IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 6, June 2016

Analysis of Forest Fire Behaviour on Thermal Images Using Data Mining Technique

Vaibhavi S. Shukla[1], Jay Vala [2]

Student, Information Technology, G. H. Patel College of Engineering and Technology, Anand, India [1]

Assistant Professor, Information Technology, G. H. Patel College of Engineering and Technology, Anand, India [2]

Abstract: As we realize that today's reality is computerized world and we have use advanced information, for example, video, sound, images and so forth in different fields for different purposes. In present situation, images assumes key part in each part of business, for example, various fields like business, medical, satellite etc. Broke down images uncover helpful data to the human clients. Image mining makes do with the extraction of information, image information relationship, or different examples which is not put away in the images. The enthusiasm of image mining additions as the need of image data is creating in everyday life. Forests fires are a tremendous problem.. To fight against these disasters, the appropriate analysis of forest flames is a crucial concern. The development in the amount of woods flares of woodland flame in the latest couple of years has obliged governments to take protections. These Forests flames are a noteworthy issue. On the off chance that the flame contenders know spreading flame and where the flame will be in once in a while it would be simple for them to take precautionary measures against the flame. In this way, for that a noteworthy prerequisite for examination and analysis of the fire of flame exists. The analysis of forest fire behavior is done using thermal images of forest fire.

Keywords: Data mining, Multimedia mining, Image mining, forest fire, Thermal image.

I. INTRODUCTION

Multimedia mining has various utilizations in today's general public. Multimedia data mining is the exploration and analysis, by automatic or semi-automatic means, of large quantities of data in order to discover meaningful patterns and rules [18]. There are two basic steps in the multimedia mining:

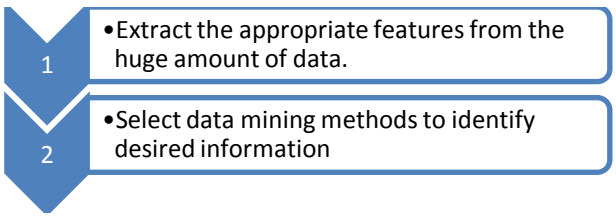


Fig 1: Basic Steps of Multimedia mining

Multimedia mining is sub field of the data mining. In multimedia mining there are two types of media like static media and another is dynamic media.

Here, as shown in fig 2 the static media and dynamic media is divided into various sub field like video mining, image mining, music mining, graphics mining, text mining, animation mining.

Other than new innovation, a gigantic volume of information in different structure has been accessible for individuals. Image data speaks to a keystone of numerous exploration ranges. Examining image information is a cornerstone of numerous exploration zones like medical field (to evaluate MRI, to interpret X Rays/CT scans), in forensic criminology field (identification of fingerprint, recognition of face), robotics (robotic vision), meteorology and geography field (satellite imagery, forest fire) as well as education and many other fields.

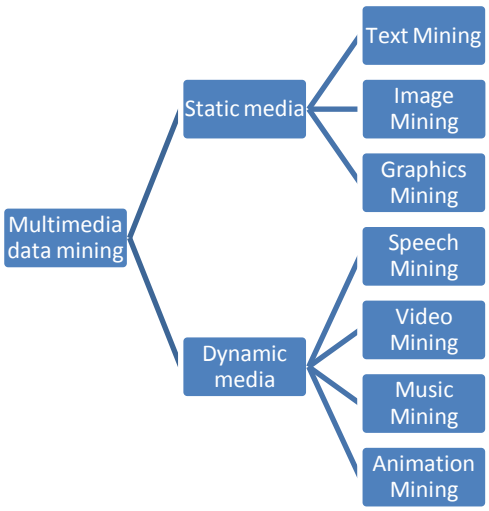


Fig 2: Multimedia Data mining

The research is on forest fire. Forest fires are the most destructive enemy of our forests. Forest fires always initiate by one of two ways:

