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Traffic Sign Detection Using a Cascade Method

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Abstract- Automatic traffic sign detection is challenging due to the complexity of scene images, and fast detection is required in real applications such as driver assistance systems. In this paper, we propose a fast traffic sign detection method based on a cascade method with saliency test and neighbouring scale awareness. In the cascade method, feature maps of several channels are extracted efficiently using approximation techniques. Sliding windows are pruned hierarchically using coarse-to-fine classifiers and the correlation between neighbouring scales. The cascade system has only one free parameter, while the multiple thresholds are selected by a data-driven approach. To further increase speed, we also use a novel saliency test based on mid-level features to pre-prune background windows. Experiments on two public traffic sign data sets show that the proposed method achieves competing performance and runs 2~7 times as fast as most of the state-of-the-art method. The main objective of this paper is to develop an algorithm so that we can automatically recognize traffic signs in digital images. This work uses basic image processing technique for automatically recognizing two different traffic signs- stop sign and yield sign in an image. The proposed method detects the location of the sign in the image, based on its geometrical characteristics and recognizes it using colour information.

Keywords: Traffic sign detection, cascade system, fast feature extraction, saliency test.

I. INTRODUCTION

Along with the urbanization, the violently increasing of the volume of automobile brings some problems such as traffic jams and traffic accidents, etc. The driving aided system based on computer vision is one important measure to solve these problems. The traffic indication sign recognition is essential to the ITS (Intelligent Transport System). Every year 1.3 million people worldwide are killed on roads, and between 20 and 50 million are injured. A good solution to this problem would be to develop machines, which take into account the environment. That is why today, safe auto driving is becoming a popular topic in many fields, from small projects to large car factories. However this topic also raises many questions and problems. There is a need to define the width of the edges of the road, recognize road signs, traffic lights, pedestrians, and other objects which contribute the driving safely. There are many methods for solving these tasks. Recognition of traffic signs has been addressed by a large amount of classification techniques: from simple template matching (e.g. cross-correlation similarity), to sophisticated Machine learning techniques (e.g. support vector machines, boosting , random forest, etc), are among strong candidates to assure straightforward outcome necessary for a real end- user system. Moreover, extending the traffic sign analysis from isolated frames to videos can allow to significantly reduce the number of false alarm ratio as well as to increase the precision and the accuracy of the detection and recognition process. Research groups have focused on other aspects, related more with the development of an automatic pilot to detect road borders or obstacles in the vehicle's path such as other vehicles or pedestrians. 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. Traffic sign detection plays an important role in intelligent transportation such as driver assistance systems, road maintenance and automated driving. Although signs are designed with distinct colour and simple shape, automatic detection is still challenging in complex scenes, because the background and illumination are changing, signs may be distorted in colour and shape, and sometimes, partially occluded. In addition, the image undergoes motion blur when the vehicle moves fast. A traffic sign detection method should be designed to overcome these problems to achieve high accuracy and reliability. Moreover, detection should be fast to satisfy real-time applications such as driver assistance systems. Automatic object recognition has long been an interesting research area in image processing, one specific area with practical importance is automatic traffic sign recognition. A robust traffic sign detection algorithm is an essential part of applications like automatic vehicle control, navigation, etc. Many researches have been done on this topic and have shown promising results. This work tries to get a first taste of this topic using the image processing techniques introduced in the class. Our main objective is to detect two signs namely stop sign and yield sign. By using colour shape and size –being the properties of the sign we can separate them from other part of the image and the filling ratio is used to separate these two sign from each other. We have also used Image dilation to connect the possible fragmented region of the traffic sign after thresholding. We have collected a number of images on stop sign and yield sign and divided them into two groups: a training group of and a testing group. Training group is used to select the proper threshold for the algorithm and the testing group is used to test the effectiveness of the algorithm.

Traffic sign detection has been studied intensively in the past decades and many approaches have been proposed. Early methods usually exploited the colour or geometric information of traffic signs. Since the famous Viola-Jones detector was successfully used in face detection, sliding window and machine learning based methods have become prevalent. Recently, some sliding window based methods achieved leading performance in the competition of Germany Traffic Sign Detection Benchmark (GTSDB). Nevertheless, these methods are computationally expensive. We aim to design a fast traffic sign detection system to maintain the performance advantage of sliding window based methods with significant speedup. The research on traffic signs recognition generally includes two modules, detection and classification. Colour or shape are usually used to detect the region may contain the traffic sign. Classification is further to identify the meaning of traffic signs.

II. SYSTEM DESIGN

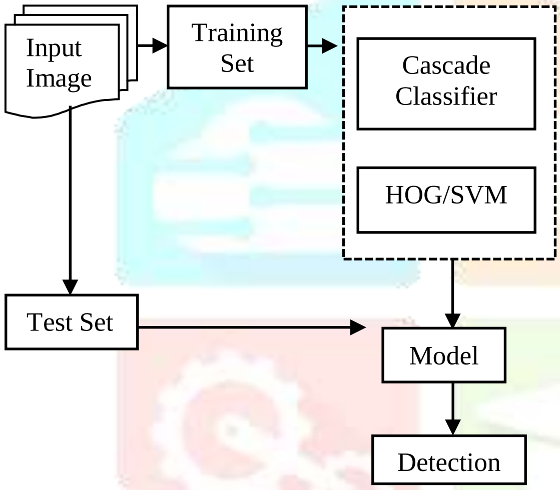

Fig 1. Architecture of the project

The figure illustrates the architecture of the project. The research on traffic signs recognition generally includes two modules - Detection and Classification. Image input and processing image. The frame is in RGB colour format. These frames are converted into YCbCr format. Extract Cr frame. Check for biggest area. Classify signal using cascade classifier. Preparing training data. Send the detected output to controller and emit the sign through the voice using APR kit. The HOG is a type of algorithm, It is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image. Cascading classifiers are trained with several hundred positive sample views of an object and arbitrary negative images of the same. The classifier is trained and later applied to a region of an image and detect the object in question. To search for the object in the entire frame, the search window can be moved across the image and check every location for the classifier.

