Development of Lane Departure Warning System Based on Monocular Vision

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Abstract: With the continuous improvement of society and economy in China, every family can afford a vehicle. As a result, the demand for automobiles in China is rising every year, but the traffic accidents have also increased to a very high level. Therefore, the driving safety performance has become the focus of people's attention. According to the statistics, in the traffic accidents that occurred in recent years, the lane departure accidents caused by the driver's distracted attention while driving a vehicle account for as much as 37% of all traffic accidents. Therefore, relevant departments must pay enough attention to traffic accidents caused by vehicle deviation and increase the development of lane departure warning system. Only in this way can the chance of traffic accidents be reduced. And Lane departure warning system can effectively mitigate the occurrence of vehicle deviation accident. The most widely used is the lane departure warning system based on monocular vision which includes two core algorithms: lane detection and lane departure warning. The main content of this thesis is a brief analysis of lane departure warning system based on monocular vision. It is hoped that this method can contribute to the development of lane departure warning system based on monocular vision.

1. Introduction

What is lane departure warning system? The main function of lane departure warning system is as follows: If drivers lose their attention while driving a vehicle, which leads to early warning when the driving lane deviates, the driving safety of the vehicle can be guaranteed by the lane departure warning system. Lane departure warning system is mainly based on the principle of machine vision, designed with a single camera to capture road information, using TMS320DM642 as the main processor to pre-process the captured image and extract the lane line, and then combined with the car CAN bus transmission the current status of the car information for early warning decision. In the hardware configuration, mainly by two-chip SDRAM image processing, which caches a large amount of video data, the first use of TVP5150 has been collected image data decoding process, so as to provide effective image data processing support SAA7121 The image data is encoded for real-time video display.

Image processing technology belongs to visual processing technology, and its application has been widely applied to all fields. The current highway construction has made great development; the development of the transportation field cannot be separated from the support of graphics processing technology. According to relevant statistics, while the car ownership in our country keeps rising, the incidence of traffic accidents has also been at a high level. In particular, the traffic accidents on the expressway have caused great harm to people's lives and social assets Loss.

As mentioned above, about 50% of traffic accidents are caused by drivers' discrepancy in driving the vehicle, which in turn causes the vehicle to deviate from the lane. In general, if the driver's reaction time is advanced within 0.5 seconds, it is possible to effectively reduce the incidence of 60% rear-end traffic accidents, 50% cross-traffic accidents and 30% head-on traffic accidents. Lane departure warning system can effectively solve the above problems, which has become the focus of driving safety research.

According to the design concept of lane departure warning system, lane departure warning system includes early warning system based on road infrastructure and early warning system based on vehicle driving conditions. Compared with the two systems, the lane departure warning system based on road infrastructure is mainly aimed at optimizing the road conditions. The system needs to arrange professional electromagnetic signs on both sides of the vehicle road, and then the system can be based on the electromagnetic signs arranged on both sides of the road accurately determine the location of the vehicle in the current road, this lane departure warning system has a very high cost of use, which has a serious impact on its development; and vehicle-based lane departure warning system is the main principle: the vehicle installation visual system or professional sensor device to determine the location of the lane line, vehicle-based lane departure warning system is easy to improve and handle more flexible, especially the use of machine vision lane departure warning system has a strong visual characteristics, and the system can vehicle driving video professional processing, analysis, but also can jointly use auxiliary methods to enhance processing speed.

The lane departure warning system based on machine vision mainly includes the front lane deviation early warning system and the rear lane deviation warning system according to the installation position of the shooting head. Among them, the front lane departure warning system relies mainly on the shooting head, the system is relatively simple and the application cost is low. Therefore, the development of lane departure warning system based on monocular vision mainly relies on the front view system. Monocular cameras are mounted on the car's rear-view mirrors to collect video from vehicles and are equipped with professional video signal processing equipment. The working flow based on the monocular visual lane departure warning system studied in this paper is that the driving environment of the vehicle can be photographed by the monocular camera installed in the vehicle rearview mirror and the professional decoding device can be used after obtaining the video data Video data decoding, the decoded data will be sent to the algorithm device and then the corresponding algorithm processing, including algorithm processing, including Hough transform detection and detection of the lane line these two ways; after the above analysis of the final in accordance with the car signal pair The car's driving status to make an accurate analysis to determine whether the car is in the lane deviation state, if the car is judged to be in lane deviation, the system will be able to give timely warning of the driver to prevent the development of serious accidents. Among them, the warning methods include flash, alarm sound and electricity in three ways.