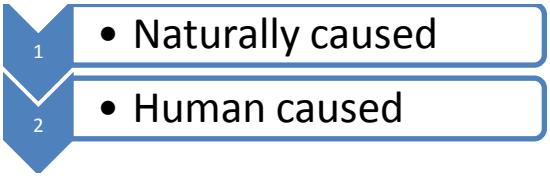


Fig 3: Two ways forest fire caused

DOI 10.17148/IJARCCE.2016.5682

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 6, June 2016

The fires which are caused naturally they are generally started by lightning, with a very small percentage started by spontaneous combustion of dry fuel such as sawdust and leaves. Whereas, the fires which are caused by human that can be due to any number of reasons. Clearly, a flame that is identified in its initial stages will be much simpler to smother than a flame that has been burning for quite a while. In 2016, forest fires have been noted in various spots over the Indian state of Uttarakhand. The forest department estimated that 3,500 hectares (8,600 acres) of forest had been burnt. Nearly 1,600 incidences of fires were detected which were brought under control by 2 May [20]. As we realize that Forests flames are a critical issue. To battle against these fires, the exact forecast of flame is a urgent issue. The effect of flame harm includes the measure of timber smouldered as well as ecological harm to forested landscapes. The increment in the quantity of fire in the most recent couple of years has constrained governments to take safeguards. In the event that the flame contenders know fire initially and analyse fire behaviour than it would be simpler for them to stop the fire spread. In this manner a major requirement for foreseeing the fire exists. Thermal imaging is method of improving visibility of objects in dark environment by detecting the objects infrared radiation and creating an image based on that information.

II. LITERATURE SURVEY

There are a large number techniques are used for forest fire detection and analysis of the fire. Comparison between these methods is shown in Table 1.Different algorithms are used for forest fire detection.
These methods have their own advantages and disadvantages

TABLE 1 Comparison of different techniques

Title, Author, Publication	Method used
Title: Analysis of Wild Fire Behaviour in Wild conservation Area using Image Data mining [9] **Authors:** Divya T.L, Vijayalakshmi M.N **Publication:** IEEE, 2015	**Agglomerative hierarchical clustering**. Satellite images are used.
Title: Development of Frame Work for Prediction of Forest Fire and Fire Spread Direction Using Image Mining [10] **Authors:** Divya T.L, Vijayalakshmi M. N **Publication:** IJARCCE , 2013	To predict next fire affected area, pixel values are clustered using **Density-based Clustering**
Title: Implementation of data mining techniques for Temperature Extraction for forest fire occurrence with Image Analysis [11] **Authors:** Divya T.L, Vijayalakshmi M.N **Publication:** IJIRCCE , 2013	**Association rule method** is used to identify fire occurring temperature and fire danger rate for loss of vegetation.
Title: Identification Method of Forest Fire Based on Color Space [12] **Authors:** Fei Van, Xing Xu, Ning Han **Publication:** IEEE,2010	Flame region may be identified based on **RGB** color space and **HSV** color space.
Title: Optimized Flame Detection [22] **Authors:** Abhilash Nunes, Leroy Dias, Meena Ugale, Shalem Pereira **Publication:** IJCA,2015	**Fuzzy logic** or fuzzy inference system (FIS) to detect fire pixels. And RGB color model is used.
Title: Prediction of Soil Erosion Depth Due to Increase in Forest fire Danger Rate by Data Mining [23] **Authors:** Divya T.L, Dr. Vijayalakshmi M.N **Publication:** IJCA,2011	General Unary Hypotheses Automaton (**GUHA**) is used to predict the forest land area burnt in hectare and **Apriori** is used.

III. PROPOSED METHODOLOGY

The existing method for analysing forest fire behaviour uses RGB color model and hierarchical agglomerative clustering algorithm is used. And it is applied on satellite images of forest fire.RGB color model are based on lighting condition of R,G,B – so that it may happen that it cause non flame pixels to be considered as flame pixels. And the existing method converts the color image into gray scale image. But Color image is important .Through color image one can identify object & extract from scene easily. For many applications color is very important & converting to gray scale can worsen results.