III. HARDWARE IMPLEMENTATION

A. Micro Controller(16f877A)

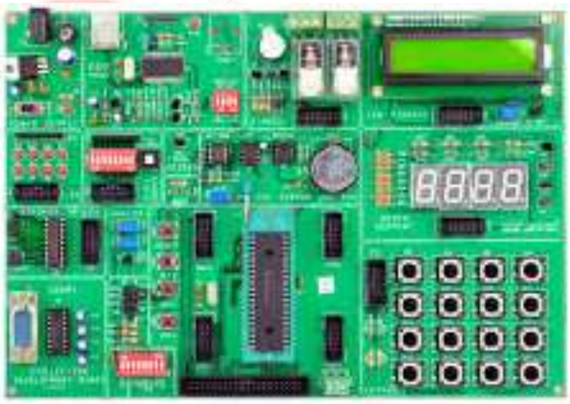

Fig 2. Pic 16f877A Micro controller Board

This is basic PIC development board with DIP(Dual in-line package) socket. This board is perfect for programming PIC microcontroller as well as for designing and testing PIC based projects. The board has on-board PIC16F877A MCU. The bridge rectifier allow this board to be powered with both AC and DC power supply adapters. Board has on board 5v power supply circuit,DB9 RS232 port for serial communication with computer and other serial devices.

B. APR Speech Kit

Fig 3. Voice recording circuit

You can make a voice recording and playback circuit using the easily available IC APR 9301. The circuit can record and playback the voice up to 30 seconds. The IC APR 9301 is provided with the circuitry capable of storing and reproducing the sound without using any microcontroller or some other software. No external ICs are required in the operation of the voice recording. IC 9301 is a versatile 28 pin IC with non-volatile flash memory. It can perform around 100 K recording cycles and can store the memory around 100 years. The memory cells can store more than 256 voltage levels. The IC is a low voltage version and requires only 5 volts and 25 mA current for its normal working.

III. SOFTWARE AND ENVIRONMENT

A. MATLAB Software

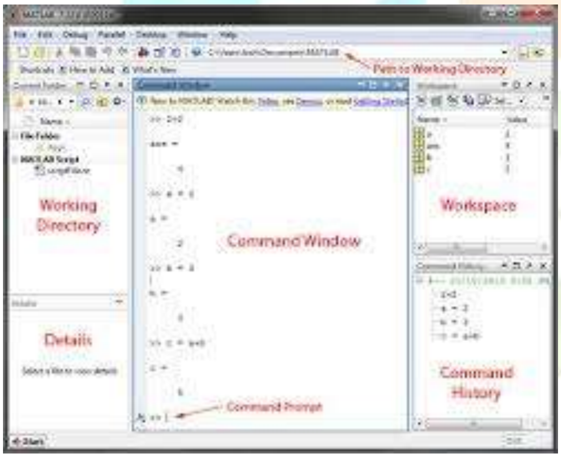

Fig 4. MATLAB program developing environment

MATLAB is an interactive mathematical program that allows mathematical calculations as well visualization of this data. MATLAB has hundreds of built-in functions and can be used to solve problems ranging from the very simple to the sophisticated and complex. Whether you want to do some simple numerical or statistical calculations, solve simultaneous equations, make a graph, or run and entire simulation program.

B. MATLAB Environment

MATLAB can be an effective tool. Since it is such a large and versatile application, the information in these modules will be split into small segments in order to help you gain familiarity. MATLAB uses its own set of commands and code to be used to solve a problem. If the commands are typed incorrectly, the program either will perform an undesired operation or do nothing at all and give you an error message.

III. CONCLUSION

The application software developed in this work recognizes and classifies traffic signs from an input image. The image processing techniques used in this software include a pre-processing stage, regions of interest detection, potential traffic sign detection, according to the traffic sign shape patterns, and finally, the recognition and classification of these potential traffic signs according to a database of traffic sign patterns. The performance of this application depends on the quality of the input image, in relation to its size, contrast and the way the signs appear in the image. With this consideration, the percentages of recognized signs for this application are high. We propose a cascade detector called HHVCas for fast traffic sign detection. It uses multiple stage classifiers in coarse-to- fine manner. To evaluate a large number of windows at the first two stages, we design fast feature extraction techniques and use linear classifiers. The Stage III and Stage IV use features of increasing dimensionalities. The Stage I also use neighboring scale awareness to save the computation of window evaluation. The rejection thresholds of HHVCas are optimized jointly by a data-driven approach. In addition, a novel saliency test based on mid-level features is introduced to pre-prune sliding windows while maintaining detection accuracy. Experiments on the GTSDB dataset show that our HHVCas achieves competitive performance in comparison with state-of-the-art methods, while running 2~7 times as fast as most of them. Compared with a very recent fast method, the HHVCas relies on little color information and has fewer free parameters.

IV. REFERENCES

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