SUMMARY OF Ph.D. DISSERTATION

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Title

Traffic monitoring using machine vision technology

Abstract

The traffic monitoring is a basic and important technology in ITS (Intelligent Transport Systems). Currently, the ultrasonic sensors and the loop coil detectors that are often called 'local sensors' are used to measure several kinds of the traffic parameters. In the future, traffic monitoring system is expected to be extended to an accident detection system and an illegal parking detection system. However, the local sensors cannot get enough information about traffic situation to realize such an intelligent system. Therefore, the global sensors based on image processing currently attract many attentions, because they can get more detailed information on the traffic situation than the local sensors.

In this paper, we propose a novel vision-based traffic monitoring system that works in various traffic situations. The system uses the already existing surveillance cameras on the roads to reduce the installation costs. The system has following five features: (1) Single monochrome camera is used, (2) Various camera positions are available, (3) The system has robustness for changing lighting conditions, (4) The system can obtain not only the positions but also the trajectories of vehicles on the image sequences, and (5) The system has robustness for occlusion problem.

I regard the vehicle tracking problem as the clustering problem of feature points that have the histories of past positions. The feature point is basic feature that can be obtained from gray-scale image. Because the texture of an artificial thing like the vehicle has much edge components, a sufficient number of feature points can be detected from various viewpoints. Moreover, feature points detection process is robust to illumination change. Therefore, the feature points are appropriate feature for traffic monitoring. First, we extract feature points from an input image. These feature points include so many background components that the background points are deleted according to the normalized correlation between input and background image. The feature points of vehicles are tracked at every frame.

In order to classify the trajectories of feature points into each vehicle, we define the similarities between all the combinations of two trajectories. The similarity is the evaluation value that will be high when two trajectories are detected from the same vehicle. The similarities are defined by combining two components: edge-based similarity and distance-based similarity.

Regarding the trajectories as vertices, and their similarities as weights of edges, a weighted complete graph can be constructed. By applying graph cut algorithm to the weighted complete graph, the positions and sizes of every vehicle can be obtained. The graph cut algorithm is less subject to the local error. To avoid occlusion problem, I used the tracking results of previous frames. Subject to preserve the previous tracking results, the optimal cut is searched in feasible solution space which is bound by constraint points.

The experimental results reveal that our system works very well in various traffic situations in common parameter configuration. My achievement will lead to the realization of integrated traffic monitoring system.