

Efficient algorithm for automatic road sign recognition and its hardware implementation

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Abstract The automatic detection of road signs is an application that alerts the vehicle's driver of the presence of signals and invites him to react on time in the aim to avoid potential traffic accidents. This application can thus improve the road safety of persons and vehicles traveling in the road. Several techniques and algorithms allowing automatic detection of road signs are developed and implemented in software and do not allow embedded application. We propose in this work an efficient algorithm and its hardware implementation in an embedded system running in real time. In this paper we propose to implement the application of automatic recognition of road signs in real time by optimizing the techniques used in different phases of the recognition process. The system is implemented in a Virtex4 FPGA family which is connected to a camera mounted in the moving vehicle. The system can be integrated into the dashboard of the vehicle. The performance of the system shows a good compromise between speed and efficiency.

Keywords Detection · Recognition · Classification · Hardware implementation

1 Introduction

Automatic recognition of road signs is a very attractive modern application because it helps reducing the risk of traffic accidents. This application improves the vigilance of the vehicle's driver by warning him of the presence of road signs that he has, perhaps, missed. Automatic recognition of road panels allows the driver to react on time according to the indication of road signs. The application may warn the driver by an audio and/or video alert. It represents an electronic driving aid like anti-lock breaking system (ABS), the system trajectory control (ESP for 'Electronic Stability Program'), and the automatic parking cameras and mirrors. The proposed system is also an application that has very high cultural and economic impact.

At the first glance, the road sign recognition problem may appear simple as road panels are fixed in standardized positions in traffic scenes, their shapes, colors and pictograms are known following international standards. In reality the problem is complex, as we must add additional features that influence the recognition system design and performance. In fact, road signs are acquired from a relatively high speed moving car. Thus, the traffic scene images often suffer from vibrations and the color information is affected by variable illumination. Moreover, road signs are frequently partially occluded by objects present in traffic scenes which make the sign detection hard. The presence of pedestrians, other vehicles, buildings, colored objects and billboards may cause the detection system to be confused by patterns similar to that of road signs.

According to the Vienna Convention of 1968 on road signs and signals [37], road signs are classified into seven categories: (1) danger warning signs; (2) priority signs; (3) prohibitory or restrictive signs; (4) mandatory signs; (5) information, facilities, or service signs; (6) direction,

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