TRAFFIC SIGN DETECTION AND RECOGNITION

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ABSTRACT

Traffic signs displayed on the roads play an important role in our lives while driving. They supply critical information, for the road users. This successively requires them to regulate their driving behaviour and ensure that they strictly follow the road regulations currently enforced without causing any trouble to other drivers and pedestrians. Traffic Sign Classification is employed to detect and classify traffic signs to inform and warn a driver beforehand to avoid violation of rules. There are certain disadvantages of the existing systems, used for classification, like incorrect predictions, hardware cost and maintenance, which are to a great extent resolved by the proposed system. The proposed approach implements a traffic signs classification algorithm employing a convolutional neural network. Also, it consists of the feature of web cam detection of the traffic sign. This will help the driver to observe the sign close to his / her eyes on the display screen and thus save his/her time in manually checking the traffic sign each time.

Keywords :

1. Introduction

In current traffic management systems, there is a high probability that the driver may miss some of the traffic signs on the road because of overcrowding due to neighbouring vehicles. With the continuous growth of vehicle numbers in urban agglomerations around the world, this problem is only expected to grow worse.A visual-based traffic sign recognition system can be implemented on the automobile with an aim of detecting and recognizing all emerging traffic signs. The same would be displayed to the driver with alarm-triggering features if the driver refuses to follow the traffic signs. 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. To make them easy for drivers to read and recognize, traffic signs are often designed to be of a particular shape and color with symbols inside, so that there is a significant difference between the traffic signs and the background. For example, the speed limit 60 traffic sign is a circular shape with a strong number “60”. These features are also important information for traffic sign recognition systems. Although the same kind of traffic signs have some consistency in color, in outdoor environments the color of the traffic signs is greatly influenced by illumination and light direction. Therefore, the color information is not fully reliable. As vehicle mounted cameras are not always perpendicular to the traffic signs, and the shape of traffic signs are often distorted in road scenes, the shape information of traffic signs is no longer fully reliable.

1.1 Applications of Emotion Detection

The applications of the traffic sign detection and recognition system are as follows:

Traffic Sign Classification is very useful in Automatic Driver Assistance Systems. A convolutional neural network is a class of deep learning networks, used to examine and check visual imagery. It is used to train the image classification and recognition model because of its high accuracy and precision. The traffic signs are of different variety, background, and colour variation which in turn will help the model to perform accurately. Traffic sign classification is the process of automatically recognizing traffic signs (like speed limit, yield, and caution signs, etc.) and accordingly classifies them as to which class they belong to. The purpose of road signs is to promote road safety and efficiency by providing for the orderly movement of all road users on all roads in both urban and non-urban areas

2. LITERATURE SURVEY

In today's world, identification of traffic signs has become an important aspect of our lives. Looking at the increasing traffic, to ensure safety of all and for automatic driving in the future, traffic sign classification is utmost necessary. Considerable research has been done around recognition of traffic and road signs. In 1987, the first research on the topic "Traffic Sign Recognition" was done by Akatsuka and Imai , where they tried to build a fundamental system that could recognize traffic signs and alert the drivers and ensure his/her safety. But this was used to provide the automatic recognition for only some specific traffic signs.

Traffic sign recognition initially appeared in the form of only speed limit recognition in 2008. These symbols could only detect the circular speed limit signs. On the other hand, later, systems were designed that performed detection on overtaking signs. This technology was available in the Volkswagen Phaeton and in the 2012 in Volvo S80, V70 and many more. But the major drawback of these systems was that they could not detect the city limit signs as they were mostly in the form of direction signs. But nowadays, such systems are expected to be present in the future cars to help drivers while driving.

