A Survey on Rainfall Forecasting using Image Processing Technique

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ABSTRACT

Rainfall forecasting is important for Agriculture and living things. Agriculture plays an important role in Indian financial system. Agriculture is backbone of our country. Almost 70 percent population is dependent on agriculture. Many industries dependents on agricultural products like sugar industries, Paper industries, tobacco industries etc. Some of the agricultural products like some fruits, vegetables and flowers are exported. Agriculture supports railways and roadways transport. Rainfall is the primary source of water. Human depends on water in daily needs as well as drinking. Water is mainly used in planting trees which are used to bringing natural rainfall. Some agricultural products like rice and corn grown in rainy climate only. Agriculture products are dependents on water so irrigation system is used to provide natural flow of water. Irrigation system is also dependent on rainwater harvesting. Water is essential for the chemical and physiological process in the growth of plant. To find the accurate forecasting, we must know cloud status and sky status. To find the status of cloud, sky and rain required some image processing technique. Image processing is used to enhance images which are taken by Digital camera. It can forecast the behavior of cloud and sky. Image processing has been successfully used by many researchers during last two to four decades. This paper provides a survey of available literature of some methodologies developed by different researchers to forecasting rain by using Image Processing. This survey also reports most suitable technique to forecast rainfall by using Image processing rather traditional statistical and numerical methods.

Keywords

Cloud status Digital Image Processing, Image Processing, Rainfall Forecasting, sky status.

I.   Introduction

Accurate rain forecasting is the most important for an agricultural and water resource. All living things need water to leave. It is very important to maintain water-cycle and keep proper ecological condition. In the, normal water-cycle rain water goes into the earth. In the earth water moves and reaches it into lakes, sea or ponds. And that water is again lifted out by sun using high elevation as cloud. When cloud reaches at certain height it will cooled and converted into water vapor. Due to gravity it again comes on to the earth. By forecasting rainfall cropping system can be planned according to rainfall pattern. Rainfall forecasting is useful in taking decisions on time of sowing, planning of irrigation, time of harvesting. It is also useful to designing farm ponds, tanks or irrigation projects. In crop production system important aspects of rainfall are its amount, distribution and intensity.

Many different researchers developed different model of rain forecasting by using newer technologies. Rainfall is of non-liner nature so that accuracy of forecasting is in satisfactory level. Image processing technique is an attractive approach to forecast rainfall because of it keeps consistently high quality of Image. It is also low cost processing. It has ability to manipulate all aspects of the process. In this processing images are effectively stored and efficiently transmitted. Image processing has been successfully used in this numerous approaches like Image denoisy, Watermarking, Medical Imaging, and Brain-computing.

II.   Concept of Image Processing

Image processing is a technique to enhance raw images taken by digital camera, satellite, space probes or air craft for various applications. Image processing systems are developed due to easy powerful enhance personal computer available, more storage device and graphic software available. Image processing is used in many applications such as:

- Medical Imaging
- Remote Sensing
- UV Imaging
- Robot Vision
- Hurdle Detection
- Pattern Recognition
- Video Processing

The Image processing common steps are: Image Scanning, Image storing, enhancing and interpretation. **[1]**

III.   METHODOLOGY

The various Image processing methods are: Image storage and manipulation, enhancement, restoration, analysis, reconstruction, compression.

3.1. Methods to be used in processing data

3.1.1. Image storage and manipulation

In this method, First of all Images are stored in to different format. In earlier window operating system, Images are stored in bitmap format. In UNIX operating system, Images are stored in raster file format. After saving the images different functions are applied to read the images.

3.1.2. Image enhancement

In this method different methods are applied on to images to enhance its visual appearance which is easier to machine or human interpretation. Image enhancement examples are noise filtering, contrast and edge enhancement, pseudo-coloring, sharpening, and magnifying. In Image enhancement process only some characteristics added. These algorithms are generally interactive and application specific. Some enhancement techniques are: contrast stretching, Noise filtering and Histogram Modification. **[2]**

3.1.3.Image restoration

In this method, degradation or noise is removed. In this method some functions are applied like de-blurring, noise filtering and correction of distortion.

3.1.4.Image analysis

In Image analysis quantitative measurements are derived in to description **[3]**. Image
Analysis technique includes some extraction feature that will used to identify object. Some of its usages are quantitative information used to take sophisticated decision like robot moves his head. Quantitative measurements of objects allow classifying of images.