2. A brief analysis of the key technologies of hardware system design in early warning system

2.1. Brief analysis on structural design of lane departure warning system

The next figure is based on monocular vision lane departure warning system structure, the processor belongs to TI professional digital image processing chip, has a very powerful video and image processing capabilities. Video capture device for the CCD model of the capture device captured by the CCD capture data and then decoded by the appropriate decoding device. Figure 1 monocular vision LDWS hardware system structure. The processor uses specialized signal processing devices to convert the collected video material into a digital signal that the system can recognize. Typically, the vehicle battery voltage is configured to 12 volts DC voltage, the power supply system inside the device can be provided by the car battery 12V DC voltage for the normal operation of the DSP 3.3 volts and 1.4 volts Voltage, and 1.8 V for normal operation of the video conversion device.

The workflow of lane departure warning system based on monocular vision is shown in Figure 2 below. The sensing module existing in the early-warning system can use the photographing device to obtain the road information of the vehicle, and the lane detection function can comprehensively analyze the lane line in the image, and then can accurately judge the driving according to the actual situation of the traveling vehicle itself Whether the vehicle is off the lane line on the road.

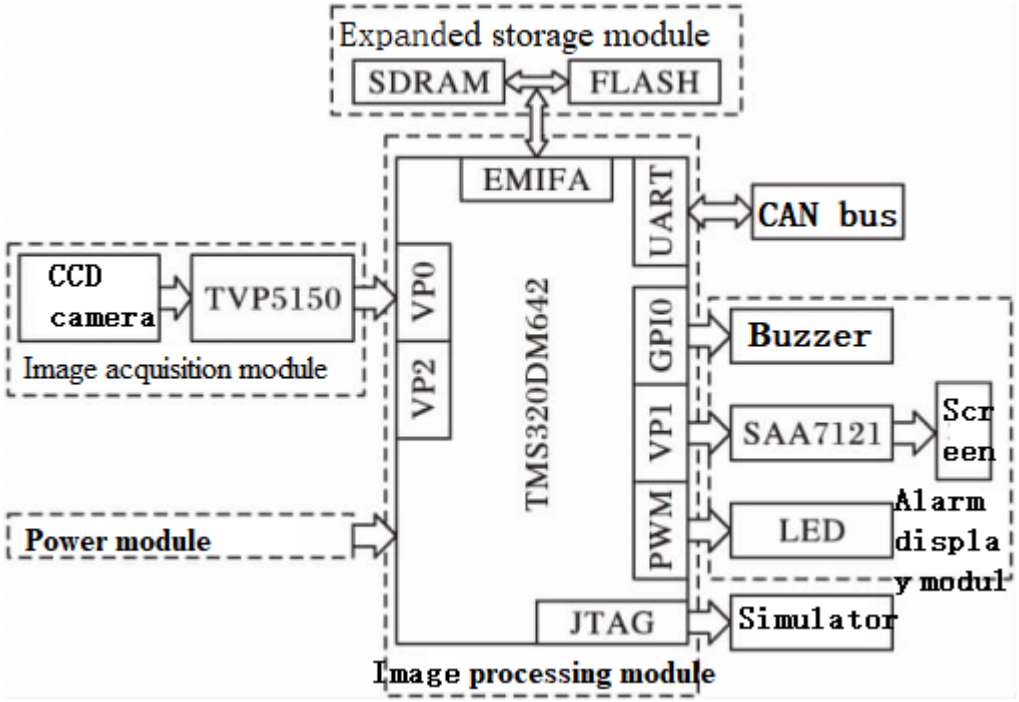

Figure. 1. Lane departure warning system hardware system block diagram

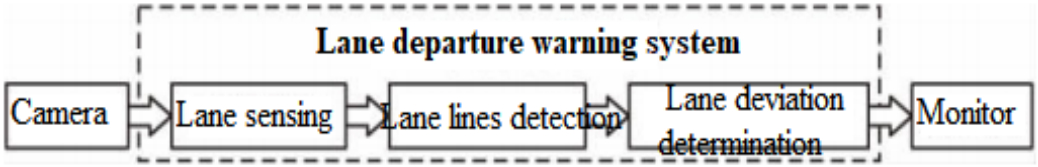

Figure. 2. Lane departure warning system workflow

2.2. Lane departure warning system has image data cache capabilities

The lane departure warning system based on monocular vision real-time acquisition of a large number of traffic information during the driving process of the vehicle during the operation and processing of these data to take up a lot of storage space, so lane departure warning System in the process of image acquisition to maintain the image data storage. The system uses a professional data cache device, and then use the device has the characteristics of independent address and data signals can be independent of the cache data read and write, will not affect the rest of the device, thereby greatly increasing the cache access performance.

