Automatically Identification and Classification of Moving Vehicles at Night

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Abstract

Today's moving object detection plays an important role in computer vision filed. Although a lot of moving objects detection methods has been proposed but monitoring at nights is still a challenging topic. In this paper, a robust algorithm is proposed for automatic detection moving vehicles at night or in environments with low level of light which has quality problems. In this algorithm, first preprocessing steps were conducted. Then all of vehicles in frame identify and classify according their type. Finally, the moving vehicles detected. The results demonstrate that the proposed algorithm significantly outperforms existing algorithm for the detecting and classification of moving vehicles at night.

Keywords: *Automatic Detection, Moving Vehicles, At Night, Low Level of Light.*

1. Introduction

As a new technology developed on the basis of image processing, moving object detecting is one of the important research subjects used in computer vision field such as video surveillance, robotics, target recognition, intelligent monitoring , traffic monitoring and biomedicine, etc [1-4].

The procedure of detecting moving objects is to first detect all the objects in video, then to recognize and detect moving objects. There are three types of approaches for detecting moving objects: background subtraction method [6,7], optical flow method [8,9], and adjacent frame difference method [10,11].

Background subtraction method is a technique by using the difference between the current image and the background image detect the moving objects. In this method, first the background frame is modeled. Then the current frame has been modeled, then, it subtracted from the background model and finally the moving objects were detected [6]. This method is sensitive to illumination changes and small movement in the background. So estimating background models is challenging issues because always there are some environmental factors which has an important effect on background model, such as wavering tree branches, rippling water, etc. To overcome this problem, many techniques have been proposed [12-14]. The mixture of Gaussians [15] is one of the popular techniques to estimate illumination changes and small movement in the background. However, estimating background models is a common problem and usually requires a long time because the speed of illumination changes and small movements in background is very slow.

Optical flow, a popular method for extracting motion information has been applied to moving object detection [16]. In this method the motion field is estimated to incorporate similar motion vectors into moving object. This method is an unstable approach because it is extremely sensitive to external factors, such as illumination changes and noise. And also its real-time performance and the practicability are poor. So this method is difficult to be used in real-time video processing [5].

In adjacent frame difference method, moving object is extracted according to the differences among two or three continuous frames. In fact, this method only detects objects making relative motions and using frame differences detect those pixels causing images to change distinctly when the target moves [5]. This method in compare to other methods is the most

simple and direct, and the changing part in video can be quickly detected [11].

2. Description of the Proposed Algorithm

The computer language MATLAB is engineering and scientific software, which has been widely used in various fields such as image information processing, signal analysis, etc. The image processing toolkit of MATLAB, provided the functions which saves time and energy for the image processing staff and consequently, improves the efficiency of image processing [17].

In this paper we proposed an algorithm able to detect moving vehicles and classify them according to their types at night. This algorithm implemented on computer by MATLAB software and was adopted in an experiment on three different video sequences.

In this algorithm, the camera should be replaced in one meter height from the surface of the ground.

3. Preprocessing

As we know, a video sequence consists of frame sequences which have certain temporal continuity. So this video string should be split into its constituent frames. Then each frame is grabbed and has to go through the same chain of processing. The first process is gray scaling. In this step, the color image is converted into grayscale image. A grayscale image is an image in which the value of each pixel is a single sample in computing. So using this transformation reduces computation power and makes computing threshold value based on light intensity easier.

In this algorithm, everything which can be seen in one frame is considered as an object. These objects can include traffic lights, car lights, their light reflection in environment, their light reflection on other bodies of cars, noise, etc. Therefore using a suitable threshold value can omit unwanted objects and extract cars' light correctly.

Figure 1 shows frame 52 of the first video sequence was taken. This frame consider as an example that different process conducted on that.

Fig. 1 The color image was taken at night from first video sequence.

As mentioned at the previous section, in this part the color image is converted to the grayscale image till using investigation the gray intensity and considering a suitable threshold value, many superfluous lights were removed and omitted.

Fig. 2 The experimental result when the color image convert to grayscale image.

As showed in figure 3, using a threshold, based on light intensity can remove many noises and superfluous lights in frame but not perfectly.

Fig. 3 The experimental result after threshold based on light intensity.

So in order to remove the remaining superfluous lights use another threshold but this threshold is based on objects' area. In this step, the threshold is important because it can be one of the most influential factors on the accuracy rate of outcomes.

Fig. 4 The experimental result after threshold based on objects area.

As can be seen in figure 4, with using threshold based on area, almost all of the superfluous lights have been deleted and we can extract the cars' lights correctly.

4. Identification and Classification of Moving Vehicles

Since the goal in this paper is to identify moving vehicles, the first step is that the consecutive frames are subtracted till the vehicles are moving can be recognized and the vehicles that stops were removed.

