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Real time traffic sign detection and classification system on Jetson TX1 Embedded Development Board

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ABSTRACT: *Traffic sign detection and recognition are important functions in an Advanced Driver Assistance Systems (ADAS). The detection of traffic sign will locate the presence of the signboard and its recognition will identify the detected sign. In the real world, knowing the content of the sign is much more important than simply knowing the existence of a sign. This paper implements traffic sign detection using color and contour analysis and compares the performance with Single Shot Multi Box Detector deep learning algorithm (SSD). The classification of traffic signs is also done using Convolutional Neural Network (CNN).*

Keywords:*Traffic Sign detection, Convolutional Neural Network (CNN), Contour based Segmentation, Single Shot Multi Box Detector (SSD), Jetson TX1*

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I. INTRODUCTION

Traffic signs are road facilities that convey, guide, restrict, warn, or instruct information using words or symbols. With the development of automotive intelligent technology, famous car companies, such as Mercedes-Benz, BMW, etc., have actively invested in ADAS (Advanced Driver Assistance System) research. Commercialized ADAS systems not only include Lane Keep Assist Systems, but also include TSR (Traffic Sign Recognition) systems to remind drivers to pay attention to the speed. If drivers and pedestrians do not notice this information, it can lead to the occurrence of traffic accidents. With the increasing demand for the intelligence of vehicles, it is extremely necessary to detect and recognize traffic signs automatically through computer technology. Research in this area began in the 1980s, to solve this problem.

II. BACKGROUND

Shu-Chun Huang et alproposed in their paper sheds light on design and development of Traffic sign Recognition (TSR) system by using Convolution Neural Networks (CNNs) as both feature extractor as well as classifier for Bangladeshi traffic signs. Image acquisition, preprocessing is performed. Then image is segmented using HSV. Morphological closing is executed to fine the segmented image. After performing Filtering using shape signature, the desired region is cropped. At the end finally extracted sign areas are classified by automatic feature extraction with the help of CNN. Proposed paper is giving good result in terms of accuracy but the only drawback is that training is quite slow due to absence of good GPU.

Abhaya et al [2] proposed a smartdriver assistancesystemthatwillhelpdriverstoavoidaccidentsduring lane departures by providing prompt and quick marking of lanes. Proposed novel system is providing automaticdetectionandrecognitionoftrafficsigns.Detectionisproviding good results under different lightning conditions. Recognition is based on cascade pattern of CNNs that are trainedusing Histogram of orientedgradient(HOG). The region where Traffic signs are located are identified as a candidate region and can be calculated through the process called MSERs. Synthetic data set has been generated so as to increase the number of images in data set to increase the perform anceinterms of accuracy and totrain model better.

III. ALGORITHM

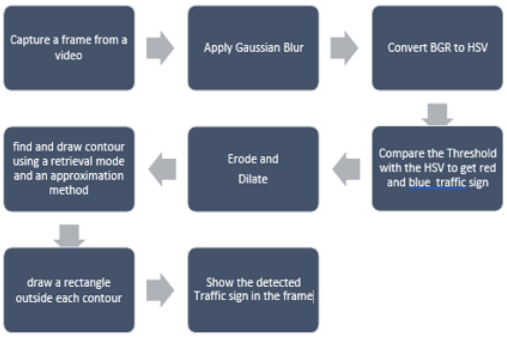
Template Matching

Template Matching is a method for searching and finding the location of a template image in a larger image.

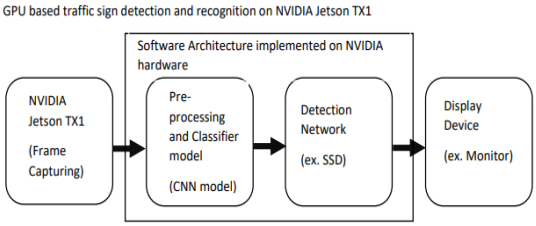
It simply slides the template image over the input image (as in 2D convolution) and compares the template and patch of input image under the template image. It returns a grayscale image, where each pixel denotes how much does the neighborhood of that pixel match with template.

