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Traffic Sign Detection for Motorists using Machine Learning

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Abstract - Motivated by the recent success of supervised and weakly supervised common object discovery, road signs are important to ensure smooth traffic flow without mishaps. Road symbols are pictorial representations having different necessary information required to be understood by the driver. Road signs in front of the vehicle are omitted by the drivers and this can lead to fatal accidents. This paper displays a summary of traffic sign board detection and recognition and implements a method to extract the road sign from a natural complicated image, process it, and warn the driver using voice command It is implemented in such a way that it acts as a boon to drivers to make efficient decisions Traffic sign detection is a critical component of advanced driver assistance systems (ADAS) and autonomous driving systems. This paper presents an approach for detecting traffic signs using machine learning techniques. The proposed method uses a convolutional neural network (CNN) to classify images of traffic signs.

Keywords: Traffic sign detection, CNN, Raspberry Pi, Camera Module.

I. INTRODUCTION

In this project, we will understand what traffic sign detection is and look at a few different approaches one can take to solve problems in this space. Road signs give several messages regarding the road and what you as a driver should expect on the road. They support the traffic to move freely by assisting drivers reach their goal and letting them know entry, exit, and turn points in advance. Pre-informed drivers will naturally bypass committing errors or taking sharp turns resulting in bottlenecks. Road signs, indicating turns, directions, and landmarks, also assist to preserve time and fuel by delivering data on the path to be taken to reach a certain

goal. Road signs are kept in particular areas to make sure the safety of drivers. These signs let drivers understand how fast to drive. They also notify drivers when and where to turn or not to turn. To be a driver, you need to have an understanding of what the sign means. Route signs convey a variety of signals about the road and what motorists should be aware of. By guiding motorists to their destinations and informing them in advance of entry, exit, and turn locations, Route signs maintain traffic flow. To ensure that drivers are safe, road signs are put in strategic locations. Drivers can determine their speed thanks to these signs. Additionally, signs advise motorists when and where to turn or not turn. To prevent accidents and bottlenecks in traffic, road signs are crucial. Road symbols are visual representations of various information that drivers must be able to understand. Drivers frequently fail to see traffic signs in front of their vehicles, which can have disastrous consequences. This research implements a procedure to take out the road sign from a naturally complex image, process it, and warn the driver using voice instructions. It also provides an overview of the detection and recognition of traffic sign boards. It is put into practice in a way that assists drivers make easy decisions.

I. LITERATURE SURVEY

A key challenge in using traffic sign detection is the lack of automated optimization techniques. In this section, the work done in this field by various persons so far in the study of these techniques is presented.

Xiong Changzhen, Wang Cong, Ma Weixin, and Shan Yanmei have proposed a Traffic Sign Detection Algorithm Based on Deep Convolutional Neural Network in which Traffic sign detection plays an important role in driving assistance systems and traffic safety. But the existing detection techniques are usually finite to a predefined set of traffic signs. Hence, we present a traffic sign detection model based on a deep Convolutional Neural Network (CNN) using Region Proposal Network (RPN) to detect every Chinese traffic signs. Then a traffic sign detection CNN model is skilled and evaluated by fine-tuning technology using the complied dataset. lastly, the model is verified by 33 video clips with a size of 640×480. The result shows that the presented model has real-time detection speed and above 99 detection accuracy. The method can detect all seven main categories of the Chinese traffic sign. [1]

Xu Zhe1, Ren Jingyi1, and Bao Chaoqian have proposed a Traffic signs Detection Method of Contour Approximation based on Concave Removal. In this survey, an easy and effective algorithm for detecting blurred and occlusion triangular and circular traffic signs under unusual natural scenes is proposed. Firstly, the image is segmented and binarized. Then the convex hull of each contour obtained from the binarized image is evaluated. After that, the contour is compared to a polygon. lastly, those contours which can be found near a triangle is the triangular traffic signs, and other contours comparisons that can be approximated to an ellipse with random least squares fitting is the circular traffic signs.[2]

