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Detection and Classification of Different Cloud Images for Meteorology Alert System

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Article Info
Volume 82
Page Number: 10801 - 10805
Publication Issue:
January-February 2020

Article History
Article Received*: 18 May 2019*
Revised*: 14 July 2019*
Accepted*: 22 December 2019*
Publication*: 19 February 2020*

Abstract
Sky–cloud pictures procured from ground-based sky cameras are by and large discovered using a fisheye point of convergence with a wide field of view. In any case, the sky shows a colossal exceptional range similar to luminance, past what a standard camera can get. It is as such difficult to get the nuances of an entire scene with a standard camera in a lone shot. A great part of the time, the circumsolar region is overexposed, and the areas near the horizon are underexposed. This renders cloud division for such pictures irksome. In this paper, we propose HDR Cloud Seg – a practical system for cloud division using high-dynamic-go (HDR) imaging subject to multi presentation blend. We depict the HDR picture age method and release another database to the system for benchmarking. Our proposed approaches is the principle using HDR splendor maps for cloud division and achieves great results and besides mastermind the cloud types by using KNN portrayal.

Keywords: AdaBoost, comma-shaped cloud, meteorology, pattern recognition, satellite images, severe weather forecasting.

1. Introduction

Severe weather events such as thunderstorms cause significant losses in property and lives. Many countries and regions suffer from storms regularly, leading to a global issue. For example, severe storms kill over 20 people per year in the U.S. The U.S. government has invested more than 0.5 billion dollars on research to detect and forecast storms, and it has invested billions for modern weather satellite equipment with high-definition cameras. The fast pace of developing computing power and increasingly higher definition satellite images necessitates a re-examination of conventional efforts regarding storm forecast, such as bare eye interpretation of satellite images. Bare eye image interpretation by experts requires domain knowledge of cloud involvements and, for a variety of reasons, may result in omissions or delays of extreme weather forecasting. Moreover, the enhancements from the latest satellites that deliver images in real time at a very high resolution demand tight processing speed. These challenges encourage us to explore how applying modern learning schema on forecasting storms can aid meteorologists in interpreting visual clues of storms from satellite images. To capture the comma-shaped cloud pattern accurately, meteorologists have to read different weather data and many satellite images simultaneously, leading to inaccurate or untimely detection of suspected visual signals. Such manual procedures prevent meteorologists from leveraging all available weather data, which increasingly are visual in form and have high resolution. Negligence in the manual interpretation of weather data can lead to serious consequences. Automating this process, through creating intelligent computer-aided tools, can potentially benefit the analysis of historical data and make meteorologists' forecasting efforts less intensive and timelier. This philosophy is persuasive in the computer vision and multimedia community, where images in modern image retrieval and annotation systems are indexed by not only metadata, such as author and timestamp, but also semantic annotations and contextual relatedness based on the pixel content.

2. Related Work

To decrease the shocking information investigating Cloud segmentation is an important method for detecting storm cells. Lakshmanan et al. [8] proposed a hierarchical cloud-texture segmentation method for satellite image. Later, they improved the method by applying watershed

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transform to the segmentation and using pixel intensity thresholding to identify storms [9]. However, brightness temperature in a single satellite image is easily affected by lighting conditions, geographical location, and satellite image quality, which is not fully considered in the thresholding-based methods. Therefore, we consider these spatial and temporal factors and segment the high cloud part based on the Gaussian mixture model (GMM). Cloud motion estimation is also an important method for storm detection, and a common approach estimates cloud movements through cross correlation over adjacent images. The works in and applied the cross correlation method to derive the motion vectors from cloud textures, which was later extended to multichannel satellite images. The cross correlation method could partly characterize the airflow dynamics of the atmosphere and provide meaningful speed and direction information on large areas. After being introduced in the radar reflectivity images, the method was applied in the automatic cloud-tracking systems using satellite images. The work implemented the cross correlation in predicting and tracking the mesoscale convective systems (a type of storms). Their motion vectors were computed by aggregating nearby pixels at two consecutive frames; thus, they are subject to spatially smoothed effects and miss fine-grained details. Inspired by the ideas of motion interpretation, we define a novel correlation aiming to recognize cloud motion patterns in a longer period. The combination of motion and shape features demonstrates high classification accuracy on our manually labelled data set.