Traffic sign detection and recognition using Contour

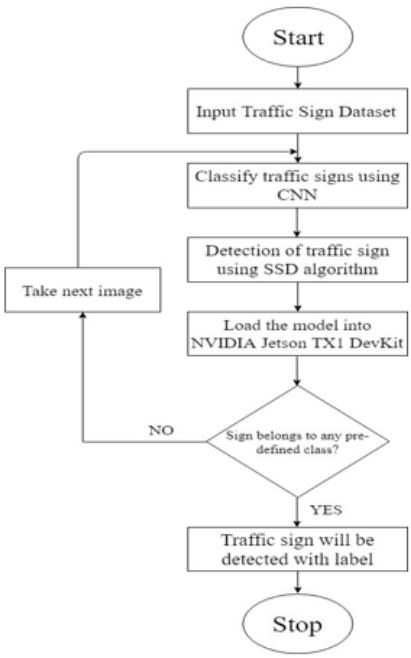
Traffic sign detection is based on colour analysis, using the HSV colour space.The detected ROIs are then tested for their shape, which allows discarding most false positive initial detections, resulting from non-sign image areas sharing sign colours.



BlockDiagram of Traffic Sign Detection with CNN



FlowChartof Traffic Sign Detection with CNN



Data Pre-Processing

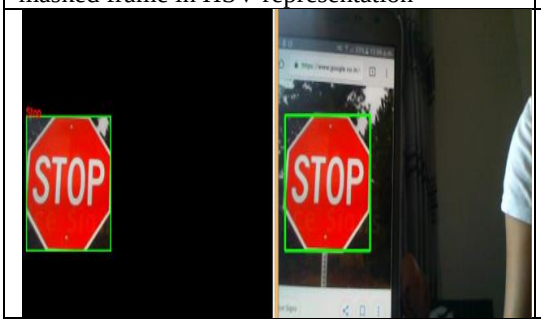
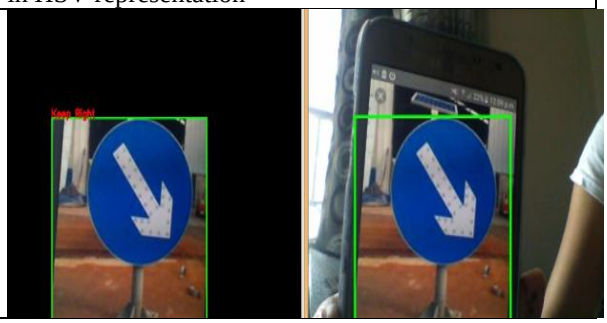
One of the limitations of the CNN model is that they cannot be trained on a different dimension of images. So, it is mandatory to have same dimension images in the dataset.We'll check the dimension of all the images of the dataset so that we can process the images into having similar dimensions. We will transform the image into the given dimension using OpenCV package.

SSD, the abbreviation for Single Shot Multi-box Detector. To better understand SSD, let's start by explaining where the name of this architecture comes from:**Single Shot:** this means that the tasks of object localization and classification are done in a single forward pass of the network. **MultiBox:** this is the name of a technique for bounding box regression developed by Szegedy et al. (we will briefly cover it shortly)**Detector:** The network is

an object detector that also classifies those detected objects SSD is an object detection algorithmand is one of the
most-often used detection frameworks so far. The object is detected by the color and edge information of the image, which undermines the detection effects of those objects that do not have enough image information, particularly when small and weak objects and large-area occlusion of objects are involved.

IV. RESULTS:

The System is implemented using Python and OpenCV on Jetson TX1 Embedded Development Board.The results of proposed model are shown in Figure.

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Original Image before detection for image1</td><td>Image after detection</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Original Image before detection for image2</td><td>Image after detection</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Detected output of Take Right sign with its masked frame in HSV representation</td><td>Detected output for Stop sign with its masked frame in HSV representation</td></tr>
<tr><td>  </td><td>  </td></tr>
</table>

Real time Detection of Stop Sign using Laptop Camera	Detection of Keep Right Sign using Laptop Camera
	
Output of detection for Stop sign using SSD	Output of detection for Traffic Signal using SSD
	
Output of detection for Maximum Speed Limit Sign using SSD	Output of Classifier on Jetson TX1

V. CONCLUSION:

In this paper, a novel traffic sign detection and recognition method was presented, which aimed to address the problem of real time traffic sign detection and classification.Traffic sign detection is adone using three approaches: One based on colour analysis, using the HSV colour space and then using contour analysis for detecting traffic signs. The Second approach detects traffic sign boards using template matching method.The third approach used CNN for traffic sign detection and classification. The accuracy for CNN based approach is very High compared to other two methods but the computational time required is very high which prevents it from using in embedded environments like Raspberry Pi. The Jetson TX1 GPU embedded board is used for deploying CNN based traffic sign detection and classification system for real time performance.

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