Autonomous Road Sign Recognition and Lane Detection Using Convolutional Neural Networks

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Abstract **- Approximately 1.35 million people die each year as a result of road traffic crashes, and between 40 to 70 million are injured drastically. Most of these accidents takes place due to lack of response time to instant traffic events. To design such recognition and detection system in autonomous cars, it is important to monitor and guide through real time traffic events. This involves 1) Road sign recognition 2) Road lane detection. Road sign recognition have been studied for many years and with many good results, but road lane detection is a less-studied field. Road lane detection provide drivers with very valuable information about which lane they are following and any possible lane departure, in order to make driving safer and easier. In this paper, an attempt is made to develop such system, by applying image recognition to capture traffic signs, classify and process them correctly using Convolutional Neural Network.**

Index Terms **- Computer Vision, Canny Detection, Neural Networks, Gaussian filters.**

I.INTRODUCTION

Road safety was always an area that concerned many people around the world, due to the number of road accidents increasing day by day. According to surveys, most driving accidents occur due to Human Mistakes. In order to make the driving process safer, an attempt is made to design a driver-assistance system with road sign recognition and lane detection features. In this system we are focusing on two important aspects, Road sign recognition and lane detection. The process of road sign recognition in video can be broken into two main areas for research: detection and classification using convolutional neural networks. Traffic signs will be detected by analysing colour information, notably red and blue, contained on the images whereas, in classification phase the signs are classified according to their shapes, characteristics. In this system along with road sign recognition we will be focusing on Lane detection which is one significant method in the visualization-based driver support structure and capable to be used for vehicle guiding, road congestion avoidance, crash avoidance, or lane departure warning. A lane departure warning system is a technology developed for warning a driver when any lane departure occurs. This system will be capable to navigate autonomously or guide driver in all types of lanes straight or curved, white or yellow, single, or double and pavement or highway lane boundaries. This system will be able to recognize sign boards and detect lane even in noisy conditions such as fog, shadow, and stain.

II. EXISTING SYSTEM

1. Focused primarily on road sign detection using Histogram of Oriented Gradient (HOG) and Pyramid Histogram of Gradient (PHOG) on a Support Vector Machine (SVM), with the Indonesian database of traffic signs.
2. Applied an ensemble classification algorithm for convolution neural networks. They have used the US traffic database as the test dataset and also used CNN with 3 convolution and pooling connected layer and they used a private test dataset.
3. Suggested a robust method for the detection on the road sign. According to their method, the Input image is converted into YCbCr color space, and shape filtering technique is used for the detection purpose. They used color segmentation

to eliminate the undesired background from the image, and the segmented images are then fed to an ANN (Artificial Neural Networks).

- Drawbacks of Existing system are:
  1. Color detection in RGB.
  2. Costlier installation.
- Advancement of road sign detection:
  1. Lane detection
  2. Autonomous Driving

III. OBJECTIVES

- Identify between various Traffic Sign using Convolutional Neural Network.
- Train the Perceptron – Based Neural Network to Classify between Binary Classes.
- Identify the Lane lines for Safe Driving using Computer Vision Techniques.
- Train the Deep Neural Network to Complex Datasets.
- Make a Fully Functional Automated System in a car for Safe and Easy Access.

IV. MATHEMATICAL MODEL

System Description:
Input: Video files, Input img frames, Road and Traffic Sign Dataset Models.
Output: Targeted Sign Recognized and Lane Detected.
Functions: Detect (), Extract (), Filter (), Classify ().
Mathematical Formulation:
S = (I, F, O)
where, Input = (I1, I2, I3...., In)
Function = (F1, F2, F3....., Fn)
Output = (O1, O2, O3....., On)

- Success Conditions: Traffic Sign and Road Lane are Successfully Detected and Recognized. And Expected output displayed on Dashboard.
- Failure Conditions: Camera did not Capture input frame, Traffic sign not found in Road and Traffic Sign Datasets Modules.

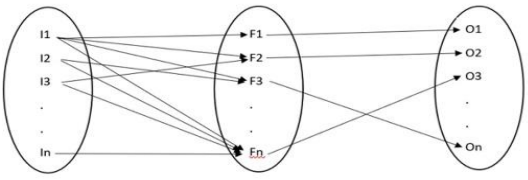

Fig1, Venn Diagram

V. SYSTEM ARCHITECTURE

This System includes Mainly two phases, first phase consists of Recognising the traffic Signs and Second phase consist of Lane detection. In that first phase, Convolutional Neural Network is used to Recognise Traffic sign and Some Features Extraction Methods are used to Extract Targeted image. This System Phase consists of 9 modules like video input, image frames, compress image, segmentation, pre-processing, Canny edge Detection, image classification, recognized result, output as alert text/voice message.

