ROAD SIGN RECOGNITION AND ANNOUNCEMENT USING MACHINE LEARNING

Nathi Prakash M[*1], Mohammed Roshan M[*2], Pavithran

C J [*3], Mrs. Sugantha Priyadharshini P[*4]

[1,2,3]*UG Student, Department of Computer Science, Sri Ramakrishna Engineering College, Coimbatore, Tamil Nadu, India*

[4] *Assistant Professor, Department of Computer Science, Sri Ramakrishna Engineering College, Coimbatore, Tamil Nadu, India*

ABSTRACT

Abstract - *The main purpose of the project is to create a road sign detection system which detects road signs and displays and announces it to the driver. In order to solve the concerns over road and transportation safety, road sign detection and recognition system is required. The system should detect and recognize road signs from and within images captured by cameras or imaging sensors. In adverse road conditions, the driver may not notice road signs, which may cause accidents. In such scenarios, the system comes into action and recognizes the signs and announces it to the driver..*

Keywords: - *Road sign recognition, CNN, Adam Optimizer, ReLU function, Pyttsx3.*

1. INTRODUCTION

Today, the number of vehicles is rapidly increasing. In parallel, the number of ways and road signs have increased. As a result of increased road signs, the drivers find it hard to focus on road signs and the other vehicles in adverse driving conditions. A system to automatically recognize the road signs and announce them to users is needed to make the driving easy and reduce the accidents. The road sign recognition and announcement system meet this need. Also, to achieve level 5 autonomous, it is necessary for vehicles to understand and follow all traffic rules. Many researchers and big companies like Tesla, Uber, Google, Mercedes-Benz, Toyota, Ford, Audi, etc. are working on autonomous vehicles and self-driving cars. So, for achieving accuracy, the system must identify the road signs accurately and take decisions accordingly. Our system includes road sign recognition and announcement. In this project, some image processing techniques are used to detect traffic signs and CNN (Convolutional Neural Network) is used to recognize traffic signs. Both more accuracy rate result and low computational cost are obtained from our system in its recognition stage. Experimental results show that our model is highly reliable, and the processing time is reasonable.

2. METHODOLOGY

In a Convolutuional Neural Network it consists of several convolutional layers and more than one layer which is fully connected as a standard multilayer neural network. The architecture is designed in such a way that it takes advantage of 2d structure of an image which is given as input. This can be achieved through local connections weights can be tied followed by some form of pooling which results in translation invarient feature. An advantage of CNN is that they can be easily trained and can have many fewer parameters than fully connected networks with Hidden units of same number.