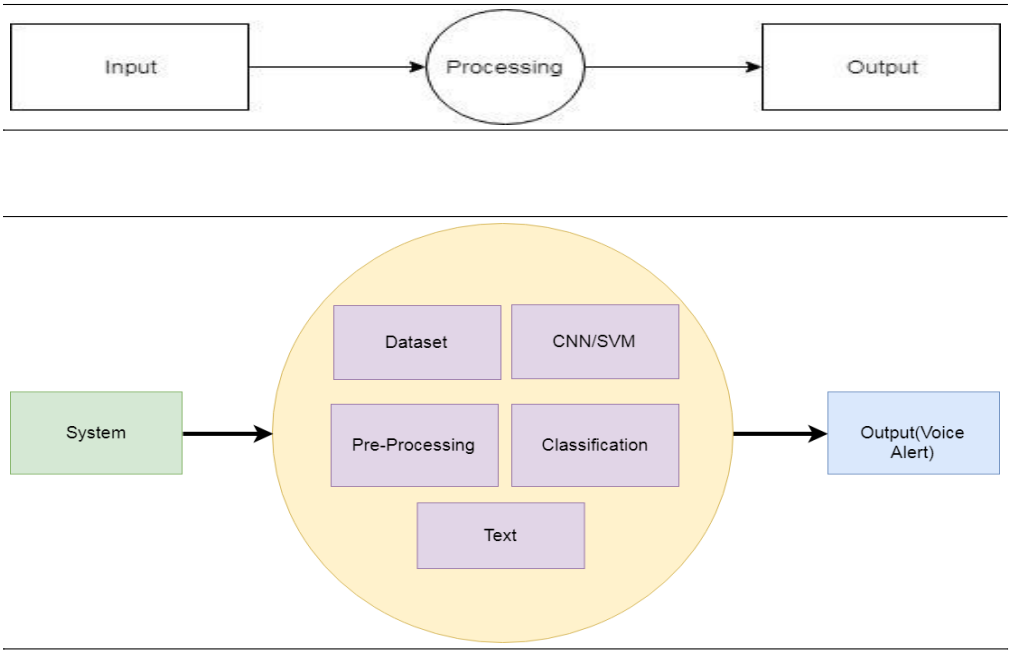
Shuang Wu1, Chenglu Wen1*, and Huan Luo have proposed, Using Mobile Lidar Point Clouds for Traffic Sign Detection and Sign Visibility Estimation. This paper displays an easy method for traffic sign detection and visibility evaluation from mobile Light Detection and Ranging (LiDAR) point clouds and the related images. The algorithm involves two steps. Firstly, the standard steps for detection are based on the modern retro-reflectivity of the traffic sign from the MLS point clouds is planned for sign detection in tricky road scenes. To obtain a solution on the spatial traits of traffic signs, we also develop geo-referenced association between traffic signs and roads related to the ground. Secondly, we present a visibility analysis method to obtain the visibility level of the traffic sign based on a combination of visual appearance and spatial-related features. The proposed algorithm is validated on a set of transportation-related point clouds acquired by a RIEGL VMX450 LiDAR system.[3]

Carlos Filipe Paulo and Paulo Lobato Correia have proposed an Automatic Detection and Classification of Traffic Signs. This paper presents standard steps for the automated detection of traffic signs from photo or video clips and their segregation to provide the driver a warning notification. Traffic signs are noticed by examining colour data, specifically red and blue present in the images. The obtained signs are then separated according to their shape basis, such as triangular, squared, and circular shapes. mixing colour and shape data, traffic signs are divided into one of the following classes: danger, information, obligation, or prohibition. Both the detection and classification algorithms contain innovative parts to enhance the overall system efficiency. This paper presents an automatic traffic sign detection and classification model. As anticipated, accurate traffic sign detection is necessary for accurate segregation.[4]

Bao Trung Nguyen, Jae Ryong, and Shim have proposed a Fast Traffic Sign Detection under Challenging Conditions. In recent years, a lot of research on traffic sign detection and recognition has been done. But most of them were tested under restricted conditions such as the camera with high resolution and sensitivity,

highway environments, or roadside having a lot of trees and very few distracting objects. In this paper, we present a speedy and vigorous traffic sign detection system including two main stages: segmentation and detection. The accuracy rate is tested to be at least 86. The dataset used in experiments is recorded with a VGA camera under diverse lighting conditions, from the dark or cloudy sky to glaring conditions, in an urban area where a lot of confusing objects appearing on the roadside and target objects in a few cases are partially occluded. An automatic real-time system for detecting traffic signs has been shown and demonstrated successfully.[5]

II. SYSTEM ARCHITECTURE



It consists of input which is given by the camera module then it is passed to the processing block in which the input is first pre-processed and then recognized and classified into specific traffic signs it is corresponding to with the help of a trained dataset and CNN algorithm. After this, the output is generated and displayed on the monitor.