3.1.5.Image reconstruction

In Image reconstruction method two – dimensional images are converted into single dimension projection. Each projection is calculated by passing X-ray beams from an object. Reconstruction algorithm derives a thin axial slice of object; allow viewing inside the object without cutting. Such techniques are used in medical Imaging.

3.1.6.Image compression

Image compression coverts image into some data which can be transmitted on to the network. There are two mainly techniques for image compression: Lossy compression and lossless compression. In recent year wavelet based compression techniques are used for higher compression ratio.

3.2. Parameters

Most of the studies in rainfall forecasting are primarily based on statistical and empirical techniques. For the forecasting rainfall studies of historical data sets have brought out several predictors. These parameters represent different components like sky, cloud and its shape, color and type. In this section, the characteristic features of the known predictors grouped into appropriate categories are described.

3.2.1.Status of Sky

To find status of sky we will be used either texture description method or wavelet. In that method we can identify clouds and distance of them.

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3.2.2.Status of cloud

The clouds are changed according to its thickness. High density will be detected. Middle level density will be known as sky. Mild time density will be known as cloud. The highest weight will be considered as sky and lower weight will be considered as cloud.

3.2.3.Types of cloud

To find the types of cloud, cloud status is used because cloud has different shapes and different density. These values will be matched accordingly in different algorithm. Different concepts like color, texture and shape used to find the types of cloud.

3.3. Proposed system Design

The proposed system design steps are as follows:

- In the first step, the clouds images are taken by digital camera are processed by Image processing software.
- From the digital images information is collected in binary format. So that Images data can be read and write.
- To forecasting rainfall three parameters are used with the Image data. Three parameters are: Status of sky, Status of cloud and cloud type.
- After combining all the data are inputted to algorithm and that will find accurate rainfall estimation.
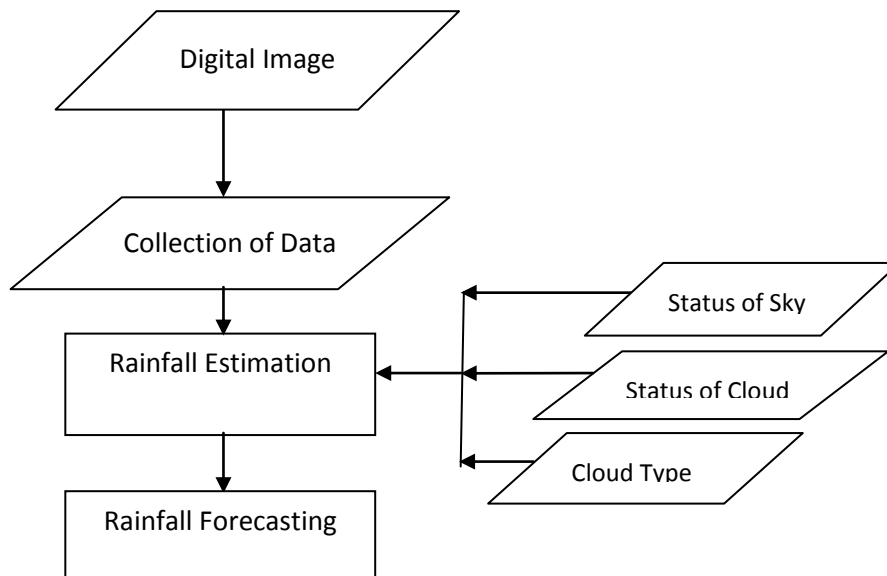
IV. *Literature review*

YanlingHao, Wei ShangGuan, Yi Zhu, and YanHong Tang **[4]** describes the method Content- based cloud image processing and information retrieval(CBIPR) for finding texture for clouds. In this method satellite Images of the clouds are used. It has the features of texture of clouds. This method describes basic character, like cloud's color, texture, edge and shape from the cloud image. In this method satellite images of the clouds are stored into the database and database will provide basic characteristics.There are some limitations in traditional image capturing method for realized image retrieval accurately and quickly. So, CBIPR method is adaptive. This method is very much useful for finding cloud texture, size and color. It gives accurate result.