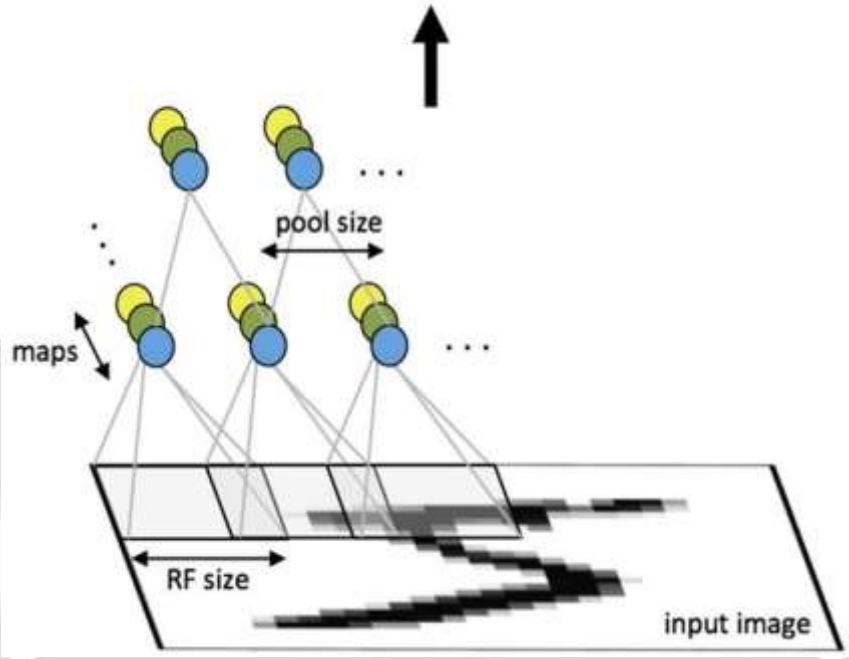


FIG 1 - CNN Maps

CNN contains a number of subsampling and convolutional layers optionally followed by fully connected layers. The input given to the convolutional layer is m x m x r image where r is the number of channels and m is the height and width of the image, CNN does not know exactly where to match there features so it tries them everywhere, in every possible position. We make it a filter in calculating the match to a feature across the whole image. Convolution is the math we perform here, from which the name is derived as convolutional neural network.

2.1 Proposed workflow using CNN

In our proposed model, the images are taken from a Kaggle dataset for the application and using CNN the model is built and finally the recognition is done.

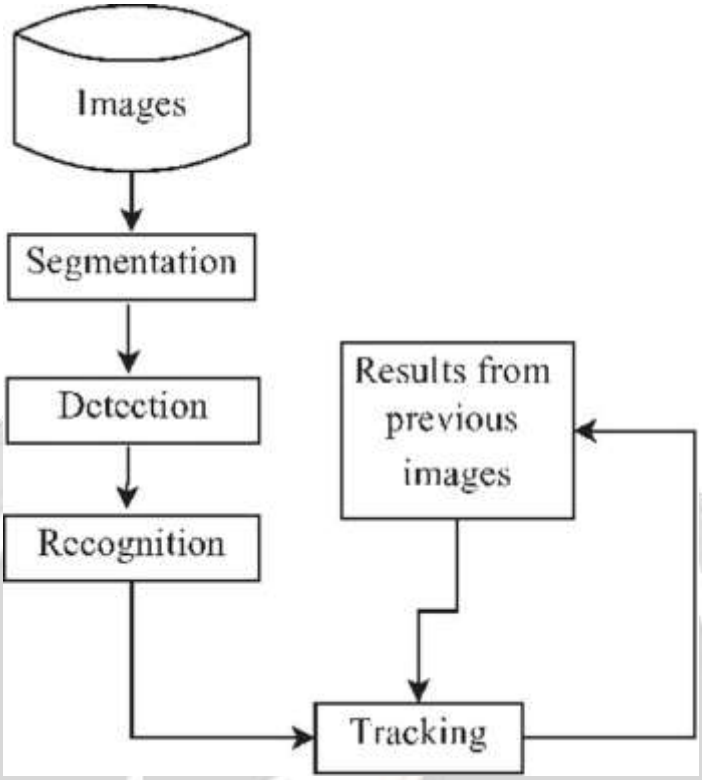


FIG 2 - Workflow of CNN

In an image the road signs are detected by certain rules which might restrict colour, shape and require signs to appear only in limited regions .The template matching method is used to recognize them and they are tracked through a sequence of images. It is a fast and simple method which can be modified and include new classes of signs. For an example, all the warning signs are almost diamond shaped and are in orange colour, while the regulatory signs are red with white writing or white with black writing. To locate signs in image sequence we make use of both colours and shapes.

2.2 Feature extraction using CNN

We multiply each pixel in the feature by the value of the corresponding pixel in the image in order to compute the similarity of a feature to the patch of an image.

