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Development of Frame Work for Prediction of Forest Fire and Fire Spread Direction Using Image Mining

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Abstract: Forest Fire prediction plays a very important role in security of the forest and wild life. There are some frameworks available which predicts the forest fire. These frameworks use various techniques like fire mapping and monitoring. The current framework is intended to do the similar task by measuring the intensity graph of the fire in an image. The pixel level analysis is done for plotting the intensity graph which gives fire danger rate. In order to predict next fire affected area, pixel values are clustered using Density-based Clustering. Density-based Clustering has shown the result in an efficient way for showing the next fire affected region..

Keywords: Fire prediction, Intensity graph , DENsity-based CLUstEring.

I. INTRODUCTION

Forest fire will be common in the place of terrestrial area and also Mediterranean countries. In India nearly 20.55% geographical area is covered by forest. India is having different types of climatic conditions. In summer season usually trees will be littered and leaves also become dry. In such a dry area of forest, fire may occur with the influence of different meteorological parameters like air pressure, low humidity and high temperature.

Forest fires cause a significant environmental damage while threatening human lives. In the last two decades, a substantial effort was made to build automatic detection tools that could assist Fire Management Systems (FMS). Indian forests are also in risk due to the forest fires primary to their degradation. Fires caused huge damage in the year 2007 affecting huge territories besides notable number of human sufferers . Forest fires create constant threats to ecological systems, social system and wild lives [3].

In this work, we propose a framework which uses forest fire image pixel values for the realisation of early fire prediction. The advantage is that such data can be collected in real-time and with very low costs, when compared to the satellite and scanner approaches [1]. The proposed system is complete system which achieves early fire prediction, fire danger rate and fire spread direction detection. The early fire prediction system will help to predict the fire and take necessary actions to resolve the problem.

II. RELATED WORK

In order to predict forest fire, based on real time implementation, researchers have used artificial intelligence, neural networks, image processing and so on. Due to the rapid developments in digital camera technology and developments in content based image mining, more and more vision based fire detection systems are introduced to show the fire mapping[1][3].

Currently some systems are available which uses satellite images which can sense the occurrence of fire. These systems will either detect the fire by capturing the image or by sensing the smoke. These real time systems work efficiently and send necessary signals to the alarm system [1].

The application of remote sensing is at present a significant method for forest fires monitoring, particularly in vast and remote areas [2]. Predicting natural hazards using satellites has begun in 2000, and it has changed the way natural disasters are being assessed. Satellite images provides almost real-time data for forecaster to predict natural

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hazards, atmospheric interfering such as clouds, smoke and smog grounds distortions in the images retrieved [3][4].

Using meteorological data ,histogram is drawn to show the fire obtained regions in particular space[10].Different approaches like satellite data, infrared/smoke scanners and local sensors and sensor inputs are used for the automatic detection of fire [11][12].

But, in this paper a framework is developed to predict forest fire with clustering and histogram techniques in data mining.

III.PROPOSED ALGORITHM

The images of forest fire occurrence can be classified into 3 categories,

- Dry forest area images where fire may occur, if the temperature exceeds 40 degree centigrade [2](before fire occurs).
- An active fire image which has the data about fire location and intensity of fire's burning at the time of observation(presence of fire).
- Burned area picture which shows historical mapping(after fire occurs).

The proposed frame work has three major steps.

1 .Generation of pixel values and storing values in the database.
2 .Obtaining the fire intensity graph for fire affected and non fire Region in an image.
3. Obtaining the clusters of image using pixels values.

Step1: Generation of pixels values and storing in the data base.

For the purpose of investigation two images are taken. One image with dry forest area (without fire fig 3).Another image with fire in the same location of the forest (fig 4).These images are fed into the system in order to obtain the pixel values. Based on the color and fire intensity the pixel value varies. The obtained pixel values are stored in the database.

Step2: Plotting the intensity grap.

The assessment of graph is based on fire segmentation of pixel values. Different color spaces suggest the typical feature for prediction of fire. Almost all the vision based fire detection systems use some sort of a hybrid model which combines motion, geometry and colour information. In general, fire detection systems use colour clues as a precondition to generate areas for possible fire regions since it is the most discerning feature. An effective colour model for fire pixel classification is thus essential for almost all vision based fire detection systems.

Two histograms are formed for fire and Non-fire groups of pixels, and slope value is assessed normalizing pixel values of each histogram by obtaining the difference. Pixel values are slightly higher in the RGB colour space of image.