3. Literature Survey

FengYuan and Yee Hui et al., proposed Comparison of Radio-Sounding Profiles for Cloud Attenuation Analysis in the Tropical Region, [6] relationships of radio-sounding profiles with different objectives are performed for desire for cloud choking in the tropical district. The Salonen and Uppala model which was represented to have a staggering desire capacity for cloud narrowing is used. One-month data is set up for calculating the height of cloud base, the 0ºC isothermal level, and the cloud debilitating. The results show that the free radiosonde data with low objectives is satisfactory for the cloud narrowing desire.

Savoy, Joseph et al., proposed Cloud Base Height Estimation Using High-Resolution Whole Sky Imagers, and Fine scale cloud checking utilizing ground-based imagers is getting famous for an assortment of uses and spaces. We present a structure for cloud base stature estimation utilizing two such imagers; our technique depends on stereoscopic scene stream. We show the plausibility of our methodology and use PC created pictures with controlled cloud stature to approve the precision of our strategy.

Heinle, A.Macke and Srivastav et al., proposed Automatic cloud classification of whole sky images. The starting late extending improvement of whole sky imagers engages transient and spatial significant standards sky observations. One application recently went about when in doubt is the estimation of fragmentary sky spread. A capability between different cloud types, regardless, is still in progress. Here, a modified cloud gathering count is displayed, considering a ton of for the most part verifiable features portraying the concealing similarly as the outside of an image. The k-nearest neighbor classifier is used in light of its prevalent in clarifying complex issues, ease of use and low computational multifaceted nature. Seven particular sky conditions are perceived: high thin fogs (cirrus and cirrostratus), high fixed cumuliform fogs (cirrocumulus and altocumulus), stratocumulus fogs, low cumuliform fogs, thick fogs (cumulonimbus and nimbostratus), stratiform fogs and clear sky. Considering the Leave-One-Out Cross-Validation the count achieves an exactness of about 97%. Likewise, a preliminary of unpredictable pictures is shown, so far beating past figurings by yielding a triumph pace of about 75%, or up to 88% if simply "real" bumbles with respect to radiation influence are considered. Purposes behind the decrement in accuracy are discussed, and contemplations to furthermore improve the request results, especially in dubious cases, are analyzed.

Shuang Liu et al., proposed Ground-Based Cloud Detection Using Automatic Graph Cut, Ground-based cloud revelation envisions an essential activity in meteorological research, and thing division procedures have starting late been alright with extricate up this issue. As a kind of article division system, sharp graph cut has rose as an incredibly indispensable resource considering its profitable division limit. In any case, it imagines that customers should offer names to express pixels as "article" or "establishment," which unavoidably restrains revamp cloud an area in colossal scale applications. In this letter, we turn around the issue of changed cloud zone and propose a novel figuring named as adjusted arrangement cut. We treat fogs as a phenomenal kind of solicitation and crash human checking by two systems. In any case, we adaptively register the edges for each cloud picture which commonly mark a few pixels as "cloud" or "clear sky" with high affirmation. By then, those named pixels fill in as hard essential seeds for the going with plot cut estimation. The starter results show that the proposed estimation not simply achieves best results over the cutting edge cloud certification figurings yet also achieves basically indistinct results with the trademark division count.

