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Road Sign Detection: A Survey

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A B S T R A C T

Road signs are important to ensure smooth Road flow without bottle necks or mishaps. Road symbols are the pictorial representations having different necessary information required to be understood by driver. Road signs in front of the vehicle are ignored by the drivers and this can lead to catastrophic accidents. This paper presents an overview of the Road sign board detection and recognition and implements a procedure to extract the road sign from a natural complex image, processes it and alerts the driver using voice command. It is implemented in such a way that it acts as a boon to drivers to make easy decisions.

Keywords:Deep Learning, CNN, preprocessing, road sign.

Introduction

Traffic signs provide the necessary information and warn of potential dangers. They are an important part of keeping drivers and pedestrians safe on the road. Road signs play an important role in the smooth flow of traffic and avoid hazardous accidents. Because the primary purpose of traffic signs is to help prevent accidents and protect people on the road, it is critical that they be prominently displayed to command attention and placed in such a way that drivers have enough time to respond to the command given by each sign. From speed limits to directions on where and when to turn, traffic signs provide a wealth of information. Following traffic signs helps to keep everyone on the road safe by reducing the chances of drivers colliding with other vehicles, pedestrians, or cyclists.Accidents can occur, for example, because drivers do not notice a sign in time or by lack of attention at a critical moment. In bad weather conditions such as heavy rain showers, fog, or snow fall, drivers pay less attention to traffic signs and concentrate on driving. In night driving, visibility is affected by the headlights of traffic oncoming and drivers could easily be blinded.Hence, we propose a system for detection of traffic sign and convey the driver the sign using audio output.

Literature Review

This paper describes an approach for detection and recognition of Road signs in real time with account for illumination and distance changes. A small single- board computer Raspberry Pi 2 and a webcam Hama AC-150 were used to implement the proposed algorithm. A scheme for determination Road sign location uses colour filter with morphological operators and Canny edge detector, identification of sign type is based on multilayer perceptron neural network. Variations of five Road signs were used to train and test an algorithm. As a result, experiments were successfully performed. Developed system is robust to light changes and is able to recognize Road signs 20 cm in diameter from 1.5–2 m distance.[1]

Colour represents an important attribute in the field of Road sign recognition. However, when the colour of the Road sign fades or the Road scene is collected in grey as in the case of Infrared imaging, then colour-based recognition systems fail. Other problems related to colour are simply that different countries use different colours. Even within the European Union, colours of Road signs are not the same. This paper aims to present a new approach to detect Road signs without colour at- tributes. It is based a two-stage sliding window which detects Road signs in the multi-scale image. Histogram of Oriented Gradients HOG descriptors are computed as a quality function which are evaluated by two SVM classifier; the coarse and the fine detectors. Different objects detected by the coarse detectors are clustered and a fine search is conducted in the areas where Road signs are more probable to exist. Experiments conducted to detect Road signs under different light conditions such as sunny, cloudy, fog and snow fall have showed a performance of 98% and very low false positive rate. The proposed approach was tested on the Yield Road signs because it has a simple triangular shape which can be found in

many places other than the Road signs which represent a challenge to the proposed approach.[2]

Road sign recognition, including sign detection and classification is essential for advanced driver assistance systems and autonomous vehicles. This paper introduces a novel machine learning-based sign recognition scheme. In the proposed scheme, detection and classification are realized through learning in a coarse-to-fine manner. Based on the observation that signs in the same category share some common attributes in appearance, the proposed scheme first distinguishes each individual sign category from the background in the coarse learning stage (i.e., sign detection) followed by distinguishing different sign classes within each cate- gory in the fine learning stage (i.e., sign classification). Both stages are realized through machine learning techniques. A complete recognition scheme is developed that is effectivefor simultaneously recognizing multiple categories of Road signs. In addition, a novel saliency-based feature extraction method is proposed for sign classification. The method segments salient sign regions by leveraging the geodesic energy propagation. Compared with the conventional feature extraction, our method provides more reliable feature extraction from salient sign regions. The proposed scheme is tested and validated on two categories of Chinese Road signs from Tencent street view. Evaluations on the test dataset show reasonably good performance, with an average of 97.5% true positive and 0.3% false positive on two categories of Road signs.[3]