Drawback of existing method:

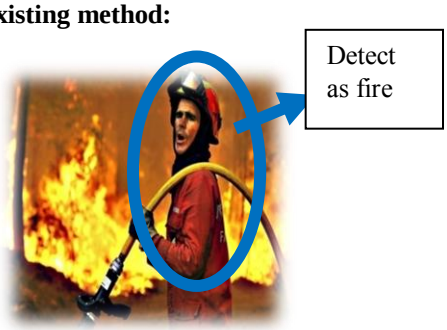


Fig 3 : Drawback of exsting method

Disadvantage of this method RGB color model is that it also Detect a man with red color costume as fire. Here, HSV color model is used .H-> Hue S-> Saturation, V->Value

TABLE 2 Hue, Saturation, and Value

Hue	Hue represents color. It is angle from 0 degree to 360 degree

DOI 10.17148/IJARCCE.2016.5682

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 6, June 2016

Saturation	Saturation shows amount of gray (0% to 100%) in color. Sometimes faded color is there it is due to low saturation level, which means the color is having more gray
Value	Value is brightness or intensity of color from 0% to 100%.When the value is '0',the color space will be totally black, with increase in value, the color space brightness up and shows various colors.

Why do we use the HSV color model?
Unlike RGB, HSV color model separated image intensity form the information of color. This is very useful for many applications.RGB color model is way how computer treats color but in the HSV color model HSV is try to capture components as we humans perceive the color.

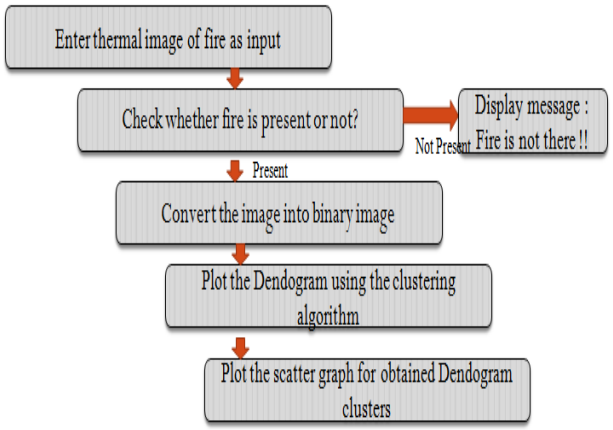


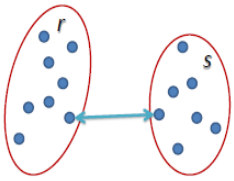
Fig 4: Work flow of proposed method

Steps involved in proposed method:
Step 1: First of all select the input image. Here thermal image is used.
Step 2: After selecting the image select flames HSV's value
Step 3: Then find out fire is there or not.
Step 4: If fire is present then convert image into binary image
Step 5: After completion of 4th step for plotting the Dendogram by using the clustering algorithm is carried out.
Step 6: At last scatter graph for obtained number of clusters is plotted

Before any clustering is performed, it is required to determine the proximity matrix containing the distance between each point.

3 methods – how distance between cluster measured
1. Single linkage method
2. Complete linkage method
3. Average linkage method

→ Single linkage

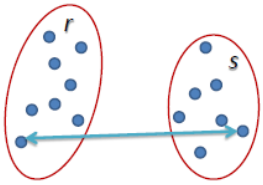


$$L(r,s) = \min(D(x_{ri}, x_{sj}))$$

Fig 5: Single linkage

Shortest distance between 2 clusters

→ Complete linkage

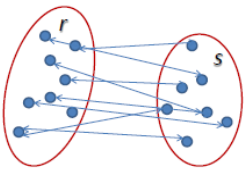


$$L(r,s) = \max(D(x_{ri}, x_{sj}))$$

Fig 6: Complete linkage

Longest distance between 2 clusters

→ Average linkage



$$L(r,s) = \frac{1}{n_r n_s} \sum_{i=1}^{n_r} \sum_{j=1}^{n_s} D(x_{ri}, x_{sj})$$

Fig 7: Average linkage

Average distance between each point in 1 cluster to every other clusters.