Qing Zhang et al., proposed Cloud Detection of RGB Color Aerial Photographs by Progressive Refinement Scheme,[9] a programmed and powerful cloud discovery calculation for shading ethereal photos. In light of the properties got from perceptions and measurable outcomes on an enormous number of shading ethereal photos with cloud layers, we present a novel dynamic refinement conspire for identifying mists in the shading airborne photos. We first develop a noteworthiness map which

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features the contrast between cloud locales and noncloud areas. In view of the noteworthiness map and the proposed ideal edge setting, we acquire a coarse cloud identification result which orders the information airborne photo into the up-and-comer cloud districts and noncloud locales. So as to precisely recognize the cloud locales from the competitor cloud areas, we at that point develop a vigorous detail map got from a multi-scale reciprocal decay to direct us in expelling noncloud districts from the applicant cloud locales. At long last, we further play out a guided feathering to accomplish our last cloud identification result, which identifies semitransparent cloud pixels around the limits of cloud areas. The proposed technique is assessed as far as both visual and quantitative correlations, and the assessment results show that our proposed strategy functions admirably for the cloud discovery of shading ethereal photos.

Soumyabrata Dev et al., proposed High-dynamic-range imaging for cloud segmentation, 2018. Sky–cloud images obtained from ground-based sky cameras are usually captured using a fisheye lens with a wide field of view. However, the sky exhibits a large dynamic range in terms of luminance, more than a conventional camera can capture. It is thus difficult to capture the details of an entire scene with a regular camera in a single shot. In most cases, the circumsolar region is overexposed, and the regions near the horizon are underexposed. This renders cloud segmentation for such images difficult. In this paper, we propose HDRCloudSeg – an effective method for cloud segmentation using high-dynamic-range imaging based on multi exposure fusion. We describe the HDR image generation process and release a new database to the community for benchmarking. Our proposed approach is the first using HDR radiance maps for cloud segmentation and achieves very good results.

4. Existing System

Meteorologists use shapes and advancements of fogs in satellite pictures as markers of a couple of noteworthy sorts of extraordinary storms. Nonetheless, in light of the fact that satellite picture data are in dynamically more significant standards, both spatially and momentarily, meteorologists can't totally utilize the data in their figures. Modified satellite picture assessment strategies that can find storm-related cloud structures are along these lines looked for after. We propose an AI and model affirmation based approach to manage perceive "comma-formed" fogs in satellite pictures, which are unequivocal cloud scattering plans decidedly associated with twister definition.

5. Proposed System

We proposed a discriminative transfer learning structure for general picture reconstructing. By joining advanced proximal streamlining figuring's and discriminative learning frameworks, a single getting ready procedure prompts a transferable model important for a combination of picture revamping endeavors and problem conditions.

6. Modules

1. PREPROCESSING
2. COLOR CHANNEL SEGMENTATION
3. RGB
4. HSV
5. YIQ
6. PCA

Description

Preprocessing

Instructive lists can require preprocessing frameworks to ensure precise, successful, or critical assessment. This framework includes resize the data picture and changing over the data picture into diminish scale picture and using channels. Data cleaning insinuates techniques for finding, emptying, and displacing horrible or missing data. Perceiving neighborhood remarkable and startling changes can perceive significant information plans. Smoothing and detrending are structures for expelling rattle and direct models from information, while scaling changes the cutoff purposes of the information. Gathering and binning frameworks are approach that sees relationship among the information factors.

Color Channel Segmentation

We consider a great deal of 16 concealing channels and portions c1, c2, c16 (see Table I). They contain concealing spaces RGB, HSV, YIQ, L∗a∗b∗, different red–blue blends (R/B,R − B, B−R B+R), and chromaC = max(R,G,B) − min(R,G,B). In the present composition, generally concealing channels c1−9 [16], [17]and c13−15, have been used for sky/cloud picture division. Despite these, we also consider L∗a∗b∗space (c10−12) in perspective on its perceptual consistency properties as well as chroma (c16), considering the way that fogs will when all is said in done be dry.