In which DM642 chip can be flexible allocation of RAM space is only 288Kb, due to the lane departure warning system for video data processing, the resolution of the image acquisition requirements of 576 × 720, each image sample point of the gray level of 256 b Therefore, in order to ensure the smooth operation of the lane departure warning system, the memory needs to be expanded to expand the memory module through the DM642's 64-bit external memory interface (EMIF) Two 128 Mb SDRAM memories and a 32 Mb NAND FLASH.

2.3. A brief analysis of can bus for lane departure warning system

CAN can control the LAN bus. The control needs to transmit signals through the corresponding transmission physical medium (professional optical fiber or coaxial cable), etc. The CAN bus system mainly consists of a device with control function, a transceiver device, a data transmission device and the like. The data transmission line includes a high data transmission line and a low data transmission line. Compared with the traditional communication bus, CAN bus has higher flexibility and reliability, and it can carry out real-time transmission with a very high price / performance ratio. Therefore, CAN bus is the only one with the current international standard field bus, CAN bus has

been widely applied to the car production.

CAN bus on the car connected to a larger number of sub-controllers, including automatic transmission systems, engine systems, etc., based on monocular vision lane departure warning system mainly uses the car CAN bus access to the car during the turn signal, speed And steering wheel and other information, the combination of these information combined with the detected distribution of the lane line will be able to early warning of lane departure conditions, including the main warning process is as follows:

First, the road can detect the situation: the driving vehicle toward a lane line, then the steering wheel has the appropriate angle, if the driver did not hit the turn signal or hit the turn signal error, when the wheel pressure line close to the wheel over Line, this lane departure warning system will take the warning light warning mode, according to the corresponding direction of the lane deviation to give the corresponding direction alarm prompt (left or right direction); if the vehicle wheels completely over the lane line, then the lane Deviation warning system In addition to the warning light warning method, but also through the speaker warning to the driver to remind the driver driving the correct route.

Second, failure to detect the road route: If the lane departure warning system does not detect the road route, that is, no road line is detected in the image; the steering wheel exceeds a larger angle at this time. If the driver does not hit the turn signal or If the turn signal is incorrect, the lane departure warning system will remind the driver directly through the warning light and the alarm speaker.

2.4. A brief analysis of software implementation of lane departure warning system

In the process of computer image processing technology, the automatic image detection technology has been a research hotspot, which has a great relationship with the development of computer graphics, such as image-based modeling and user interface. In the development of computer graphics technology, linear detection has been widely used in various fields: for example, the field of camera calibration, self-navigation robotics and inheritance sensing. Hough Transform (Hough Transform, HT) because it is insensitive to noise interference and data loss, Hough Transform is an effective tool to detect a straight line in an image. Therefore, Hough Transform is the preferred algorithm for straight line detection.

Before detecting the lane line, necessary preprocessing is performed on the ROI area image, for example, image grayscale processing, image smoothing processing, image enhancement processing, and the like. Through the PC device, in VC6.0 environment can use the corresponding algorithm to simulate the highway car driving conditions, the next Figure 3 is the actual linear detection effect, from which you can analyze the algorithm used in this paper can be stable detection The car's debut line, in line with real-time requirements.

Figure. 3. Lane line results of this algorithm detection

Lane departure warning system hardware circuit board as shown in Figure 4 below:

Figure. 4. Lane departure warning system hardware circuit board

3. Conclusions

In summary, the traffic accident rate has grown to a very high level, therefore, the car's driving safety performance has become the focus of attention. According to the statistics, in the traffic accidents that occurred in recent years, the lane departure accidents caused by the driver's distracted attention while driving a vehicle account for as much as 37% of all traffic accidents. Therefore, relevant departments we must pay enough attention to traffic accidents caused by vehicle deviation and increase the development of lane departure warning system. Only in this way can we reduce the chance of traffic accidents. Lane departure warning system can effectively mitigate the occurrence of vehicle deviation accident. The most widely used is the lane departure warning system based on monocular vision. The system includes two core algorithms: lane detection and lane departure warning.

If the driver loses his attentiveness while driving the vehicle, the driver can make early warning when the driving lane deviates, and the driving safety of the vehicle can be ensured through the lane departure warning system. Lane departure warning system is mainly based on the principle of machine vision, designed a single capture device to collect road information, using TMS320DM642 as the main processor to pre-process the captured image and extract the lane line, and then combined with the vehicle CAN bus transmission The current status of the car information for early warning decision. If we can accurately determine whether the vehicle is in the lane departure, the system can promptly alert the driver in time. After getting the warning information, the driver can adjust the steering wheel or perform emergency braking in time to prevent the more serious accident. Therefore, in order to effectively reduce the incidence of traffic accidents, relevant departments must pay enough attention to the development of lane departure warning system, increase the development of lane departure warning system, provide the driver with a stable driving environment through the lane departure warning system, Reduce the incidence of traffic accidents.

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