ENVIRONMENTAL MONITORING BY ONLINE SOCIAL MEDIA

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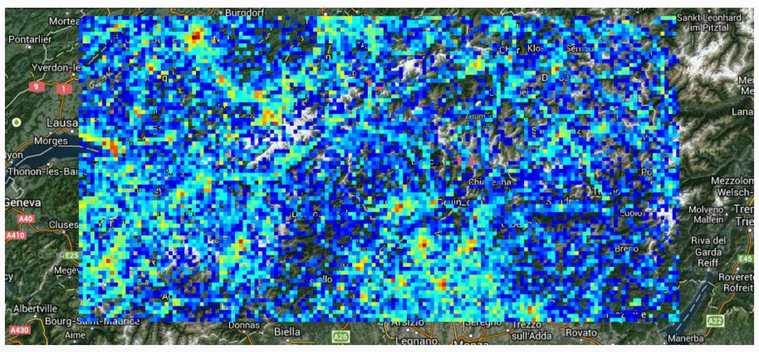
Abstract

We present a system for environmental monitoring based on online social media. In particular we address the problem of snow cover and snow level estimation through the analysis of publicly available mountain photographs and webcams. The pipeline includes the geo-tagged photo crawling and classification, photo orientation estimation, mountain peak identification and snow mask estimation.

Mountain Photo Crawling

Considering a 300 × 160 km region across the Italian and Swiss Alps, Flickr contains 600k photographs with a valid geo-tag. We carried out a crowdsourcing experiment on a random sample of images taken at an elevation of 600 meters or above, obtaining that approximately 21% of the photographs contain a distinctive skyline of the mountain profile. A supervised learning SVM classifies the crawled photographs (contains / does not contain mountain profile) with an accuracy of 92 %.