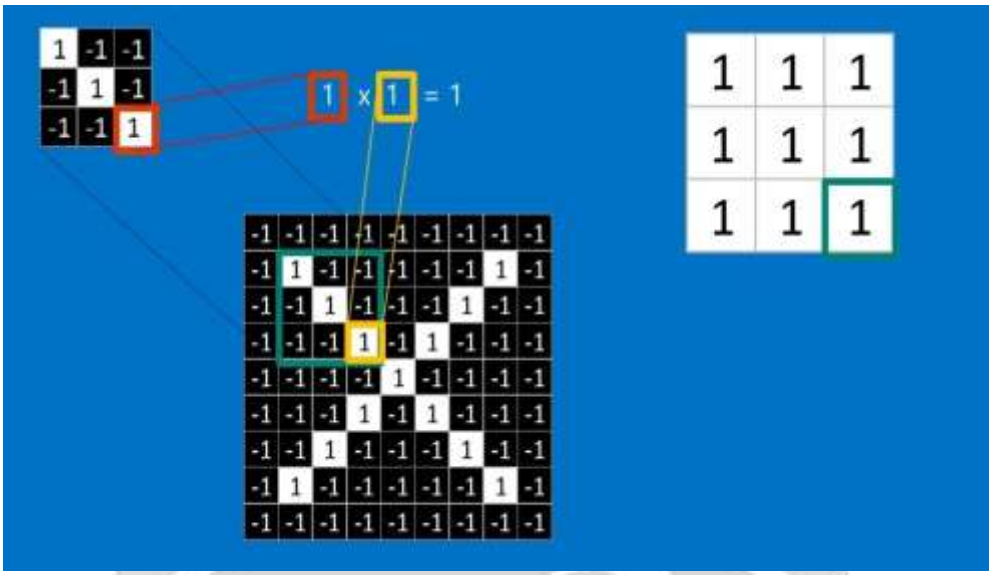


FIG 3 - Feature extraction

Then we have to add the answers and divide it by the total number of pixels. If both pixels are white then multiplied value is 1. If both are black, then (-1) * (-1) = 1. Somehow the result is 1 for every matching pixel whereas for mismatched pixel the result is -1. The result will be 1 if all the pixels match in a feature when we add and divide them by total number of pixels. Likewise if none of the pixels match in a feature then the answer is -1.

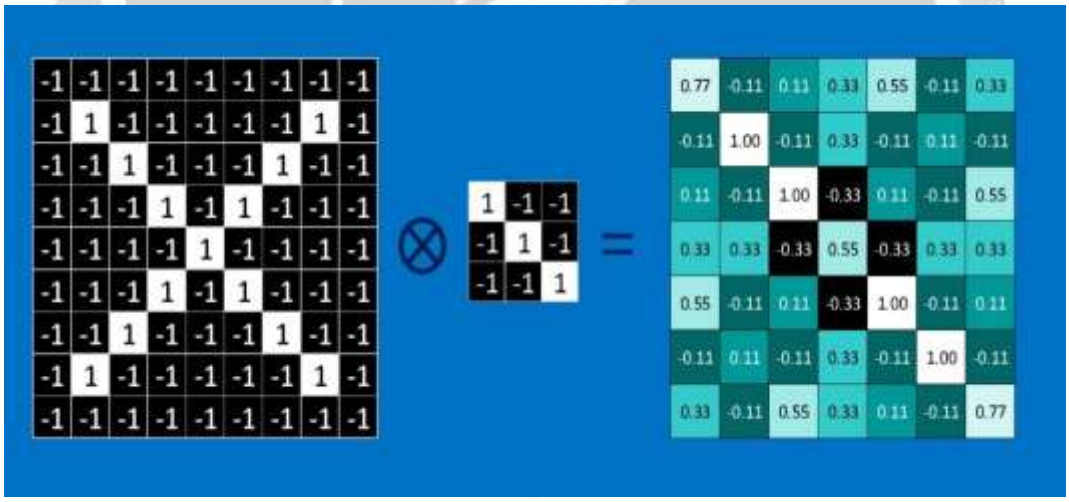


FIG 4 -Map of pixel features

It is like a map where in image a feature is obtained. Strong matches represents values close to 1, the values close to -1 represents strong values for photographic negative of the feature, and no match of any sort is represented for values near zero.

3. IMPLEMENTATION

There are four main modules which are concerned with the project:

Collecting and exploring the dataset:

In this project, we have extracted our dataset from Kaggle where there are many collections of datasets are available. In this dataset (Traffic signs dataset) there are almost 50000 images of different road signs which are classified into 43 different classes. Each class contains more than one image of same type. The dataset has two folders named train and test for which it contains images for training and testing our model.