Here, Single linkage is used. Here agglomerative hierarchical clustering algorithm is applied. Agglomerative is bottom up approach.
Terms those are used in this method:

TABLE 3 Hue, Terms and its meaning

Dendogram	"It is tree diagram frequently used to illustrate the arrangement of clusters produced by hierarchical clustering. It is used to exemplify clustering samples."
Scatter graph	"To predict the fire propagation a scatter graph is used based on fire hotspots."
Distance matrix	"Matrix contains the distances taken pair wise. Before any clustering is performed it is required to determining

DOI 10.17148/IJARCCE.2016.5682

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 5, Issue 6, June 2016

	matrix containing the distance between each point using a distance function then the matrix is updated to display the distance between each cluster. “

IV. RESULT & ANAYSIS

Result

→ **Tool:** Implementation is carried out in matlab.

→ **GUI**

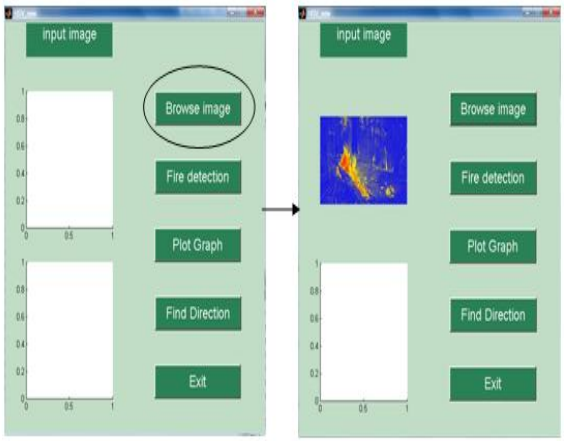


Fig 8 GUI Fig 9 Select image from dataset

As shown in fig, it is graphical user interface.First step is to select the image of thermal from the dataset.

→ **Fire Detection :**

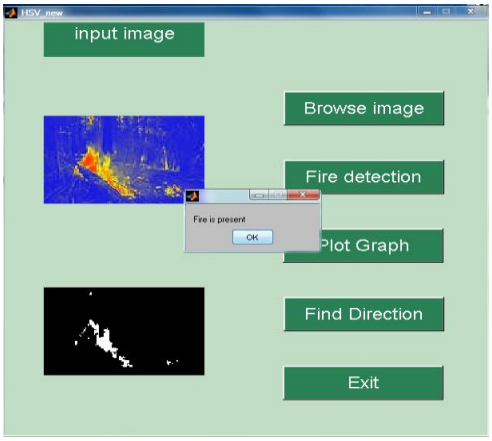


Fig 10 Detection of fire

Here, weather a fire is present or not in the given image is checked by fire detection button. After clicking on this button if fire is present then fire present pop-up box is generated and portion having fire is displayed with white color. If fire is not there then it will display message that fire is not present. Here, H, S, V values are extracted from the given image.

Here, Dendrogram is generated which is used to illustrate arrangement of clusters produced by hierarchical clustering. Here in the above table distance between two clusters are shown.