In the next step the moving vehicles are classified according to 3 types including cars, Lorries, motorcycles. To achieve this goal, three features of cars' lights are investigated separately including their area; centroid and bounding box.

As we know, the lights which belong to one car, always have a fixed distance from each other and have a same level of place in compare to each other. With using this characteristic, in this algorithm, first each of the cars should be separated and recognized from each other, and then, they should be classified according to their types and detected later. For reaching this aim, in this step, first the centroids of each of the lights were reviewed. Logically, with reviewing the axis of X and Y in each of the lights, first the lights which belong to one car were recognized or in other words, each car was recognized from another. Then, with calculating the area of these lights and their heights from the ground, (with paying attention to the place of camera which is 1 meter height from the ground), the models of each cars can be recognized and classified.

In the last step, all of the cars were clarified according to their types with paying attention to their bounding box characteristic.

Fig. 5 The experimental results when the moving vehicles identified and classified in monitoring video at night.

As the result showed in figure 5, the results came to the point that the proposed algorithm is able to identify moving vehicles and classify them at night correctly.

In this algorithm in order to determine class of each vehicle, the cars were plotted with red line, the lorry with green line and the motorcycle with blue line.

In this part, the experimental result was shown on several different videos were taken. Figure 6 shows frame 23 of the second video sequence was taken. This frame includes cars and lorry and other superfluous lights that consider as an example and different process conducted on that.

Fig. 6 The color image was taken at night from second video sequence.

As mentioned in previous section, in this part after the color image is converted to grayscale image, using threshold based on light intensity many superfluous lights have been deleted. Figure 7 shows the experimental result after threshold.

Fig. 7 The experimental result after threshold based on light intensity.

As shown in figure7 and told also in previous section, there are still some superfluous lights. In order to remove them, using threshold based on objects area.

In this step, the area of cars' lights is the most important point because with considering a suitable range based on that can remove the vehicles are far from camera. In fact with this way the detection be limited in the distance that cause decrease error coefficient.

Fig .8 The experimental result after threshold based on objects area.

As can be seen in figure 8, using threshold based on objects area the remaining superfluous lights and also the vehicles are far from camera are omitted and the moving vehicles within defined distance identified and classified.

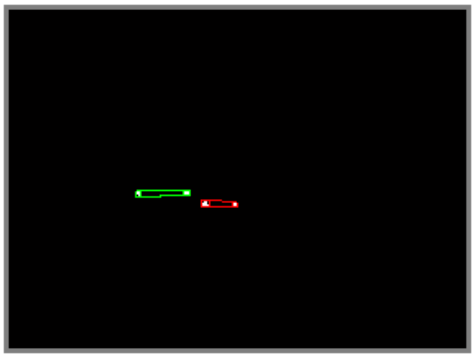

Fig. 9 The experimental results when the moving vehicles identified and classified in monitoring video at night.

Finally after threshold and subtract 2 consecutive frames, the moving vehicles were identified and classified according to their types.

In this part we show another scene at night that using proposed algorithm has been processed. As can be seen in figure 10, there are cars and motorcycle and other superfluous lights in this scene.

Fig.10 The color image was taken at night from third video sequence.

This frame like other frames, was processed, according to the steps which were explained in previous parts. The point which can be mentioned here, is the height of cars' and motorcycles' lights from the ground. As shown in figure 10, the level of cars' and motorcycles' lights are very near to each other. So with considering cars' lights area, they can be classified correctly.

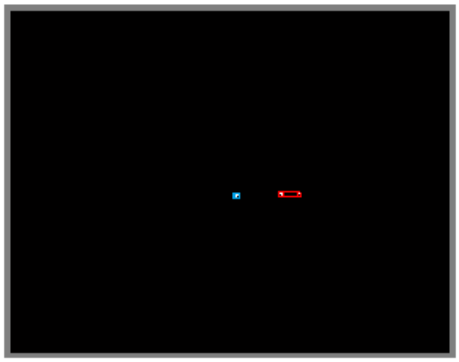

Fig. ١١ The experimental results when the moving vehicles identified and classified in monitoring video at night

As shown in figure 11, moving objects in the frame were detected, classified, and final clarified in correct way.

5. Conclusions

In this paper, an algorithm was proposed for automatic visual surveillance in low light level environments or at night, which has some quality problems, such as low brightness, low contrast and high-level noise. As the experimental results showed this algorithm in compare to low quality frames and drastic illumination changes and also environmental factors such as rain and snow has acceptable performance. And also this algorithm compared with the algorithms presented has easy operation and high processing rate. Moreover, illumination changes in difference image have little influence on that, because the time interval between two images is quite short. So, the detection by this algorithm is effective and stable.

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