Michel
Ott

Graduate Candidate	Michel Ott
Examiner	Prof. Stefan F. Keller
Co-Examiner	Claude Eisenhut, Eisenhut Informatik AG, Burgdorf, BE
Subject Area	Software and Systems
Project Partner	Meteomedia AG, Gais, SG

Detection of Weather Conditions from Consumer Webcams

Supervised Application for Object Recognition using Color and Textural Features

Fig. 1: Horizon detection (image segmentation) using yellow and black channels after converting an image to the CMYK color space

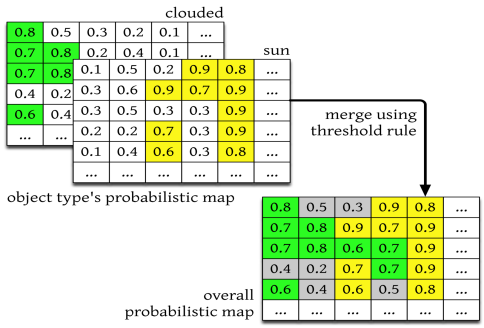

Fig. 2: Probabilistic pixel maps used for classifying and generated by a multivariate Gaussian assumption for each pixel using moving box

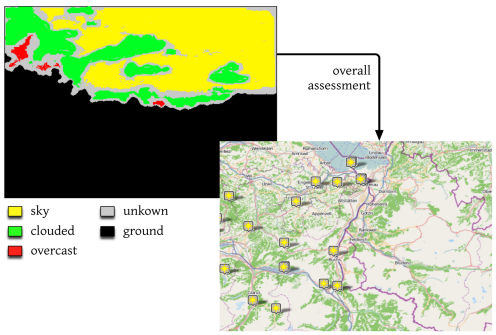

Fig. 3: Image showing weather conditions in color based on the overall probabilistic pixel map and overall assessment

Introduction: The detection of weather conditions defines the ability to recognize objects on an image and categorize them into types, like sun, cloud, overcast or fog. This thesis focuses on the detection of such sky conditions. Hence two questions arise: "How does a human being classify weather conditions by looking at the sky?" and "How does this ability can be adopted by a system?" Like humans who subconsciously compare regions with textural and color information of stored images, in this approach a supervised training and classification system has been implemented.

Approach/Technologies: The realized web application and measuring backend extends the existing prototype called «fog map» using modern software engineering techniques. In the training phase, the system reads a set of images and adjusts for each weather condition (also called 'object type') the color and textural information parameters (aka. features). In a subsequent process it tries to find the most significant feature set that best describes an object type without degrading the quality of the recognition system. The system uses the Bhattacharyya distance to measure the divergence between two subsets. This process is being repeated for all weather conditions. In the segmentation phase the system first needs to cut off the sky from the ground. This is accomplished using the yellow and black channels from the CYMK color space after having removed image noise (fig. 1). In the classification phase each pixel is being analyzed to calculate the probability of a pixel j characterized by the feature's vector x_j of belonging to an object type O_{Li} under a Gaussian assumption and using a moving box. Thus, it assigns the pixel to the object type, which possesses the highest probability and it results in an overall probabilistic pixel map, which gives information about which pixel belongs to which weather condition (fig. 2). Lastly the system is doing an overall assessment by looking at the highest pixel count (fig. 3).

Result: The proposed workflow consists of a proven segmentation and classification process and promises valuable help to automate weather detection based on consumer webcams. While the horizon segmentation performs satisfactory, the weather classification process seems to rely significantly on the training images. Thus the overall recognition rate is not yet satisfying (below 90%). But there is still much room for improvements.

- http://www.nebelkarte.ch