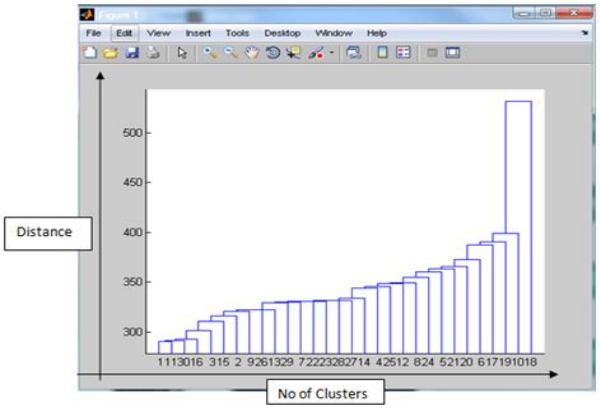


Fig 11 Dendrogram

```
Z =

    3.0000   73.0000   92.7200
   52.0000   83.0000   97.9541
   32.0000   84.0000  108.0185
    4.0000   17.0000  111.7900
   40.0000   86.0000  121.1652
   13.0000   85.0000  132.2724
    5.0000   12.0000  139.7605
   39.0000   87.0000  140.7196
   16.0000   90.0000  153.1339
   65.0000   89.0000  154.0162
   51.0000   88.0000  159.4647
   38.0000   92.0000  161.4714
    6.0000   76.0000  163.7009
   72.0000   93.0000  164.0427
   91.0000   95.0000  176.1250
    2.0000   74.0000  181.4111
   15.0000   97.0000  184.2743
   71.0000   96.0000  184.8242
   94.0000   99.0000  187.6246
   31.0000  100.0000  195.1666
   64.0000  101.0000  198.5674
   30.0000  135.0000  291.3417
   67.0000  136.0000  293.1245
   34.0000  137.0000  301.6604
   66.0000  138.0000  310.9116
   33.0000  139.0000  316.1867
   47.0000  140.0000  321.2087
   77.0000  141.0000  322.1878
   54.0000  142.0000  322.5136
  132.0000  143.0000  329.0015
   44.0000  144.0000  330.2575
   22.0000  145.0000  331.0634
   75.0000  146.0000  331.2310
   28.0000  147.0000  331.7017
   27.0000  148.0000  331.7258
   55.0000  149.0000  334.0838
   41.0000  150.0000  344.2877
   25.0000  151.0000  345.7065
   53.0000  152.0000  348.4494
   45.0000  153.0000  349.7499
   24.0000  154.0000  354.9141
   42.0000  155.0000  360.1069
   21.0000  156.0000  363.6867
   20.0000  157.0000  365.6405
   43.0000  158.0000  373.1273
   68.0000  159.0000  387.7873
   19.0000  160.0000  390.7825
   48.0000  161.0000  398.9424
   18.0000  162.0000  531.6042
```

Fig 12 Distance between clusters

→ **Scatter Graph :**

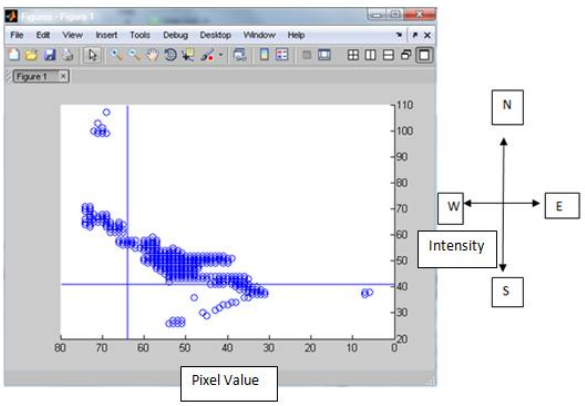


Fig 13 Scatter Graph

[

Here, for predicting the fire spread a scatter graph is used. So for that when the button plot graph is pressed then fire spreading direction of the input image is shown. Here, N for North direction, E for East direction, S for south direction and W for west direction.

Analysis

For evaluating proposed system below parameters are used.

- Precision
- Recall

- F-measure
- Accuracy

Equations for finding these parameters are given below:

- **Precision = TP/ (TP+FP)** ……..…… (1)

Where TP=True Positive and FP=False Positive

- **Recall=TP/ (TP+FN)** …….…… (2)

Where TP= True Positive and FN = False Negative

- **F-Measure=2*P*R/(P+R)** ……..……(3)

Where P=Precision and R=Recall

- **Accuracy= (TP+TN)/TP+TN+FP+FN** …….(4)

Where TP= True Positive, TN= True Negative, FP= False Positive, FN= False Negative

Table 4: TP, TN, FP, FN and its meaning

TP (True Positive)	Fire Present	Fire Detected
TN (True Negative)	Fire Present	Fire not Detected
FP (False Positive)	Fire not Present	Fire Detected
FN (False Negative)	Fire not Present	Fire not Detected