In [1], the authors used the colour processing system to reduce the effect of brightness and shadow on the images. This was the very first research done on this topic by the authors, Akatsuka and Imai. In [2], the authors have done a survey on traffic sign detection and recognition, where HOG (Histogram of Oriented Gradients) is used for classification purpose. In [3], a complete study of different traffic sign recognition algorithms has been done, where the highest accuracy (99.46%) was obtained by MCDNN (Multi-column Deep Neural Network). In [4], the authors have developed a model where they are converting the images to gray scale first and then filter those images using simplified Gabor wavelets. The gabor filters are used to extract features. These wavelets are important as they help to minimize the product of its standard deviation in both the time and frequency mapping. The authors extracted the regions of interest for recognition purpose and classified the signs using "Support Vector Machine" (SVM).

In [5], the authors have extracted the regions of interest in the detection stage and further examined the shapes of such regions. Here, in the classification system, they took the regions of interest and classified them into different classes.

In [6], the authors have created a module which consists of numerous convolutions. They combined the 1*3 kernel and 3*1 kernel and finally linked it with the 1*1 kernel to attain the 3*3 kernel. This was used to extract more features and thus reduce the number of parameters. In [3], the author has reviewed the traffic sign detection methods and divided them into 3 types of methods: color, shape and learning based methods. In [8], the author used the number of peaks algorithm to detect and recognize circular shaped traffic signs.

In [5], the authors have tried creating a classification model using the Enhanced LeNet-5 architecture, which consists of two consecutive convolution layers (before the MaxPooling layer) to extract high level features from the image. Also, they have used the data augmentation technique to make the dataset stable. In [2], the authors have used the technique of colour segmentation and the RGB based detection which is used to identify the traffic signs on the road. The optimizer used was "Stochastic Gradient Descent" with Nesterov Momentum. The text to speech system was implemented to alert the driver about the traffic sign. Also, they utilized the GPU (graphical processing unit) system, as part of hardware. In [6] the authors have tried generating a dataset for the Arabic Road signs and thus develop a CNN model for Arabic sign recognition.

3. PROBLEM STATEMENT,OBJECTIVES AND PROPOSED WORK

3.1 Problem Statement

The major traffic problem in the recent scenario is the traffic congestion and the road rash case which is increasing in a blink of an eye. In the context of Kathmandu, which is the capital city of Nepal, people have to go through

traffic congestion every single day. A proper system should be adopted in order to control this problem. By exploring various papers related to the subject matter, the problems are stated below: The existing traffic is controlled manually by traffic policeman. The complexity of road networks is increased to service the growing demand for road users.

3.2 Objectives

Objective of the traffic sign detection and recognition system as follows:

The main objective of this system is to helps the driver to observe the sign close to their eyes on the car screen. This saves the time and efforts in manually checking whether any traffic sign board is there ,identifying what type of sign it is and act accordingly . this system also helps to reduce the accident and penalty to the driver.so build a system that detect and recognition system using the opencv,keras,matplotlib and tensorflow .

3.3 Proposed Work

Traffic Signs are useful to all the individuals who are driving a vehicle on the road. Traffic Signs guide the drivers for following all the traffic rules and avoid any disruption to the pedestrians. The environmental constraints including lighting, shadow , distance (sign is quite far), air pollution, weather conditions in addition to motion blur, and vehicle vibration which are common in any real time system may affect the detection and thus the classification. Hence, there is a need for further research and advancements to deal with these issues. Also, there are certain traffic signs that may not be predicted accurately. For this, augmentation and one hot encoding techniques can be used. Augmentation involves shifting of the image, zoom in and rotate the images (if required). This system helps the driver to observe the sign close to his / her eyes on the screen. This saves the time and efforts in manually checking whether any traffic sign board is there, identifying what type of sign it is and act accordingly. Traffic Sign Classification, thus, has a wide application in building smarter cars like automatic driving cars, where the system automatically detects, recognizes a traffic sign and displays it.