III. METHODOLOGY

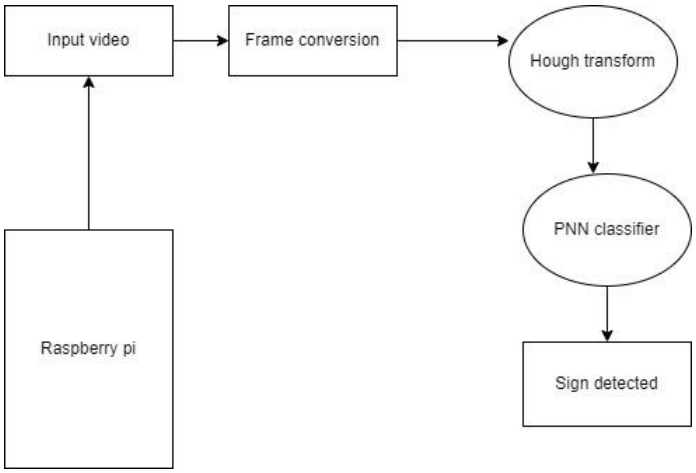
The first phase involves obtaining data about the track in front of the car using the car's environment through a mounted camera. This is followed by relaying the obtained information to the control station using wireless technology. In the second phase, CNN is used to recognize the road signs by calculating the distance of the road sign from the car and relaying the corresponding signal back to the car. The last phase involves manoeuvring the car by altering its speed, and direction based on the road sign detected.

The overall system is aimed at enabling an autonomous car to detect, and recognize road signs, detect lane path ahead, and calculate the distance to the road sign to take appropriate decisions to stop/turn/continue driving. The proposed system consists of the following phases viz., Road Sign Recognition, Distance Calculation to Road Sign, Lane Following Control, and Autonomous Driving on Assigned Tracks.

In Phase 1, the input is taken from the camera module of the traffic sign shown. This feed is streamed to the control station where it is received frame-by-frame and converted from RGB mode to grayscale. The frames of the track are given as input to the CNN and the output prediction of the road sign is then fed as a signal to Raspberry Pi.

Phase 2, includes performing training of the neural network by feeding various photos of the same traffic sign with variations in angle, and brightness. Once trained, the neural network can automatically detect the sign shown to it.

Phase 3, finally integrates all the above functionalities using Raspberry Pi, Raspberry Pi is used as a processor to control the camera module, display, etc... Once the sign is located inside the detection window it displays the detected sign, on receiving the signal, the monitor displays the signal (Stop, 30kmph, left, right)



Block Diagram

HARDWARE REQUIREMENTS

Raspberry Pi: Raspberry Pi is a small single-board computer. it is the heart of our project. By connecting peripherals like a Keyboard, mouse, and display to the Raspberry Pi, it will act as a mini personal computer.

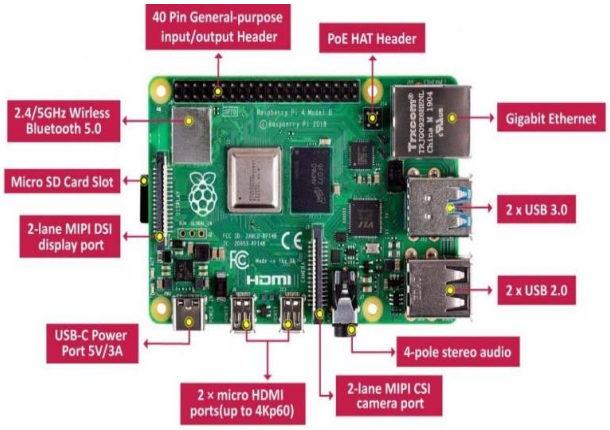


Figure: Raspberry Pi

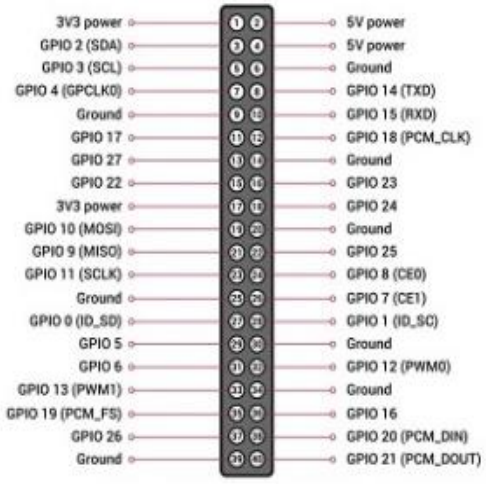


Fig: Pin Diagram

Camera Module: A webcam is a video camera that is developed to record or sequence to a computer or computer network. A webcam is a digital video device popularly built into a computer. Its main function is to transmit pictures over the Internet. It is popularly for recording images.

