DETECTION OF AUTOMOBILE FROM IMAGE SEQUENCES

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ABSTRACT

This paper presents a method for motion detection from image sequences with a moving camera. The most important problem is how to cancel the motion of backgrounds caused by the motion of camera. Existing methods can be divided into two groups. First group is using information about the motion of camera. Second group is using only image sequences. First group can be used only in restricted environment. Second group is free from environmental condition. But calculated accuracy of this method is not so high, and complex preprocessing is necessary for the detection of moving objects. In this paper, we proposed a method which can detect a moving object by using precise geometric transformation for background. Experimental results showed the effectiveness of this method.

1. INTRODUCTION

Many moving objects exist around us. It is impossible to detect the moving object from a still image. Moving objects can be detected by analyzing image sequences. The motion of background caused by the motion of observer should be canceled. Our aim is to develop a method which can detect a moving object by using precise geometric transformation for background. Moving object detection is important capabilities in active vision systems. Most of existing methods have two hypotheses. Most of the area can be approximated by orthographic projection. The area of moving object are very small compare with that of background. This research also used these two hypotheses. Automobile was used as a moving object in this study. Existing study of the automobile detection have used only two flames from image sequences which composed of binary images. Motion detection using such images has a defect which the background existing under the automobile remains after the detection. In order to improve the existing method, three flames were used in this study from the image sequences which composed of color images.

2. PROCEDURE OF THE PROCESS

There are two methods for the process. First method execute the process for each color R, G, and B image. Second method execute the process for color images directly.

Method α

First method execute following processes for an image of each color.

Let 3 flame images of image sequence be I1,I2 and I3.

(1) Let 2 flame images I1 and I2 be It and It+dt respectively.

(2) Several control points are created on It periodically. Corresponding points of control points are searched for It+dt by using minimize the square summation of difference of the pixel value for sub area.

(3) Coefficients of affine transformation for It and It+dt are calculated by using control points and corresponding points.

(4) It is converted to coincide with It+dt by using calculated affine transformation coefficients.

(5) Triangles (Ti) are created using 3 control points on transformed image of It. The square summation (Ei) of difference of the pixel values for each triangle (Ti) of the transformed image of It and It+dt.

(6) Control points which has Ei less than a certain threshold are selected.

(7) Coefficients of affine transformation are calculated by using selected control points.

(8) Affine transformation was executed for It. Difference image of the transformed image of It and It+dt.

(9) After changing the difference image to a binary image, shrink/expand and expand/shrink processing are done.

(10) The steps from (1) to (9) are executed for the image pair I2 and I3.

(11) Affine transformation are executed for the obtained image at step (10) in order to coincide with the obtained image at step (9). The calculated image are changed to binary image.

(12) Logical product is calculated for two black and white images obtained step (9) and step (11)

(13) Shrink/expand and expand/shrink processes are applied to a binary image obtained in step (12). Moving object is extracted by calculating the production of the processed image and I2.

Method β

Second method execute the above processes for color images. Basic procedure is same as method α. The creating process of binary image are executed for R,G and B images respectively. These binary images are combine by using logical summation.

3. EXPERIMENT

Image sequence of target image were taken by video camera. Moving object was an automobile whose speed is about 10 km/h. In order to track the automobile, attitude of camera was moved and zooming function of camera was used. Input images are 256 x 192 RGB color flame images which were extracted from image sequence every 4 flames. Number of control points were 36 (6 x 6). Control points were not taken from boundary area composed of 10% length from top, bottom, left and right. The size of searching window was 10 x 10 pixels. The scope of searching was 30 x 30 pixels centered by the corresponding point of It+dt. Threshold creating the binary image from difference image was calculated by using two methods. First method used the average of the pixel values in whole image. Second method used the average values in whole image plus arbitrary bias value. This bias value was determined 90 by experimental results. Thresholding methods often produce objects whose boundaries are irregular and jittery. Shrink/expand methods may be used to detect or eliminate these small irregularities, and thus provide a form of shape smoothing. A convex defect may be removed by shrinking the object and then expanding. A concave defect may be removed by first expanding and then shrinking. The window sizes used in shrinking and expanding were 3 x 3 and 5 x 5 respectively.

Input images used in this experiment were shown in Fig.1. Extracted results of moving object by using method α and method β were shown in Fig.2 and Fig.3 respectively. These figure show that obtained results by using method α and method β are almost same. The computation time of method β is faster than that of method α.

4. SAMMARY

In this study, we tried the moving object extraction from 3 RGB color flames selected from image sequence by using 2 levels affine transformation. As the result, we found out that the method using 3 flames were better than that using 2 flames and method β is better than method α.