4. Design and implementation

4.1 System Design

Building of the model: This primarily focuses on converting the images to gray scale, normalizing the images (normalization is done to accelerate the training process and improve the model performance), histogram equalization (to improve image contrast), addition of the layers to the model, train the model, get predictions on the test data set, and finally show some sample images with their traffic sign name and class Id as the output. The train, test and validation split percentage is 65%, 25% and 10% respectively for the proposed system. One of the main functionalities which are implemented in this work, is prediction of unknown images. Here, a small dataset was generated gathering images from different sources. This was the most crucial part as this dataset includes some different images with different colour and structure. Although there are several existing datasets available, a small dataset (consisting of 13 images) is built. The dataset includes some speed limit symbols, yield sign, caution signs (like stop and no entry), informatory signs (like pedestrians, ahead only, no passing, roundabout mandatory, and right-of-way at the next intersection). Extracting features from these images is not easy for the model. The reasons being, these images are enlarged, having different background colours and reduced clarity. Despite all the issues, the model successfully predicted around 9 images out of 13.

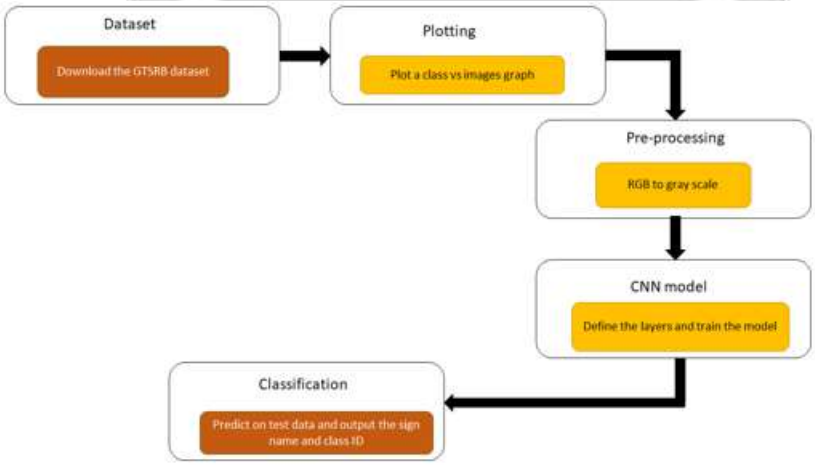

Figure1:. Flow of detection.

5. Result Analysis

In general, traffic sign recognition mainly includes two stages: the first stage is traffic sign detection, which concerns the location and size of the traffic signs in the traffic scene images, and the second stage of the process is traffic sign recognition, which pays close attention to the classification of what exact class the traffic signs belong to. Traffic sign detection is usually based on the shape and color attributes of traffic signs, and traffic sign recognition is often used with classifiers, such as convolutional neural networks (CNNs) and SVM with discriminative features.[1]
Traffic signs have a strict color scheme, which includes red, blue, and white that allow us to distinguish traffic signs from the background scene. It is not difficult for human beings to distinguish traffic signs from a background, so for a computer detection system, color information is also an important feature. In the present research, color-based traffic sign detection method is shown to be the most straightforward and simplest method .As red, green, blue image (RGB) is too sensitive to illumination, color space conversion algorithms have often been applied to traffic sign detection. For example, to segment the red road signs. Unfortunately, due to strong light, poor light, and other bad weather conditions, color-based detection methods often fail to achieve better results.[1]

Fig 2: No entry

Fig 3: General Caution

6. CONCLUSION

The proposed system is simple and does the classification quite accurately on the GTSRB dataset as well as the newly generated one (consisting of truly existing images of all type), and finally the model can successfully capture images and predict them accurately even if the background of the image is not much clear. The proposed system uses Convolutional Neural Network (CNN) to train the model. The images are pre-processed, and histogram equalization is done to enhance the image contrast. The final accuracy on the test dataset is 98% and on the built dataset is 69%. The web cam predictions done by the model are also accurate and take very less time. The benefits of "Traffic Sign classification and detection system" are generally focused on driver convenience. Despite the advantages of traffic sign classification, there are drawbacks. There can be times when the traffic signs are covered or not visible clearly. This can be dangerous as the driver won't be able to keep a check on his vehicle speed and can lead to accidents, endangering other motorists or pedestrians, demanding further research

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