IV. RESULTS

Fig. 30 kmph detected

Fig. 50 kmph detected

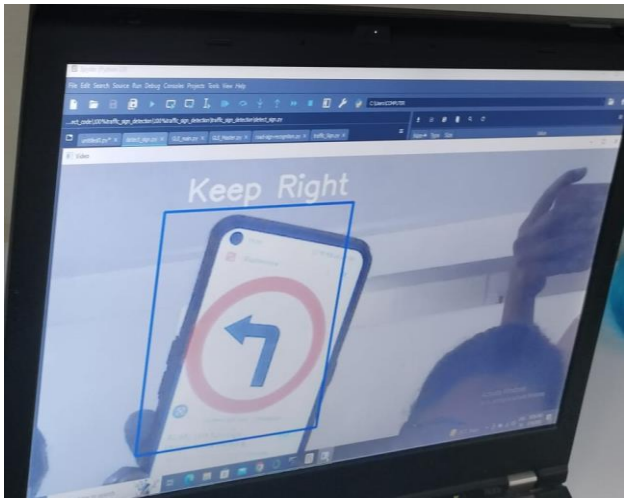


Fig. Keep Right Detected

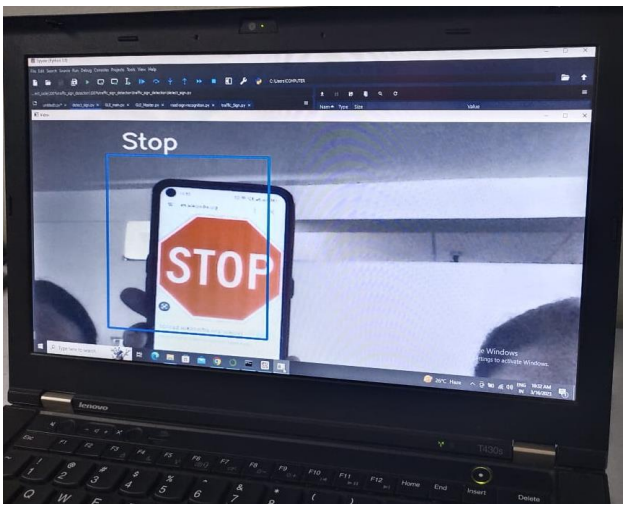


Fig. Stop detected

As can be seen in the above results, the traffic signs are captured by the camera module and are displayed on the monitor. Captured signs are first recognized and classified by the CNN which is a multilayer classification model. In the first layer the image is processed by putting an (n*n) kernel over it, later in the next layer Max Pooling is done in which we find the highest value of a pixel from a part of the image overlapped by the kernel. Max Pooling also performs as a Noise Suppressant. It removes the noisy activations simultaneously and also conducts noise removal along with dimensionality deduction. Several max-pooling layers are applied to the image and the image is flattened. Further, the results are given to Fully connected layers where each input is connected to every output. Thus, at the output layer classified image is obtained.

V. CONCLUSION

Traffic sign detection using machine learning is a promising area of research with many potential applications in the field of transportation and autonomous vehicles. Machine learning algorithms, particularly deep learning models such as Convolutional Neural Networks (CNNs) are effective in detecting traffic signs from images. One of the main advantages of using machine learning for traffic sign detection is its ability to handle complex and variable traffic sign shapes, colours, and lighting conditions. Furthermore, machine learning models can be trained on large datasets of annotated traffic sign images, which can improve their accuracy and generalization ability. However, there are still several challenges that need to be addressed to improve the performance of machine-learning models for traffic sign detection. These include dealing with occlusions and variations in traffic sign positioning, as well as ensuring robustness to changes in weather and lighting conditions. Overall, traffic sign detection using machine learning has the potential to improve road safety and efficiency by enabling autonomous vehicles to accurately detect and respond to traffic signs in real time.

VI. REFERENCES

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