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Detection of Weather Conditions in Webcam Images

Applying Supervised Learning Methods for Visual Categorization

Example images of the three weather conditions: sunny, cloudy and overcast.

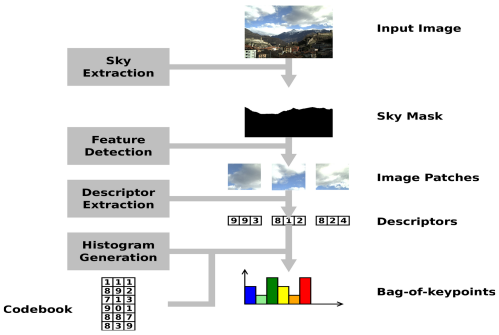

Diagram showing the process of describing an image with use of the codebook based approach.

Problem: The platform Nebelkarte.ch provides access to several stationary webcams. It allows users to plan their free time activities by examining the current weather situation in live data. However, requiring the user to click through all the webcams is not very user friendly. For this reason, an algorithm for automatic weather condition detection is desirable. A basis for such a system is contributed with this work. It is able to distinguish between sunny, cloudy and overcast weather by analyzing the visual content of single webcam images.

Approach/Technologies: In this work, several features were examined. They were evaluated on an image data set gathered from 35 different webcams during a period of 16 weeks. Mainly, the features can be separated into two groups. Members of the first one are extracted from the overall image. To these belong measurements of image contrast or image sharpness. They are based on the assumption that objects under fair weather conditions are more likely to have sharp edges and larger contrast differences. The second group consists of features describing only the sky region. This is done by implementing the popular codebook based approach. In order to do this, image patches are densely sampled from the sky area and described by a visual descriptor method such as Scale-Invariant Feature Transform (SIFT). The descriptors are then encoded into a single feature vector with use of a visual codebook. The latter is the result of a previously executed cluster analysis on a large set of descriptors.

Result: The experiments showed that features from the sky region clearly outperform the ones describing the overall image. The reason for this is that not all parts of the image are directly related to the weather condition. The best method achieved an accuracy of 86% and uses an opponent SIFT along with a local binary pattern (LBP) descriptor. However, the results strongly depend on the webcam. In some cases, more than 90% of the test data were assigned correctly. This reveals the fundamental problem of such an approach. Webcams are sometimes poorly calibrated making it nearly impossible to distinguish between weather conditions. Also, the perspective is not necessarily suitable for correct labelling in terms of meteorological definitions. Nonetheless, the system is a great basis for further examinations. To these count fusion with meteorological sensors or sequence labelling.