Satellite Image Processing and Fire Detection using Real Time Big Data Analytical Architecture

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Abstract: ***In today's era, there is a great deal added to real-time remote sensing big data than it seems at first, and extracting the useful information in an efficient manner leads a system toward a major computational challenges, such as to analyze, aggregate, and store. Nowadays, there is a large demand for real time data for remote sensing applications. A two level merging approach is used to extract the sea area. But, the performance is lower due to the lack of feature extraction. The proposed architecture comprises three main units. Remote Sensing Big Data Acquisition Unit acquires data from satellite and send to base station. The main function of Data Processing Unit is compilation, organization, and storing for further processing. The Data Analysis Decision Unit is supported by the decision algorithm, which inquire different things from the result, and then make various decisions. The decision is whether the area belongs to sea, land, forest or ice area. The sensors are deployed to feature out the temperature and pressure for the fire detection. It results in the prediction of fire and is of the high cost. So scale invariant feature transform is used to detect the fire on images and various algorithms can be used as to elaborate the working of real-time data analytical architecture.***

Keywords: Big Data, Offline, Real Time, Remote Sensors, Land & Sea Area

1. Introduction

Mining techniques can be implemented on new systems as existing methods are upgraded and new products developed. Whereas, mining tools are implemented on high-performance parallel processing systems. Thus, users can analyze large database in minutes. The advanced technology in mining techniques gives out collecting, managing, analyzing and processing of remote data. Many works have been done in the different fields of remote sensing data from the satellite, such as gradient based edge detection [2] and change detection [3]. Real-time big data analytic architecture is focused on high speed continuous real time and massive offline data.

Big data is a term for data sets that are so large or complex, traditional data processing applications are inadequate to deal with them. Challenges include analysis, capture, search, sharing, storage, transfer, visualization, querying, and updating and information privacy. Remote sensing satellite generate huge amount of data. To analyze the data is too complex by using current technology. Because data will arrive at high speed and the algorithm has to process all the arrived data. Therefore, there is a need for architecture to analyze both the real time and offline data sets.

The image processing techniques are also very important for remote sensing applications. Remote sensing images are useful for fire detection and controlling. The satellites around the earth are generating varieties of images in every second. Sensing images are in the form of digital images. The image needs to be processed efficiently. The analysis of data using Hadoop results in fast parallel processing of data. Many data mining algorithms are migrating towards Hadoop, but the speed-up of the parallel k means algorithm is not linear. The main reason results in non-linear were that the communication overhead increases as increase the dataset size. These problems can be solving by using real-time analytical architecture.

2. Related Works

Many works have been done in the field of Big Data in recent years.

Dongcai Cheng, proposed a hierarchical region merging approach [4] to automatically extract the sea area and employ edge directed graph cut [5] (GC) to accomplish the final segmentation. Firstly, an image is segmented into super pixels and a graph-based merging method is employed to extract the maximum area of sea region (MASR). Then the non-connected sea regions are identified by measuring the distance between their super pixels and the MASR.

Weihai Li, provide a detailed survey about sea land segmentation [1]. Due to the complex texture and uneven gray value of the land in optical remote sensing image, traditional sea-land segmentation algorithms often recognize land as sea incorrectly. Statistical model [3] determines the threshold according to the adaptively established statistical model of the sea area, and removes the incorrectly classified land according to the difference of the variance in the statistical model between land and sea.

Yu Xia, **Shouhong Wan**, proposed the land and sea area segmentation, by using Local Binary Pattern (LBP). LBP is more suitable for remote sensing image processing. For a land pixel, LBP finds out to always zero and to the real land pixel from satellite images, LBP is always not zero. LBP is a powerful texture feature descriptor, which has been widely used in texture analysis, face recognition and other applications.

3. Existing System

Existing system provides some methods to segment the regions. The existing methods are LBP, Gradient based edge detection, Region similarity based edge detection, and Statistical model. But performance is lower due to lack of feature extraction and it also failed in high speed data processing. LBP is more suitable for remote sensing image

processing. For a land pixel, LBP finds out to always zero and to the real land pixel from satellite images, LBP is always not zero. This will bring out false alarms. Thus, needs a method to reduce the false alarm rate and to segment the land and sea with high precision. The other issues in the existing method to segment land and sea are scalability and the data collected from remote areas are not ready for analysis.

1. Problem Definition

A novel segmentation of land and sea are carried out through offline. The segmentation approach had failed in real time data. Due to the lack of feature extraction, merging technique results in incorrect extraction of sea and land. Low cost real time analytical architecture is highly scalable and overcomes the offline issues. Remote sensors generate a huge amount of data from satellite. There is large demand for real time data for remote sensing application. In existing technology two level merging is used to extract the sea area. But the performance is lower due to lack of feature extraction. Real-time big data analytical architecture is focused on high speed continuous real time and offline data. Fire detection is accomplished in many ways, such as using temperature sampling, particle sampling, humidity sampling, air transparency testing and also smoke analysis. However, these techniques are not reliable as they cannot provide further information such as fire location, size of fire, growing rate of fire and other information that could give the exact view of the fire scene. Thus, the techniques might results in false alarm because the techniques can miss judge the energy emission of non-fire or by products of combustion. Then, in image processing analysis, the object is detected by looking the color which is motivated by two main factors. First, color simplifies object identification and extraction from a scene. Secondly, human can discern thousands of color shades and intensities, compared to about only two dozen shades of grey.