Visual-based Road sign recognition (TSR) requires first detecting and then classifying signs from captured images. In such a cascade system, classification accuracy is often affected by the detection results. This paper proposes a method for extracting a salient region of Road sign within a detection window for more accurate sign representation and feature extraction, hence enhancing the performance of classification. In the proposed method, a super pixel-based distance map is firstly generated by applying a signed geodesic distance transform from a set of selected foreground and background seeds. An effective method for obtaining a final segmentation from the distance map is then proposed by incorporating the shape constraints of signs. Using these two steps, our method is able to automatically ex- tract salient sign regions of different shapes. The proposed method is tested and validated in a complete TSR system. Test results show that the proposed method has led to a high classification accuracy (97.11street images. Comparing to the same TSR system without using saliency-segmented regions, the proposed method has yielded a marked performance improvement (about 12.84%). Future work will be on extending to more Road sign categories and comparing with other benchmark methods.[4]

This paper presents a comprehensive research study of the detection of U.S. Road signs. Until now, the research in Road Sign Recognition systems has been centred on European Road signs, but signs can look very different across different parts of the world, and a system that works well in Europe may indeed not work in the U.S. We go over the recent advances in Road sign detection and dis- cuss the differences in signs across the world. Then we present a comprehensive extension to the publicly available LISA-TS Road sign data set, almost doubling its size, now with high-definition-quality footage. The extension is made with testing of tracking sign detection systems in mind, providing videos of Road sign passes. We apply the Integral Channel Features and Aggregate Channel Features detection methods to U.S. Road signs and show performance numbers outperforming all previous research on U.S. signs (while also performing similarly to the state of the art on European signs). Integral Channel Features have previously been used successfully for European signs, whereas Aggregate Channel Features have never been applied to the field of Road signs. We take a look at the performance differences between the two methods and analyse how they perform on very distinctive signs, as well as white, rectangular signs, which tend to blend into their environment.[5]

To ensure Road safety of highway off-ramp area, it should leave enough reaction time for drivers taking corresponding actions after Road signs. And the recognition time for Road signs depends on information volume. In this study, Road sign recognition process in highway off-ramp were analysed and visual recognition time model was set up. Then, the information volume contained in Road signs was calculated using the information theory, and the information was divided it into four grades. In order to analyse the recognition time for different information grades, a simulation driving experiment was implemented. 20 participants took part in this experiment and the time for four grades was obtained. An evaluation approached was proposed, which identifies the safety conditions of highway off-ramp into four levels according to the time ranges after recognition. The proposed Road safety evaluation method may provide a new way to evaluate the safety for highway offramp for its intuitive, easy operation and reasonable, especially for setting Road signs information volume. [6]

The legibility of Road signs in urban tunnels is of great importance on Road safety. To improve legibility of Road signs, this paper attempts to assess the siting and layout of LED Road guide signs by simulation and field tests. First, the test scenarios were built in DIALUX software, where drivers' legibility distance were recorded with regard to twenty-four signs with different colours, font sizes, and contrast ratios. Then, to confirm the results from simulation, twenty LED Road guide signs with different layouts were designed. Different layouts were set up with varying sign sizes, height-width ratios, thickness of stroke and light emitting forms. By setting up those Road guide signs, field tests are conducted on Tongji University campus, South Tibet Road tunnel and Shang Zhong tunnel in Shanghai. Finally, ac- cording to the experimental results, the optimal design for urban tunnels with speed of 60km/h is recommended regarding legibility distance.[7]