Peter S. Masika**[5]** describes an algorithm for Cloud height determination and comparison with observed rainfall by using meteosat second generation (msg) imageries. In this method we can obtain approximations of surface and cloud parameters from satellite data. This algorithm developed to identify cloud-free and cloud-contaminated pixels. It will find accurate shape of clouds. This study attempts to compare computed cloud height and observed rainfall on ground station. It will derive relationship between cloud height and total rainfall from storms on the same station. The study starts from the foundation of a suitable balance between calculation speed and exactness in the output data. By using cloud masking accuracy found 87%. They give accurate result from cloud height and total rainfall. Based on the developed simple cloud mask algorithm; it was found that setting thresholds for transmission all cloudy pixels in satellite images is the most difficult part in threshold techniques. The main problem is that the thresholds are functions of many parameters such as surface type (land, ocean, ice), surface conditions (vegetation, soil vapor), current weather (which changes surface temperature and reflectance significantly), atmospheric conditions (temperature inversions, haze, foggy), season, time of day and even satellite-earth-sun geometry (hence bidirectional reflectance and sun glint).In this paper they developed simple cloud mask algorithm but it has some limitations like there were always need for spatial and temporal averaging data. In order to gain accurate result further threshold tests are required based on cloud microphysical process on cloud particles.

Shou Yixuan, Li Shenshen, Shou Shaowen and Zhao Zhongming **[6]** describe Infrared images of the clouds give information of the texture of clouds and also give the rainfall estimation. In that article they have describe the application of a classification method significant four features. Four features are: energy, entropy, inertial-quadrature and local calm. They have use neural network classification method for textural features. In addition, method identifies relationship between textural classification and rainfall. So this scheme is helpful for weather analysis and rain forecasting. This paper provides methods which is enough to whether analyzing and forecasting. But it has some limitations that it required correlative methods to compare the data such as numerical method.

Wei Shangguan; YanlingHao; Zhizhong Lu; Peng Wu **[7]** states that the research development of satellite cloud image processing technology become very quickly and it also concentrate on judge the cloud type and classification of cloud. In this study, different techniques are used such as image processing and pattern recognition. In satellite cloud image, cloud structure is very important feature. Since, satellite image has clear cloud structure and computer texture analysis provide perfect future for study and analyze all kinds of satellite images. In this paper, computer image texture analysis technology combines with variation theory. It will extract and analyze the texture feature of similar cloud and clear sky.

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K. Richards and G.D. Sullivan **[8]** describes the methods for using color and texture to discriminate cloud and sky in images captured using a ground based color camera. But in this approach method alone does not proved sufficient differentiate between different types of cloud and sky. This classification can develop by combining the features using a Bayesian scheme.

Malay K. Kundu and PriyankBagrecha **[9]** describe the M-band Wavelet Transform based feature extraction algorithm is explained in his paper. The MxM sub-bands are used as basic features. In which energies computed in a neighborhood are taken as the features for each pixel of the image. These features are clustered using FCM to get image signature for similarity matching using the Earth Mover's Distance. The results acquired were matched with MPEG-7 content descriptor based system and found to be superior.

 Wei Shangguan; YanlingHao; Kuo-Lin Hssu1, X. Gaoand Soroosh Sorooshian1 **[10]** describes the method for identifying cloud texture classification mapping using satellite images. This approach is used to identifying height of cloud and cloud texture. In this scheme firstly classifying cloud types based on texture features of regional cloud images. The output will regressing the relationship of cloud brightness temperature and surface rain rate depend upon different cloud types. In this method digital images are used so it can be taken up by digital camera so it is less costly. But this method has some limitation like it does not give accurate result. For getting accurate result variation technique must be used.

V.   CONCLUSTION

This paper reports a detailed survey on rainfall forecasting using Image processing techniques. Some of the researchers used satellite images of cloud and sky. And some of the researcher used digital image processing technique which is cheaper technique. Researchers have applied different algorithm on cloud and sky images. However in these methods some of the drawbacks have been founded. This paper is used in reference for the further development of rainfall forecasting by using image processing technique.

The survey also gives a conclusion that the forecasting techniques that use Content- based cloud image processing and information retrieval (CBIPR), meteosat second generation (msg) imageries, M-band Wavelet Transform based feature extraction algorithm. By this literature review some researcher developed adaptive method which will be helpful to me for my research.

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