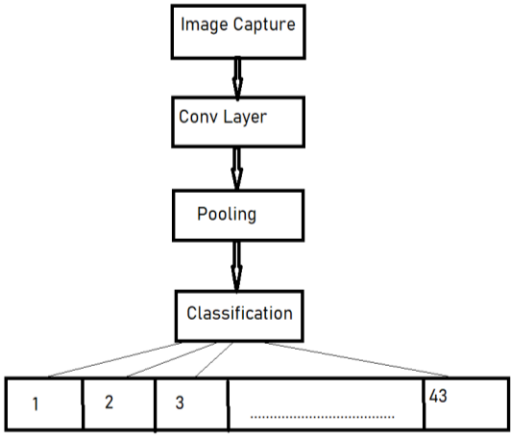

Fig: Project Workflow

A. Capturing of Image

First stage in the process of classification is capturing of the image. Image is captured through electronic camera, dashcams or webcams.

B. Convolutional Layer

Convolution of the captured image takes place. Processing of every pixels takes place.

C. Pooling

Processing of the Results from the convolutional layer takes place in Pooling stage.

D. Classification

Finally, classification of the image takes place.

III. LITERATURE SURVEY

J. Stallkamp, M. Schlipsing, J. Salmen, and CIgel, "The German traffic sign recognition benchmark: a multi-class classification competition," [6]. The outputs of the competition show that the machine algorithms perform very good in the difficult task of traffic sign recognition. They were successfully in achieving a very high performance of up to 94% positive recognition rate which is similar to human based performance on this dataset.

K. L. Valentyn Sichkar, Sergey A. Kolyubin, "Effect of various dimension convolutional layer filters on traffic sign classification accuracy" [7]. This study proposes a classification and identifications model for traffic signs detection together with chosen evaluation metrics and baseline outputs. Further, they use different filters of CNN.

Zaibi A., Ladgham A., & Sakly A, [1] worked on "A Lightweight Model for Traffic Sign Classification Based on Enhanced LeNet-5 Network" for classifying various different traffic signs using Convolutional Neural Networks(CNN).

IV. PROPOSED SYSTEM

Our Proposed system uses Convolutional Neural Networks(CNN) for classification of images as the pre-processing required in the CNN is less compared to any other classification deep learning or machine learning algorithm. The device captures the image and perform processing at pixel level.

CNN takes help of Neural Network. The Neural Network works in the same manner as the neurons in the brain. Each Neuron works as a messenger for the other neighboring neurons.

V. METHODOLOGY

1.In Sequence add the layers: Two CONV(Convolutional) layers, Single pooling layer, flatten layer, dropout layer, dense layer, then a dropout layer and at the end, the dense layer.

2.In the CONV(Convolutional) layer, count of filters is already determined. It starts the convolution operation on the captured original image and outputs a feature map for further processing.

3.The Rectified Linear Unit i.e ReLU function does the max function to convert the negative feature value to zero without replacing the positive values and outputs a rectified feature map for processing.

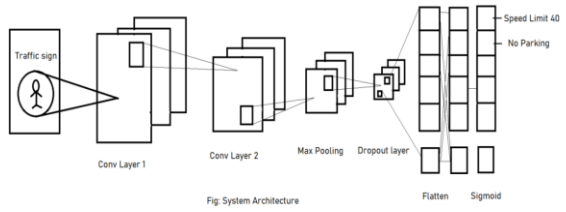

Fig: System Architecture

4. The Next layer which is the Pooling Layer takes the corrected and rectified feature map and does a down-sampling operation like Maximized Pooling or Average pooling and further reduces the dimensionality parameters of the image.

5.The flatten layer is used for the purpose to convert the input provided feature map to a single dimensional array.

6.The dropout layer is used to avoid the condition of overfitting by imposing some of the input neurons of the CONV to zero during the training process.

7.After adding of the layers, the model has to undergo compilation. The Compilation of the model initiates at this stage. After the completion of the stage. The CNN model has to undergo training with the help of training images dataset.

8.Further, the CNN model is trained using the dataset, by providing the pre-processed images from the training images dataset.

9.Finally, the identification and classification on the testing data are completed using the training completed model and the traffic sign identified name along with the class Identity is shown as an output to the user.

VI.RESULTS AND DISCUSSIONS

Table: Performance comparison of various models.

We have used ResNet Architecture of Convolutional Neural Networks for the proposed system which is commonly known as Residual Network Architecture

Data Samples	Caffe Net	Google Net	Alex Net	VGG Net	Res Net
100	73.2	73.5	74.2	73.98	79.23
200	76.2	77.2	75.7	74.2	83.6
500	75.2	79.5	77.8	76.6	90.3
1000	82.1	89.9	83.2	85.0	98.2

and got an accuracy of 98.2%.

The factors considered for calculating performance of the model includes execution time, memory consumption, overhead in the network.

Some output images of the proposed system:

Fig: STOP Traffic Sign

Class:[14]Stop :-Above result is obtained after classification done using CNN Algorithm .After classification it has obtained a probability of 99.63%.there are total 43 labels(used for classification)out of which(label=Stop)is 14th label obtained after classification.

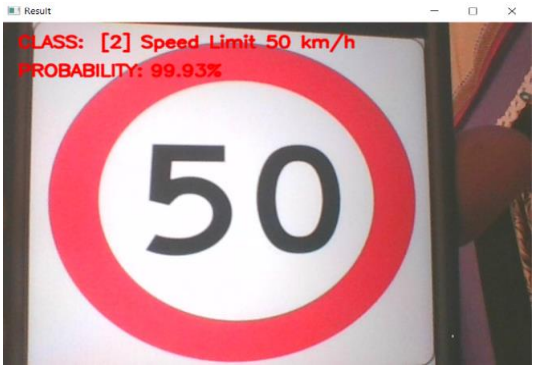

Fig: Speed Limit 50km/h

Class:[2]Speed Limit(50 km/h) :-Above result is obtained after classification done using CNN Algorithm .After classification it has obtained a probability of 99.93%.There are total 43 labels(used for classification)out of which(label= Speed Limit)is 2nd label obtained after classification.

Fig: Roundabout Mandatory

Class:[40]Roundabout mandatory :-Above result is obtained after classification done using CNN Algorithm .After classification it has obtained a probability of 93.58%.There are total 43 labels(used for classification)out of which(label= Roundabout mandatory)is 40th label obtained after classification.

VII. CONCLUSION

The proposed system of Traffic Signs Classification using Convolutional Neural Network(CNN) can help drivers identify traffic signs which can help them solve confusion identifying traffic signs which can help them to avoid road accidents as well.

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