Exploring the dataset after collection:

- There are 43 folders in train folder each represents different class and it ranges from 0 tp 42.
- Using OS module, we can iterate through all the classes and add images and their respective labels in labels and data links.
- To open image content in an array we are using pil library.
- The train_test_split() method is used to split training and testing data set using sklearn package.
- Using keras.utils package, to_categorical method to convert the labels present y_train and t_test into one-hot encoding

Build a CNN model:

In order to classify the images totheir respective categories, we should build a CNN model. CNN is the way to classify images. Adam optimizer is used to compile the model as it performs well and effective. As we have multiple classes to categorize, and the loss is categorical_crossentropy.

The basic architecture of our model is:

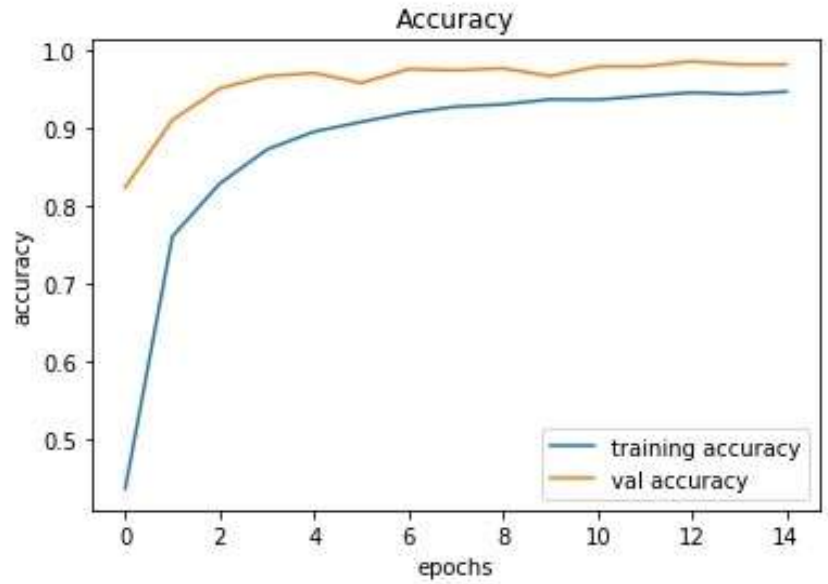
- 2 Conv2D layer (filter=32, kernel_size=(5,5), activation="relu")
- MaxPool2D layer (pool_size=(2,2))
- Dropout layer (rate=0.25)
- 2 Conv2D layer (filter=64, kernel_size=(3,3), activation="relu")
- MaxPool2D layer (pool_size=(2,2))
- Dropout layer (rate=0.25)
- Dropout layer (rate=0.5)

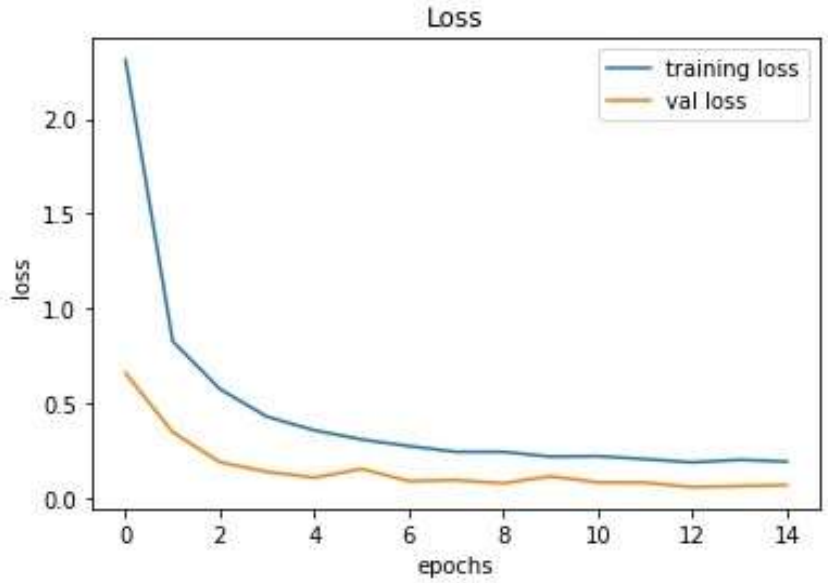
Dense layer (43 nodes, activation="softmax")