RGB

This model advises the most ideal approach to use concealing space change to choose whether a L*a*b* regard is in the RGB degree. The course of action of tints that can be addressed using a particular concealing space is called its cluster. Some L*a*b* concealing regards may be out-of-degree when changed over to RGB. Convert a L*a*b* motivating force to RGB. The negative characteristics returned show that the L*a*b* concealing [80 - 130 85] isn't in the variety of the sRGB concealing space, which is the default RGB concealing space used by lab2rgb. A RGB concealing is out of range when any of its portion regards are under at least 0 unmistakable than 1.

HSV

The HSV disguising space (Hue, Saturation, Value) is once in a while utilized by individuals who are picking tones (e.g., of paints or inks) from a covering wheel or

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palette, since it relates better to how individuals experience hiding than the RGB hiding space does. As tint changes from 0 to 1.0, the differentiating conceals move from red through yellow, green, cyan, blue, red, and back to red, so that there are amazingly red qualities both at 0 and 1.0. As soaking changes from 0 to 1.0, the seeing tones (tints) fluctuate from unsaturated (shades of dull) to completely splashed (no white part). As worth, or brilliance, changes from 0 to 1.0, the differentiating conceals become consistently continuously awe inspiring.

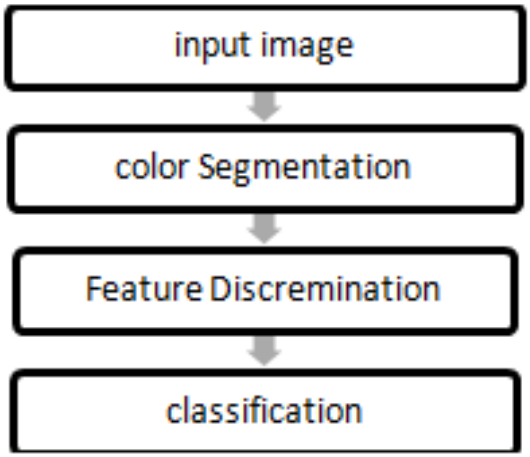
YIQ

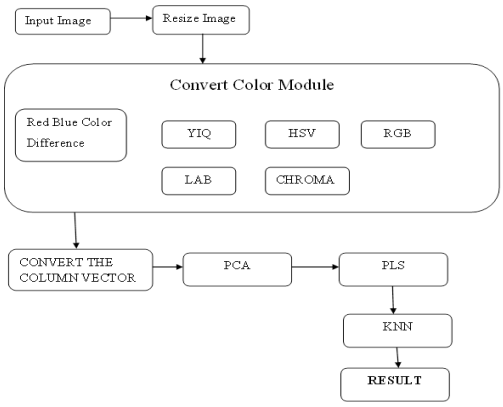
The National Television Systems Committee characterizes a shading space known as YIQ. This shading space is utilized in TVs in the United States. One of the primary focal points of this configuration is that dark scale data is isolated from shading information, so a similar sign can be utilized for both shading and highly contrasting sets. In the NTSC shading space, picture information comprises of three segments: luminance (Y), tone (I), and immersion (Q). The principal segment, luminance, speaks to dark scale data, while the last two segments make up chrominance (shading data).

PCA

We use PCA to determine the underlying structure of an image represented by the 16 color channels from Table I and analyze the inherent correlations among these components. Consider a Sample image $\mathbf{X}i$ of dimension $m \times n$ from a dataset consisting of N images (i= 1, 2, ...,N). The individual color channels$c1-16$ are extracted for $\mathbf{X}i$ and reshaped into column vectors$_\mathbf{c}j \in$IRmn×1 where j = 1, 2, 16. The $\_\mathbf{c}j$ obtained from the different color channels of the sample image $\mathbf{X}i$ are stacked alongside, to form the matrix $\hat{}\mathbf{X}i \in$IRmn×16.