Automatic Road sign detection and recognition is a field of computer vision which is very important aspect for advanced driver support system. This paper proposes a framework that will detect and classify different types of Road signs from images. The technique consists of two main modules: road sign detection, and classification and recognition. In the first step, colour space conversion, colour-based segmentation is applied to find out if a Road sign is present. If present, the sign will be highlighted, normalized in size and then classified. Neural network is used for classification purposes. For evaluation purpose, four type Road signs such as Stop Sign, No Entry Sign, Give Way Sign, and Speed Limit Sign are used. Altogether 300 sets images, 75 sets for each type are used for training purposes. 200 images are used testing. The experimental results show the detection rate is above 90% and the accuracy of recognition is more than 88%.[8]

It is important to detect and recognize the Road sign for mobile robot localization and navigation. In this paper, an algorithm frame of feature detection and matching has been developed which includes shape detection, Harris corner detection, SIFT feature matching and robust estimation method. Firstly, the colour threshold segmentation algorithm in RGB colour space is adopted to get the candidate region of Road signs and the region growing method is applied to remove the noise in this image. Secondly, the shape features on the edge image are detected using template matching. Thirdly, Harris corner features are calculated and sorted, then the SIFT feature descriptors are computed on the extraction corner points. Finally, according to the minimum Euclidean distance the matching characteristic vectors are obtained between two images then random sampling algorithm with robust estimation is used to

reduce mismatch. Experiment result shows that this algorithm is efficient.[9]
In this paper, a simple and efficient algorithm for detecting deformed and occlusion triangular and circular Road signs under complex natural scenes is pro- posed. Firstly, the image is segmented and binarized. Then the convex hull of every contour extracted from the binarized image is calculated. Some concave part of a contour is removed and is replaced by the corresponding convex edge of the convex hull. After that, the contour is approximated to a polygon. Finally, those contours which can be succeed to approximated to a triangle is the triangular Road signs, and other contours approximation which can be approximated to a ellipse with random least squares fitting is the circular Road signs. The experimental results show the detection rate reaches 86.79%, this algorithm can handle the adverse influence of Road signs' deformation, occlusion better than though method. It has better real- time performance and lower error detection rate than template method.[10]

Road Sign Detection

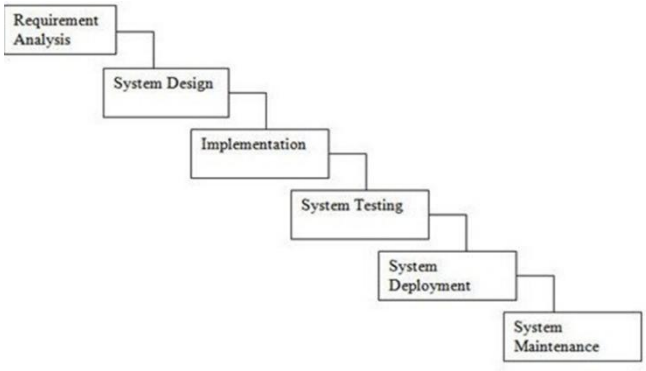
Road signs play an important role in the smooth flow of traffic and avoid hazardous accidents. Accidents can occur, for example, because drivers do not notice a sign in time or by lack of attention at a critical moment. In bad weather conditions such as heavy rain showers, fog, or snow fall, drivers pay less attention to traffic signs and concentrate on driving. In night driving, visibility is affected by the headlights of traffic oncoming and drivers could easily be blinded.
In the paper we have proposed a road sign detection using Deep Learning and CNN algorithm. We will train the machine to detect the road sign. Pre-processing of the input image will be done which will convert the image from RGB to binary. We used machine learning classifier i.e. CNN (Convolutional Neural Network) algorithm. As the road sign will be detected a voice alert will be given the driver thus avoiding any mishaps.

CNN (Convolutional Neural Network)

A Convolutional Neural Network (CNN) is a Deep Learning algorithm that takes input as an image, assigns importance measurable weights and biases to different objects in the images, and be able to differentiate from each other. The processing method required in a CNN is much lesser as compared to other classification algorithms present in today's generation. While in primary methods filters are manually handled, with enough training module, CNN have the ability to learn these filters/characteristics with proper specialization.