Train and validate the model :

Firstly we will build the model architecture and then we will use model.fit() method to train the model. We obtained a 95% accuracy on training the dataset. Using matplotlib, we will plot graph for accuracy and loss. An object-oriented API is provided which helps in embedding plots in applications using Python GUI toolkits.

```
[13]: <matplotlib.legend.Legend at 0x24eece89e48>
```





Sign announcement:

To implement sign announcement, we have used pyttsx3 library in python. pyttsx3 is text-to-speech conversion library. It can also work in offline and is compatible with both Python 2 and Python 3 unlike alternative libraries.

.

Test our model with test dataset:

Our dataset has a test folder and test.csv file, all the details regarding the image path and their respective class labels. Image path and labels are extracted using pandas. In order to predict the model, we should resize our images to 30x30 pixels and create a numpy array which contains all image data. Using sklearn.metrics, accuracy_score is imported and observed how our model projected the actual labels. A high 95% accuracy is achieved in our model.

4. FEATURES

- This system can be incorporated on self-driving cars for driving according to traffic rules.
- It can be used in the normal cars also,to give an alert announcement of road sign ahead to caution the driver.
- Adaptive Cruise Control systems will require a traffic sign recognition system for their development and this system can satisfy those requirements.
- People with difficulties in seeing to a certain extent can utilize the system for their safe driving.
- Colour blinded people can use this system for quick identification of road signs.

5. CONCLUSION AND FUTURE ENHANCEMENT

Over the years it has been made easy for the humans to detect and recognize the road signs as they have been designed deliberately. For a computer it seems to be challenging to recognize the signs especially over the full range of possible signs. In order to achieve accuracy in this technology, the signs has to be detected by vehicles and make decisions accordingly. A high level of 95% accuracy is achieve in the proposed model and it can be implemented in vehicle industry for smart vehicles. Eventually, Road sign recognition systems will provide information to other automotive electronic systems like adaptive cruise control and safety systems to expand the capabilities. For example, while using in conjunction with ACC, the Road Sign Recognition system will warn the driver if the driver drives the vehicle exceeding the speed limit and automatically warns the vehicle about the speed limit without drivers input. The system might experience certain drawbacks when colour varies due to bad weather conditions and poor quality of camera. It can be improved by extracting the signs from test images using advanced segmentation methods.

6. REFERENCES

[1] [Asmaa Abduldaem] Principles For The Design And Development Of Dashboards: Literature Review, INTCESS- International Conference on Education and Social Sciences | ISBN: 978-605-82433-5-4 [1] Piccioli, G., De Micheli, E., Parodi, P., and Campani, M., "A Robust Method for Road Sign Detection and Recognition," Image and Vision Computing, vol. 14, no. 3, pp. 209- 223, 1996.

[2] [Estevez, L. and Kehtarnavaz, N. A], Real-Time Histographic Approach to Road Sign Recognition. Proceedings of the IEEE Southwest Symposium on Image Analysis and Interpretation, 95- 100. 1996. San Antonio, TX

[3] [de la Escalera, A., Moreno,L.E., Salichs, M.A.and Armingol, J.M.]"Road Traffic Sign Detection and Classification," IEEE Transactions Industrial Electronics, vol. 44, no. 6, pp. 848-859, 1997.

[4] [Yuille, A. L., Snow, D., and Nitzberg, M. Signfinder:] Using Color to Detect, Localize and Identify Informational Signs. International Conference on Computer Vision (ICCV98), 628-633. 1998.

[5] [Huang, Chung-Lin and Hsu, ShihHung] Road Sign Interpretation using Matching Pursuit Method. IEEE International Conference on Pattern Recognition (ICPR2000), 1329-1333. 2000. Barcelona, Spain.

