Automated Moving Objects Detection with an On-Board Camera for Avoidance of Car Accident

Shohei Sunahara, Yusei Tsuboi, and Osamu Ono
Control Systems Laboratory,
Department of Electric and Electronic Engineering,
Meiji University
1-1-1 Higashimita, Tama-ku, Kawasaki, Kanagawa, JAPAN
(ce33031, tsuboi, ono)@isc.meiji.ac.jp

Abstract

In this paper, we propose a system that detects moving object detection with a CCD camera which captures visual information around a car. The system warns a driver when other vehicles come near to his car, which helps him with avoidance of the car accidents. HSV color space method is employed for the optical flow in the system. In addition, it is possible to find direction of moving objects because the system will be installed on a side door, toward the back of the car. The simulation result indicated some remarks; forty percent of a whole image was cut off by using the HSV color space method; the search time of optical flow was able to be shortened by 50% on the average. As a result, this system could shorten the entire processing time by 60% compared with the case when only the optical flow technique is used.

1 Introduction

Human error occupies a lot of ratios of the cause of traffic accident. This research is support of safe driving, which is one of nine development fields of Intelligent Transport Systems (ITS). Especially, it aims at the avoidance of the contact accident with a vehicle in the next lane at course changes, and a rolling accident with a two-wheeled vehicle at left turn. and driver is warned. In this paper, we propose a system that detects moving object detection with a CCD camera which captures visual information around a car. A CCD camera is attached on the door mirror of the car. The system detects moving objects (car and two wheeled vehicle that approaches the car) from the camera, and warns a driver when they come close to his car. It helps him with avoidance of the car accidents. For constructing the system, we improve the optical flow method by using HSV color space technique.

2 Methodology

In the proposed system, we use an image obtained from the camera on a door mirror. The range of the image obtained from the camera on the door mirror that can be recognized is wider than the door mirror. So, some moving objects within the range that was not able to be recognized only by seeing the door mirror can be recognized. If a wide angle camera is used, more wide-ranging recognition for the moving objects can be done. Moreover, it has the feature that safety is given to the driver only the camera image to be displayed in the monitor.

In this research, it was simulated on PC. The

image obtained from the camera on the door mirror is taken into PC by the AVI form, it had divided into the BMP image of full-color, and the image was processed on PC. The size of the image is 320×240, and the 10 frame at a second.

Fig. 1. Image from the camera (upper) and Reflection in a door mirror (below)

2.1 Problem of Optical flow method

When the camera is moving, the background difference method used well for the moving object detection cannot detect the moving body, because the geostationary things of the background are recognized the moving body. Therefore, we use optical flow method that detects the movement of the objects and makes the vector. However, long processing time is generally necessary for the detection of the rate vector of the optical flow method. Then, shortening the processing time is examined in this research.

2.2 HSV color space method

To solve the problem of the optical flow method, we employ the HSV color space method. To decrease the computational complexity that is the problem of the optical flow method, the processing area in the image has been reduced. As the method, the image with RGB color space first input is converted into the image with the HSV color space. And, the saturation(S) of each pixel is measured, and the pixel below the threshold has been reduced. It succeeded in the deletion of the area where the road and the sky so on saturation were low: it succeeded in the deletion of an unnecessary area from 40 to 60% by this processing.

Fig. 2. Original Image (upper) and Conversion Image by HSV color space method (below)

The following equation is a conversion equation from RGB color space to HSV color space.

$$r = \frac{R}{R+G+B} \quad (1)$$

$$g = \frac{G}{R+G+B} \quad (2)$$

$$b = \frac{B}{R+G+B} \quad (3)$$

$$H = \tan^{-1}\left[(g-b)/(2r-g-b)\right] \quad (4)$$

$$S = \left[(b-r)^2 + (r-g)^2 + (g-b)^2\right]/3 \quad (5)$$

$$V = (r+g+b) \quad (6)$$

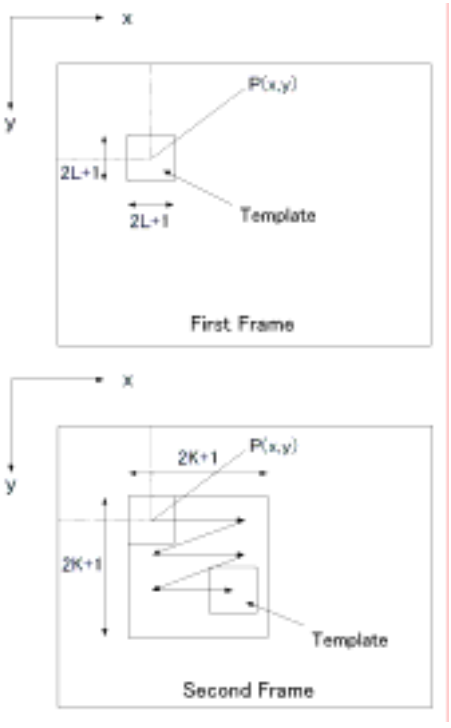

Fig. 3. Illustration of Pattern matching

2.3 Improvement of optical flow method

The pattern matching method is used as a method of requesting optical flow. The template is made in the first frame, and it searches for the place matched from the 2nd frame. It makes the place where the template moved in the matched place. And, the vector is made for the place that moved from former place of the template. It is understood beforehand that the background flows to the back of the screen, and the moving objects moves forward. Then, only the area for lower right one matches the correspondence point from a noteworthy point, a useless calculation is shortened, and the omission processing time can be shortened. The search time of optical flow was able to be shortened by 50% on the average.

Fig. 4. Original Image (upper) and Output Image (below)

3 Simulation result

The technique that has been employed is applied, and the effectiveness is examined. The targeted image is an image that a two-wheeled

vehicle approached the car from rear side. The three moving images recorded under each individual place were tested. These moving images have 10 frames per a second. Method of detecting moving objects is that the point with a lot of vectors in the same direction was made a moving object. As a result, this system could shorten the entire processing time by 60% compared with the case when only the optical flow technique is used. However, it is not possible to process in real time. Moreover, a lot of noises occur, and it causes the miss-detection. It is necessary to improve further algorithm to solve this problem. Moreover, we hope further speed up by installing hardware such as DSP.

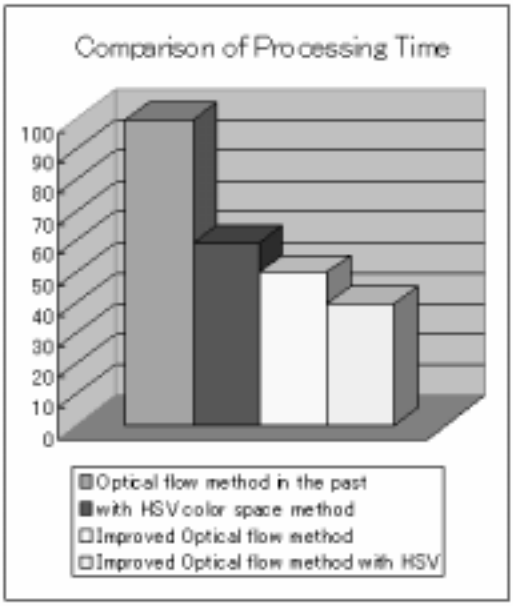

Fig.5. Comparison of Processing Time

4 Summary

In this paper, we have discussed characteristics of the system with the HSV method and the improved optical flow. As a result the system considerably reduced computational time of detection of moving objects. However, the simulation on a normal computer did not realize real-time process. We believe it is able to improve the proposed system in term of computational time. As for that, in future, the computational algorithm of the proposed system will be implemented on DSP.

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