7. System Architecture





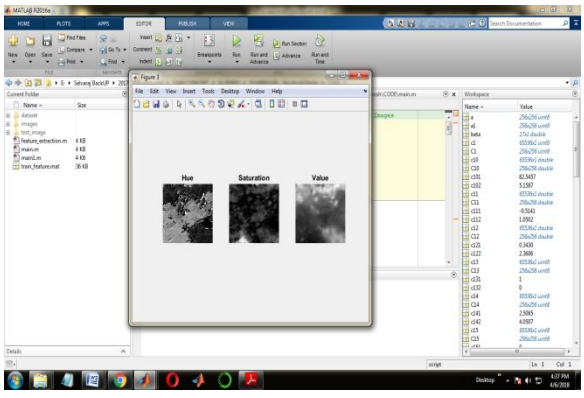
8. Future Enhancement

Moreover, our technique is adaptable and can be joined with existing priors and probability terms in the wake of being prepared, enabling us to improve picture quality on a job that needs to be done. Disregarding this consensus, our technique accomplishes tantamount run-time effectiveness as past discriminative methodologies, making it reasonable for high-Dynamic picture rebuilding and portable vision applications.

9. Conclusion

We have displayed a productive examination of concealing space sand fragments, and proposed a probabilistic philosophy using PLS-based backslide for the division of ground-based sky/cloud pictures. Our philosophy is thoroughly learning based and doesn't require any physically described edges, conditions, or parameters at any period of the computation. We also release an extensive sky/cloud image database captured with a calibrated ground-based camera that has been annotated with ground-truth segmentation masks. Our future work will include the annotation of a database with probabilistic ground-truth segmentation maps as well as the extension of this method to high-dynamic-range images. Going beyond segmentation it is also important to classify clouds into different types or estimate cloud altitude and movement, which are both part of our current research.

10. Results



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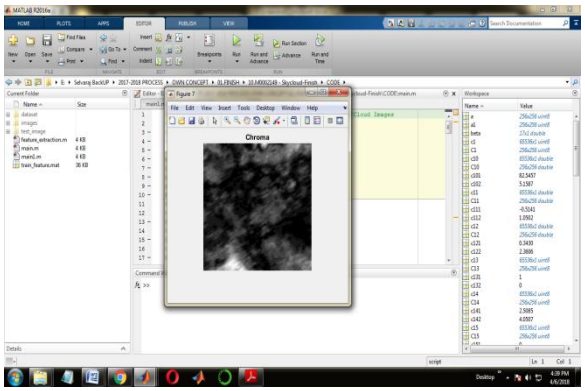

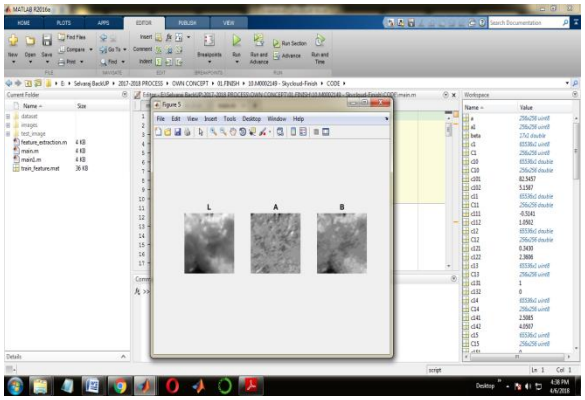

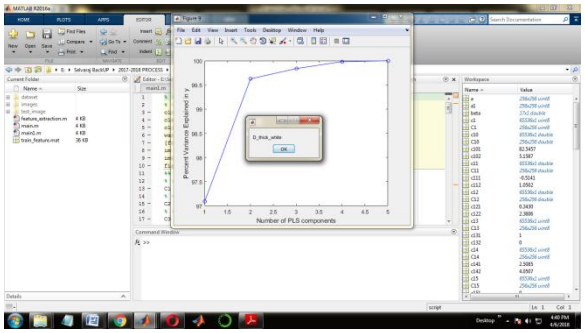

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