Waterfall Model

As shown in fig.1. below, the waterfall model is a breakdown of project activities into linear sequential stage, where each stage depends on another stage to complete a task. The approach is typical used for certain areas of engineering design. In software development, it tends to be flexible approaches, as progress flows in vast in one direction ("downwards" like a waterfall) through the stages of conception, initiation, analysis, design, construction, testing, deployment. The model is used in the manufacturing and construction industries; where the highly structured physical environments meant that design is made and became prohibitively expensive much sooner in the development process.



Feature Extraction

Feature extraction is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable

groups. So when you want to process it will be easier. The most important characteristic of these large data sets is that they have a large number of variables. These variables require a lot of computing resources to process. So Feature extraction helps to get the best feature from those big data sets by selecting and combining variables into features, thus, effectively reducing the amount of data. These features are easy to process, but still able to describe the actual data set with accuracy and originality.

In deep learning, feature extraction is performed using many layers. Each layer uses the output of the previous layer as input . Convolutional neural networks (CNN) are one of the deep learning architectures that include artificial neural networks and layers of feature extraction. CNN is also a type of Multi-Layer Perceptron (MLP). As one of the most well-known algorithms of deep learning architecture, CNN is able to classify a model directly from video, images, text, or sound.

Segmentation

Image segmentation is a commonly used technique in digital image processing and analysis to partition an image into multiple parts or regions, often based on the characteristics of the pixels in the image. Image segmentation could involve separating foreground from background, or clustering regions of pixels based on similarities in colour or shape.

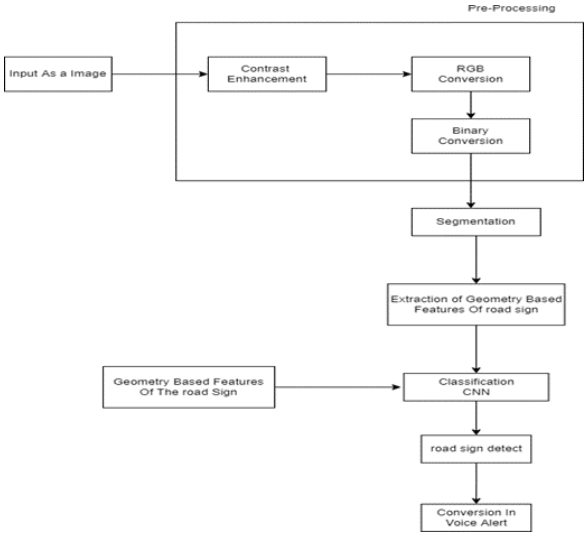
Several algorithms and techniques for image segmentation have been developed over the years using domain-specific knowledge to effectively solve segmentation problems in that specific application area.

Image segmentation involves converting an image into a collection of regions of pixels that are represented by a mask or a labeled image. By dividing an image into segments, you can process only the important segments of the image instead of processing the entire image. A common technique is to look for abrupt discontinuities in pixel values, which typically indicate edges that define a region.

Proposed system

We are proposing a system that will use machine learning algorithm i.e. CNN Convolutional Neural Network. Our planned model will be trained with around 100-500 images of and with increasing epoch in order to increase accuracy. The reason we are using CNN is it has multiple layers hence it will help into training model with easy manner. We will sue Open Computer Vision Technology simultaneously to interact with camera, to take live input from camera. We will set and define different signs with images and that image will be trained with algorithm. Person will have to perform sign in front of camera. After taking live input from camera the sign will be recognized. Recognized sign will give text output and it will be translated to audio sound. So, system will work as Sign to Speech

System architecture:



Conclusion and Future Scope

We propose a smart driver alert system which detects and recognizes Road signboard from video stream input and gives voice message to the driver. By

using this technology, we can reduce the road accidents as well as regulate Road safely. In future the system can also be developed in a way that the traffic signs focus on reduction of the traffic load on existing road network through various travel demand management

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