[6] [Soendoro W.D., Supriana I.] Traffic sign recognition with Color-based Method, shape-arc estimation and SVM; Proceedings of the 2011 International Conference on Electrical Engineering and Informatics; Bandung, Indonesia. 17–19 July 2011.

[7] [Li H., Sun F., Liu L., Wang L.] A novel traffic sign detection method via color segmentation and robust shape matching. Neurocomputing. 2015;169:77–88. doi: 10.1016/j.neucom.2014.12.111.

[8] [Bahlmann C., Zhu Y., Ramesh V., Pellkofer M., Koehler T.] A system for traffic sign detection, tracking, and recognition using color, shape, and motion information; Proceedings of the 2005 IEEE Intelligent Vehicles Symposium; Las Vegas, NV, USA. 6–8 June 2005.

[9] [Ardianto S., Chen C., Hang H.] Real-time traffic sign recognition using color segmentation and SVM; Proceedings of the 2017 International Conference on Systems, Signals and Image Processing (IWSSIP); Poznan, Poland. 22–24 May 2017.

[10] [Shadeed W.G., Abu-Al-Nadi D.I., Mismar M.J.] Road traffic sign detection in color images; Proceedings of the 10th IEEE International Conference on Electronics, Circuits and Systems; Sharjah, UAE. 14–17 December 2003.

[11] [Malik R., Khurshid J., Ahmad S.N.] Road sign detection and recognition using colour segmentation, shape analysis and template matching; Proceedings of the 2007 International Conference on Machine Learning and Cybernetics; Hong Kong, China. 19–22 August 2007.

[12] [Paclk P., Novovicova J.] Road sign classification without color information; Proceedings of the 6th Conference of Advanced School of Imaging and Computing; July 2000; [(accessed on 7 July 2000)]. Available online: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.11.3982.

[13] [Loy G., Barnes N.] Fast shape-based road sign detection for a driver assistance system; Proceedings of the 2004 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS); Sendai, Japan. 28 September–2 October 2004.

[14] [Riveiro B., Díaz-Vilariño L., Conde-Carnero B., Soilán M., Arias P.] Automatic segmentation and shape- based classification of retro-reflective traffic signs from mobile LiDAR data. IEEE J. Sel. Top. Appl. Earth Obs. Remote Sens. 2016;9:295–303. doi: 10.1109/JSTARS.2015.2461680.

[15] [Yang Y., Luo H., Xu H., Wu F.] Towards real-time traffic sign detection and classification. IEEE Trans. Actions Intell. Transp. Syst. 2016;17:2022–2031. doi: 10.1109/TITS.2015.2482461.

[16] [Yin S., Ouyang P., Liu L., Guo Y., Wei S.] Fast traffic sign recognition with a rotation invariant binary pattern based feature. Sensors. 2015;15:2161–2180. doi: 10.3390/s150102161.

[17] [Jin J., Fu K., Zhang C.] Traffic sign recognition with hinge loss trained convolutional neural networks. IEEE Trans. Intell. Transp. Syst. 2014;15:1991–2000. doi: 10.1109/TITS.2014.2308281.

[18] [Cireşan D., Meier U., Masci J., Schmidhuber J.] Multi-column deep neural network for traffic sign classification. Neural Netw. 2012;32:333–338. doi: 10.1016/j.neunet.2012.02.023.

[19] [Qian R., Yue Y., Coenen F., Zhang B.] Traffic sign recognition with convolutional neural network based on max pooling positions; Proceedings of the 12th International Conference on Natural Computation; Fuzzy Systems and Knowledge Discovery (ICNC-FSKD); Changsha, China. 13–15 August 2016.

[20] [Youssef A., Albani D., Nardi D., Bloisi D.D.] Fast traffic sign recognition using color segmentation and deep convolutional networks; Proceedings of the ACIVS 2016: Advanced Concepts for Intelligent Vision Systems; Lecce, Italy. 24–27 October 2016.