Real-Time Video Analysis for Vehicle Lights Detection Using Temporal Information

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Abstract

We have proposed a real-time system for vehicle lights detection. This goal has been achieved by combining together a rule-based approach and a temporal tracking system.

1 Introduction

Many drivers fail to be aware of oncoming vehicles at night. (e.g. leave full beam lights on). Here we aim to improve auto detection in this area.

2 Previous studies

The majority of previous studies are based on an rule-based approach. Usually consisting of two stages. Firstly, candidate-light blobs resulting from thresholded image are inspected and just those fulfilling certain conditions remain. Next, properties of the box bounding pair of car-light candidates (head-light candidates) are examined as proposed in [1]. In [2] Kim et. al. propose similar approach with additional size based reasoning. Temporal information is only utilized in [3], for increasing the probability that a particular blob belongs to a car-lights member when it is present for a longer period of time.

3 Proposed solution

Here we propose a more intensive utilization of temporal information, which significantly reduces the number of false positive detections. The tracker uses past car-light candidate appearances to predict the next light position and thus in following frames the search area of match can be narrowed. Tracking allows us to recover vector of light movement, which is later on utilized in the rule-based identification approach.

4 Principle of operation

In each frame headlight candidates are extracted by thresholding the greyscale-converted input image (Fig.1). Taillights can be similarly extracted by thresholding the same image with a lower threshold and then by inspecting whether the surroundings contain significant red pixels (in YCrCb colour space).

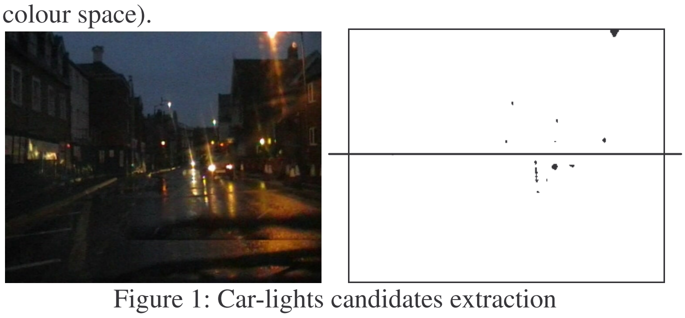

Figure 1: Car-lights candidates extraction

If the in-vehicle camera position is fixed, then the artificial horizon line may also be assumed (similar as in [1]) and therefore all car-lights candidates having centroid above this line may be instantly rejected. The next step is to validate the shape of light-candidates. Only those fulfilling area and compactness conditions remain. These are passed to the tracker which compares existing records using rule-based approach. As the head-lights movement is predictable then the following three conditions may be inspected: a) alignment of car-lights' speed vectors (S1 and S2), b) lights alignment (L - horizontal overlapping), c) bounding box width (W) to height (H) aspect ratio. (see Fig. 2)

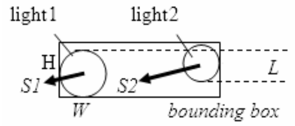

Figure 2: Car-lights verification

Once a car-light pair has been detected, then the validation process applied to it in the following frames is relaxed - such treatment appears to work well in the practice.

5 Results

Our algorithm is able to process at the average 32 fps (1.8GHz processor). The processing speed varied between 20 and 60 fps depending on the environment (town or country roads) and traffic intensity. Table 1 presents detailed results obtained for headlights.

Weather conditions	Footage length [min]	Cars detected	Cars missed	Detection ratio [%]
Dusk, clear	12	90	1	99
Dusk, rain	22	148	8	95
Night, clear	28	207	2	99
Night, rain	35	187	4	98

Table1: Results of headlights detection

Just a few false positives arose during the whole testing footage with the headlights detection ratio between 95-99 %. The algorithm worked robustly despite varying weather conditions. Testing with taillights gave only 91% detection ratio and thus further work is required here.

6 Conclusions

Utilizing spatial information results in significant reduction of false positives compared to earlier approaches [1,2]. Investigating movement vector of the light-candidates prevents incidental noise lights aligned as car-lights being considered as a positive detection.

Further Work: vehicle distance estimation

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