2. Proposed System

The segmentation approach is failed in real time data and fire detection methods generate false alarms. So here proposed a method called Real Time Big Data Analytical Architecture, can analyze data both offline as well as real time & can also detect fire on images in real time by using Scale Invariant Feature Transform. The architecture comprises 3 main units, such as RSDU, DPU & DADU. These units are working with different servers and perform different algorithms.

- **Filtration and load balancing server (FLBS):** The main goal of the FLBS is filtration of data & load balancing of processing power. The unit allow useful data, rest of data's are blocked & discarded
- **Processing Servers:** Dividing filtered data into parts & assign them in various server. Processing server makes statistical calculations & generates intermediate result. The results generated by each server are then sent to the aggregation server.
- **Aggregation & compilation server:** The result from DPU is not organized & compiled form. Aggregate, compile, organize, store, and transmit the results. Aggregation server stores the compiled and organized results into the result's storage. Any server can use it & can process at any time.
- **Decision making server:** The decision-making server is supported by the decision algorithm. Make various decisions whether the area belongs to land, sea, ice & forest area. The decision algorithm must be strong & correct.

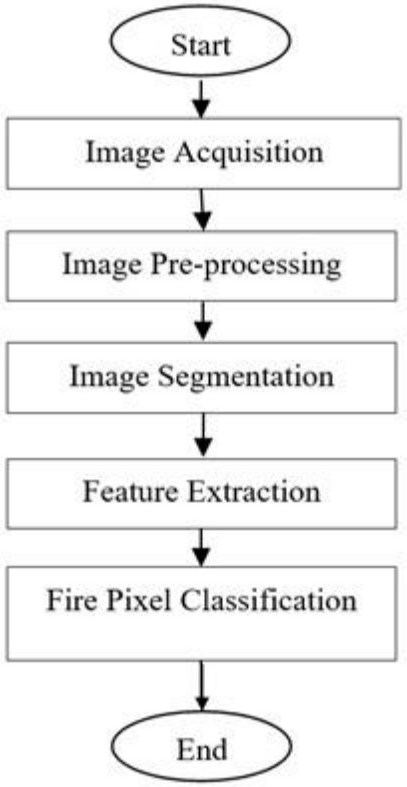

Figure 1: Process flow of fire recognition

Figure 1 shows the process flow of developed fire recognition system.

- **Image acquisition:** In this stage convert satellite raw data into image format that is RGB format. Then it converts RGB into YCbCr format.
- **Image pre-processing:** Pre-processing of the digital image is a step to make improvement and enhancement to the image, making sure all the noise is removed prior to processing step. In pre-processing, image filtering, image restoration and/or color processing are done. Image pre-processing will increase the reliability of optical inspection and recognizing the region of interest.
- **Feature extraction:** Feature extraction is where all the data pixels that represent and describe the desired pixels is been grouped. The set of features will extract relevant information accordingly to the desired task. For this project, fire pixel had been extracted by using two color spaces and seven rules that were applied for each of image tested. If a pixel satisfies these seven rules then the pixel is detected as fire.

Color space	Rules
RGB	1) R> G >B
	2) if R> Rmean ∩ G> Gmean ∩ B< Bmean
YCbCr	3) Y(x,y) >= Cb(x,y)
	4) Cr(x,y) >= Cb(x,y
	5) Y(x,y) ≥ Ymean ∩ Cb(x,y) ≤ Cbmean ∩ Cr(x,y) ≥ Crmean
	6) Cb(x,y) – Cr(x,y) ≥ Th
	7) (Cb(x,y) ≤ 120) ∩ (Cr(x,y) ≥ 150)

Table 1: Seven rules for fire recognition

4. Conclusion

This paper proposed a architecture called Real time big data analytical architecture can process real time & offline data. Architecture is worked based on various algorithms to segment the regions and also detect the fire on remote sensing image. Analysis results show that both color spaces have higher fire detection rate which is RGB 90% and YCbCr 100% respectively. Both color spaces can be used to detect fire, but YCbCr color space has a greater detection rate as to compare to RGB because YCbCr can separate luminance from chrominance more effectively than RGB. The system is able to differentiate the things in surrounding (non-fire) or reflected things that have same value as fire pixel value; false fire alarm could be avoided. Hence, recognition of fire using color spaces RGB and YCbCr through seven rules for fire pixel classification could establish highly reliable system.

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