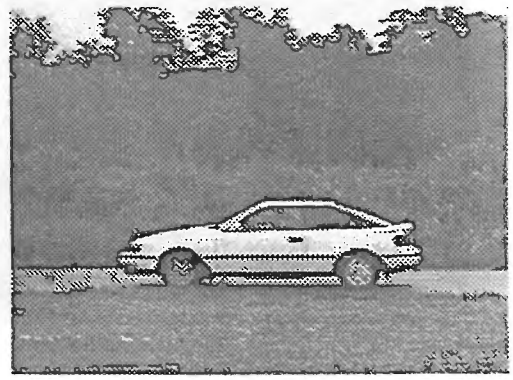
Following problems caused in this study.

(1) Body of automobile used in this experiment was white and pixel value of the body was almost same. Extracted moving object was divided into two parts, front parts and rear parts.

(2) There was wind when we took video images. Leafs in the background moved during taking of video images. Such leafs were extracted as the moving object.

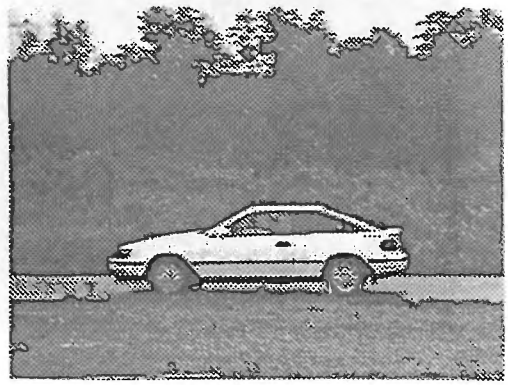
(3) Optimal setting method of control point should be considered.

(4) Determination method of the threshold value should be established.



(a) First flame image.

(b) Second flame image.



(c) Third flame image.

Fig.1 Target images.

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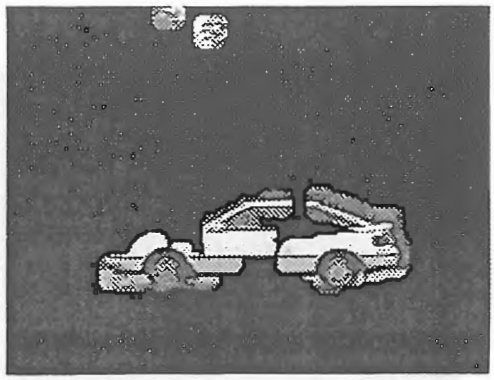
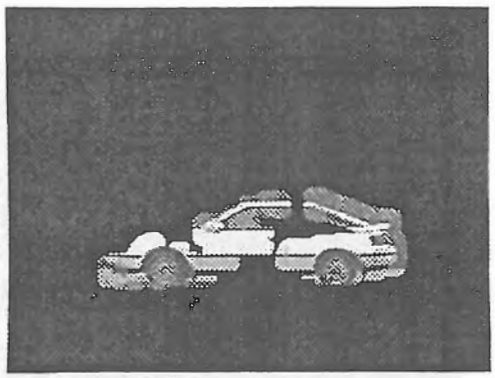
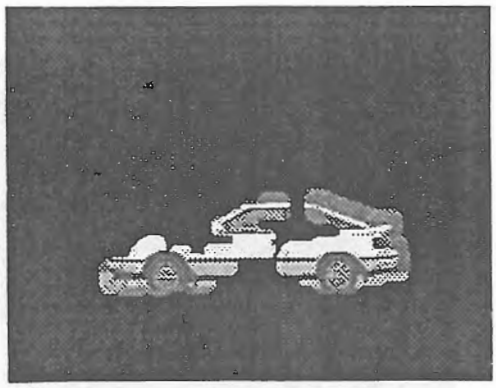


(a) Detected image using R band.



(b) Detected image using G band.



(c) Detected image using B band.

Fig.2 Detected images of moving object by using method α.

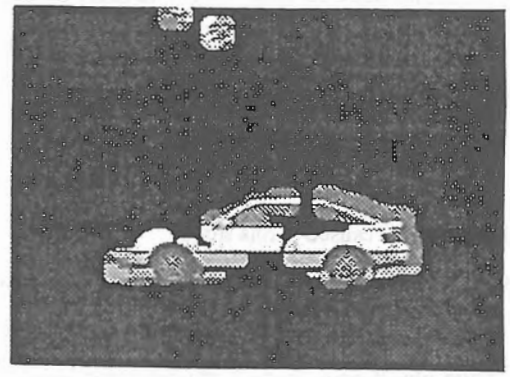


Fig.3 Detected image of moving object by using method β.