The high intensity of fire is shown in the graph (fig 5) in red colour. Low intensity i.e. non fire region is shown in blue colour(fig 5). The colour space transformations are evaluated by measuring difference between fire and non fire clusters of pixels.

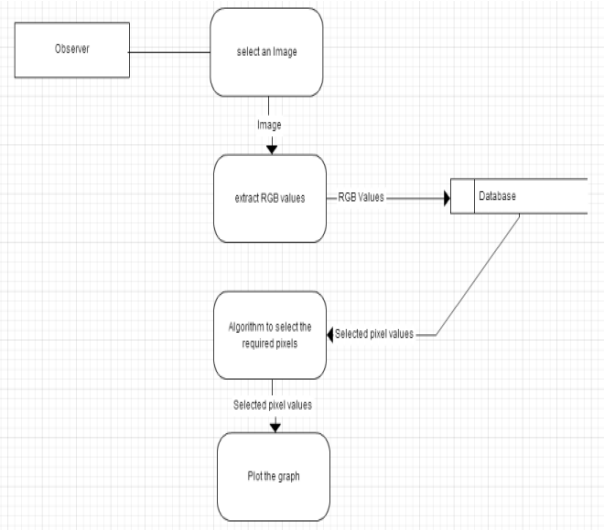

Fig 1: Data Flow Diagram for intensity plotting with pixel values

The paper is based on development of an algorithm which can predict the fire in a given image based on the pixel data reference. Initially sample images are converted back to their pixel value sets for each pixel and later these pixel values are analysed to predict the occurrence of fire.

Global remote sensing datasets are available from a variety of sources at different resolutions with fire. The proposed system uses digital images considering only pixel values for fire progress investigation. The active fire images in dry forest are considered for clustering algorithm.

Step3: Obtaing the clusters of image using DENCLUE.

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Clustering based on Density Distribution Functions (DENCLUE) algorithm is used for fire intensity comparison for fire affected and non-affected area.

Density-based Clustering(DENCLUE) is a clustering method based on a set of density distribution functions[6].The method is built on the following basis:

- The influence of each data points can be firmly modelled using mathematical function, called as influence function .This describes the impact of a data point within it's neighbourhood.
- The overall density of data space can be modelled analytically as the sum of the influence function applied to all data points.
- Clusters can then be determined mathematically by identifying density attractors, where density attractors are local maxima of overall density function[6].

From density function we define the gradient of the function ,and the density attractor. If the point p is said to be density attracted to a density attractor p^{l} if there exists a set of points p0, p1, p2,p3....pk such that p0=p,pk=p^1 .and gradient of p_i -1 is in the direction of pi for 0<i<k [6].

Following method is applied in the framework developed.

1. A data point can be modelled using a mathematical function called an influence function. It will have threshold value σ for fire intensity.
2. Overall density of pixel values can be modelled analytically as summation of applied data points.
3. Overlapping cluster are determined mathematically by identifying density attractors, i .,e local maxima of overall density function[6].

The distance function $d(x,x^1)$ must be reflexive and symmetric to obtain distance between two clusters(Euclidean distance).This can be achieved with square wave function for influence function i.e., Square wave function

F square (x, x^1) = {0 if $d(x , x^1) > \sigma$
1 otherwise

Two clusters x and x^1 are considered as far away if the distance between x and x^1 greater than threshold value σ.

If the distance is less than threshold value, it is considered as that the clusters fall under the fire affected area.

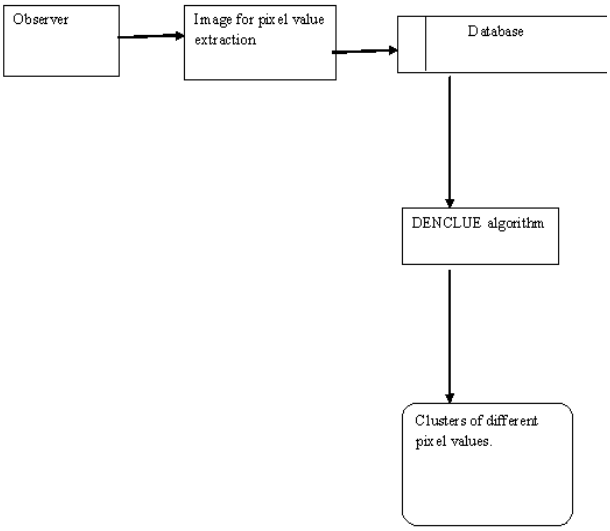

Fig 2: Block diagram of Clustering.