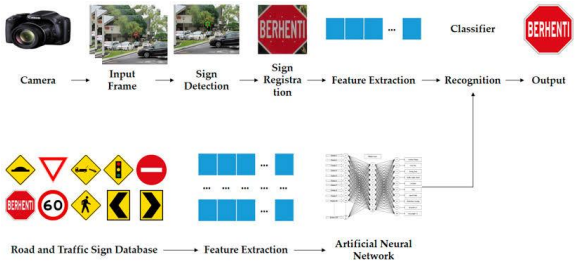

Fig2.System Architecture

First Video input is taken from camera which is placed back in rear mirror, then from the video every frame is processed by compressing image by Discrete wavelet compression method. This Method is applied that quantifies the signals by measuring the distance between the zero line and points along each wavelets and records record this distance as coefficients. The coefficients of adjacent images are averages to produce a simplified version of the signal or wave, which process Respectively half the size of the image description. This Complete process is repeated again and again until producing smaller waves. That process is called decomposition. Then after compression, segmentation is ready to process. Traffic sign board is segmented using color pixel method, where the sign board is detected using pixel intensity value of the sign board colors like red, white, and black. Where every pixel in the image is scanned for the pixel intensity value, when the value is found then the region of that image is put into bounded box. Then after the segmented image is pre-processed, where converting into gray scale and removing noise using median filter. Then starts processing for detecting Road edges or Lane using canny edge detection method. The image is converted into binary image because it makes easy for classifying the image from dataset and the processing time also decreases. Then classification is done using templates matching method, where the

processed image is compared with all the templates which is stored in the database. After recognizing the image, the output comes as alert text and voice message on Dashboard.

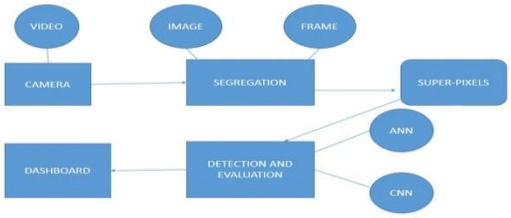

Fig3. System Flow

Now in Second phase, it detects the edges using canny edge detection method. This Method involves steps like Capturing and Decoding video le, Grayscale conversion, Reduce Noise, Canny Edge Detector, Hough line Transformation.

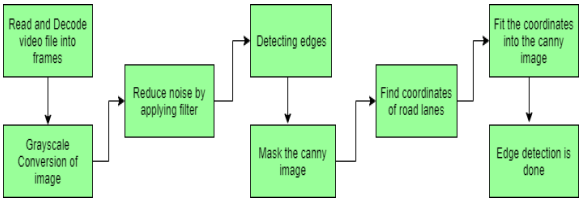

Fig4. Canny Detection Flowchart

In that, first Camera will capture the video and after the capturing has been initialized every video frame is decoded. As The video frames are in RGB format, that RGB is converted to grayscale because processing a single channel image is faster than processing a three-channel colored image. Then Noise can be Create by false edges detection, therefore before going further, it is imperative to perform image smoothening by using Gaussian filter. then it computes gradient in all directions of our blurred image and traces the edges with large changes in intensity using canny detection algorithm. Finally, Hough Line Transform is a Transform which is used to detect straight lines which gives output as the extremes of the detected lines.

Fig6. Edge Detection

VI. CONCLUSION

This Paper Proposes System that Includes efficient features extraction methods which results in appropriate outcomes. Among all Techniques the CNN and SVM are the Finest Techniques of Deep Learning for to ensure Accuracy in the Achieved Outputs. Along with HOG was also Most recent Feature extraction method out of all others Extraction Methods Used and Maximum Efficiency also be Obtained by Using Multiplayer Perceptron. This system is successfully capable of detecting, recognizing road signs, followed by calculating the distance of from the car to the said road sign. In addition, a lane Detection approach has also been Introduced to Guide the car within the lanes of the road. It has made a car as an autonomous car more intelligent at recognising and responding to real-time traffic events.

VII. FUTURE SCOPE

Future work includes larger dataset so as to train our system to recognize lesser - known traffic signs that are used in other parts of the world. Another aspect that could be improved is the ability of the system to Recognise road signs at high speeds (>100 km/hr). This would mean to substantially decrease the prediction time. We would also like to increase the maximum distance of recognition, so as to give the car sufficient time to take a real-time decision.

VIII. ACKNOWLEDGEMENT

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REFERENCES

[1] Research Article: Fast Traffic Sign Detection Approach Based on Lightweight Network and Multilayer Proposal Network Faculty of Electrical Engineering Technology, Industrial University of Ho Chi Minh City, Ho Chi Minh City, Vietnam Correspondence should be addressed to, Published 19 June 2020.

[2] S. Mehta, M. Rastegari, L. Shapiro and H. Hajishirzi, “Esp netv2: a lightweight, power efficient, and general-purpose con volutional neural network,” in 2019 IEEE/CVF Conference on Journal of Sensors 13Computer Vision and

Pattern Recognition (CVPR), pp. 9190– 9200, Long Beach, CA, USA, June 2019.
[3] J.Zhang, W.Wang, C.Lu, J.Wang and A.K.Sangaiah, "Lightweight deep network for traffic sign classification," Annals of Telecommunication, 2019.
[4] Shao, F.; Wang, X.; Meng, F.; Rui, T.; Wang, D.; Tang, J. Real-time traffic sign detection and recognition method based on the simplified Gabor wavelets and CNNs. Sensors 2018, 18, 3192.
[5] Satılmı¸, Y. Tufan, F. Sara, M. Karslı, M. Eken, S. Sayar, A. CNN Based Traffic Sign Recognition for Mini Autonomous Car.In 2018 International Conference on Information Systems Architecture and Technology, Nysa, Poland, 16–18 September 2018; pp. 85–94.
[6] T. Yang, X. Long, A. K. Sangaiah, Z. Zheng, and C. Tong, "Deep detection network for real-life traffic sign in vehicular networks," CN, vol. 136, pp. 95–104, 2018

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