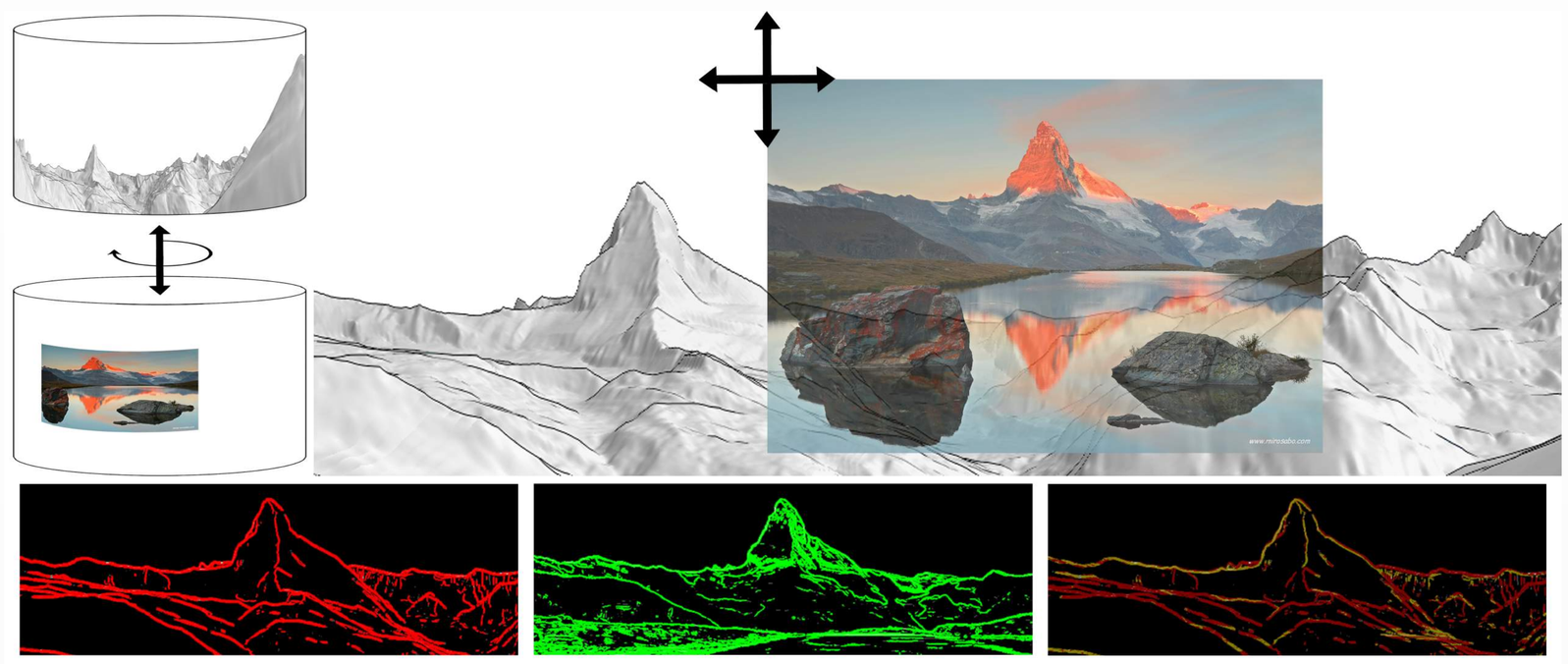


Snow Cover Detection

Each correctly aligned photograph is projected on the 3D terrain model (synthesized from a DEM) and each pixel of the terrain coverage area is classified as snow or non-snow by a supervised learning algorithm based on color statistical distribution.

Photo Orientation Estimation

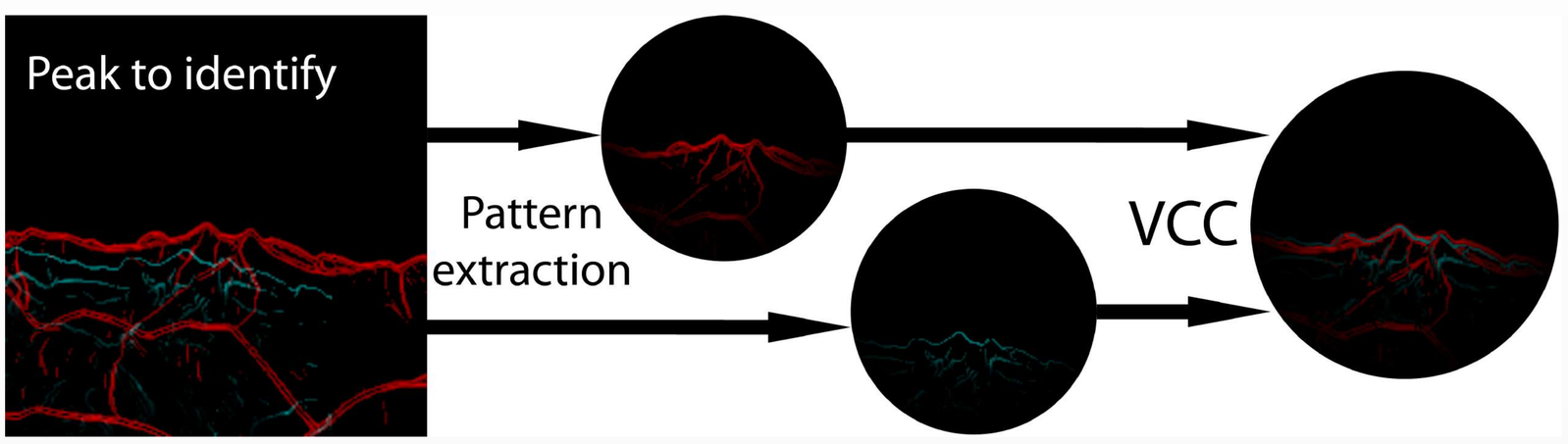
The key tenet is to perform an edge-based matching between the visual content of each photo and a terrain view synthesized from a Digital Elevation Model (DEM). The latter is generated as if a virtual observer is located at the coordinates indicated by the geo-tag. By considering the synthesized view a cylindrical image that approximates a spherical one (a legit assumption since mountains are usually placed far from the observer) we find the three dimension orientation of the camera during the shot estimating the best overlap between the two images.



The overlap is found with the vector cross-correlation measure between the edge maps of the two images (since the only common property of a mountain photo and the corresponding terrain view is the mountain contour).

Mountain Peak Identification

Our method generates a panorama from a coarse DEM, using a possibly noisy geo-tag. Therefore, in most cases the panorama does not match the photo perfectly, thus increasing the difficulty in finding a correct global alignment. Therefore, to improve the precision of the position of each mountain peak, a separate vector cross-correlation procedure is applied. Specifically, for each peak we consider a local neighborhood centered in the location identified by the global alignment. In this way each peak position is refined by identifying the best match in this local neighborhood.



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