IV. IMPLEMENTATION AND RESULTS

The developed framework reads the specified files from the memory and creates separate file for image and stores pixel values. These values are used by another module which plots the different intensity graphs for each set of images. The set refers to the images with fire and without fire. Based on graph the range is calculated, which is used for future predictions. Once the intensity is identified with algorithm, the segmentation of pixels values are done using clustering algorithm. The cluster with overlap is used for fire prediction and spreading direction. This system mainly concentrates about the path in which fire occurs, so that measure can be taken to avoid the fire.

The basic idea behind the solution is to predict the chances of fire in the dry forest images before fire occurs. Using active fire images the effort is made to detect the next fire spread direction. The whole algorithm is developed using images. Various colour schemes have been studied and analysed and range of value is got to predict the occurrence of fire . The frame work produces histogram which shows the intensity of fire in an image. The functional model handles the process perspective of the model.

The task of image segmentation is implemented after obtaining pixel values. Segmentation is the process of partitioning a digital image into multiple segments hence simplifies the representation of an image into cluster. The cluster representation is easier to analyse [4]. Image clustering is a process of grouping images based on their similarity, and is considered as important step for many image processing and computer vision algorithms. In our proposed methodology, DENCLUE algorithm for clustering is used to cluster the data[6].

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The input used here is dry forest image samples, each varying by its pixel value and intensity. It is observed that the classification accuracy is higher for images with various colors and intensity of images. It is because in natural images there are large variations of pixel values. This has resulted in maximum overlap in the feature values. Hence for classification of clusters on images we have fixed a pixel variation of 30 pixels. The developed frame work will plot the fire intensity graph for every image that is fed to the system and help observer to decide the occurrence of fire and fire danger rate. The pixel value stored in database are clustered for the prediction of next fire affected region.

Fig 3: Dry forest area where fire may occur (Image 1)

Fig 4: forest fire image (image2)

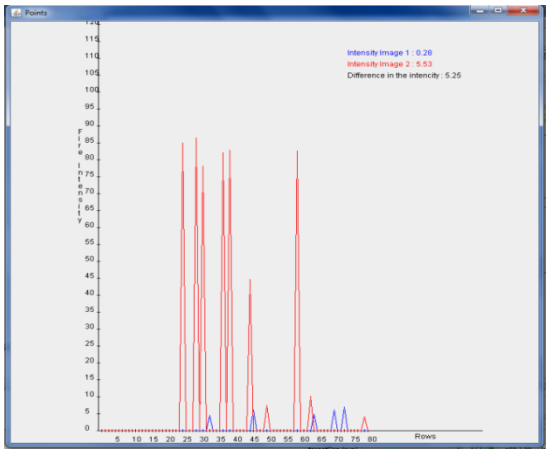

Fig 5:Histogram for fire intensity from fig1 and fig2.

Based on the result analysis, the graph is plotted, which shows the intensity difference between the images. Figure 5 shows the fire intensity (fire danger rate with red colour). Blue colour shows for the non fire region. The overlapping clusters in blue colour with red colour are predicted as next fire affected regions in the forest.

The density of pixels in fire area are more similar to specific colours such as red ,yellow and orange .The deviation of (smoke)colour with brown and black are considered for noise and outliers. From the histogram analysis we get,

Difference=Fire intensity graph- Non fire intensity graph

F intensity(x) =∑F Image1 pixel(x) =0.28
F intensity (x^1) =∑ F image2 pixel (x^1) =5.53
Difference in the intensity = 5.25

From the figure 5 , the blue colour line shows for non fire affected area with intensity 0.28 and red colour shows for the fire intensity 5.53.The intensity difference is 5.25.The spatial overlap is 5.25 .(Before fire and after fire).

The fire features are analysed using histogram. The intensity is more where ever high fire is present. The distance between the clusters of fire affected and non fire affected can be set with threshold valueσ. The threshold value for pixel cluster is set with σ is equal to 5.25.The square wave function gives that, the cluster distance which has less than threshold value σ will get affected from the fire immediately.

V. CONCLUSION

The frame work can be optimized to work faster. The direction of fire is identified with the threshold pixel value σ .This framework will helps in identifying early fire affected area and fire spread path, to predict the areas which may be affected in later stage. This algorithm can further be used to map the loss of vegetation and loss of wild life. The early warning of fire will help in protecting the wild conservation area by fire.

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BIOGRAPHIES

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