Output:
For Proposed work:

Table 5: output of thermal Fire image

Total no of image = 122	TP	TN	FP	FN
	110	1	1	10

Precision = 99.0991%
Recall = 91.6667%
Fmeasure = 95.2381%
Accuracy = 90.9836%

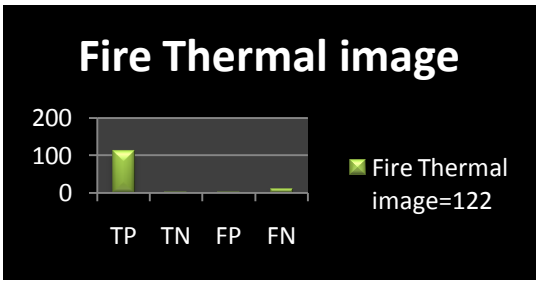


Fig 14 Graph for fire image

V. CONCLUSION AND FUTURE WORK

The present research is based on hierarchical clustering on thermal images of forest fires where the accuracy achieved is 90.98%. Here the color model used is HSV (Hue, Saturation, and Value); which gives better results than the previously used color models.
In future, analysis of forest fire can also be done by using another color models like YCbCr (according to the application) and other clustering algorithms. Some new meteorological variables like temperature, relative humidity, wind speed, rainfall, topology factors like types of forest and location can also be used for evaluation.

REFERENCES

[1] Dr. S. Vijayarani and Ms. A. Sakila, "Multimedia Mining Research – An Overview," in International Journal of Computer Graphics & Animation (IJCGA) Vol.5, No.1, January 2015.
[2] A.Hema, E. Annasaro, "A Survey In Need Of Image Mining Techniques," in International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 2, February 2013.
[3] A. A. Khodaskar, S .A. Ladhake "Image Mining: An Overview of Current Research," in Fourth International Conference on Communication Systems and Network Technologies, IEEE 2014
[4] T.Karthikeyan, P.Manikandaprabhu, "Function and Information Driven Frameworks for Image Mining - A Review" in International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 11, November 2013.
[5] Deepika Kishor Nagthane, "Image Mining Techniques and Applications", in International Journal Of Engineering Sciences & Research Technology July, 2013.
[6] K. R. Yasodha, K.S. Yuvaraj, "A Study on Image Mining Techniques", In International Journal of Applied, December 2013.
[7] Prabhjeet Kaur, Kamaljit Kaur, " Review of Different Existing Image Mining Techniques", In International Journal of Advanced Research in Computer Science and Software Engineering, June 2014.
[8] Ji Zhang, Wynne Hsu, Mong Li Lee, "Image Mining: Trends and Developments", International Workshop on Multimedia Data Mining, 2001.
[9] Divya T.L, Vijayalakshmi M.N, "Analysis of Wild Fire Behaviour in Wild conservation Area using Image Data mining",,IEEE,2015
[10] Divya TL, Vijayalakshmi M.N, "Development of Frame Work for Prediction of Forest Fire and Fire Spread Direction Using Image Mining",, IJARCCE,2013
[11] Divya TL, Vijayalakshmi M.N, "Implementation of data mining techniques for Temperature Extraction for forest fire occurrence with Image Analysis",, IJIRCCE,2013
[12] Fei Van, Xing Xu, Ning Han, "Identification Method of Forest Fire Based on Color Space",,IEEE,2010
[13] Young Gi Byun, Yong Huh, Kiyun Yu, Yong Il Kim, "Evaluation of Graph-based Analysis for Forest Fire Detections",,IEEE,2005
[14] Yong Poh Yu, Rosli Omar,Rhett D. Harrison, Mohan Kumar Sammathuria and Abdul Rahim Nik," Pattern clustering of forest fires based on meteorological variables and its classification using hybrid data mining methods" Journal of Computational Biology and Bioinformatics Research, 2011
[15] Divya TL, Dr.Vijayalakshmi MN, "Envisagation and Analysis of Air Pollution Caused by Forest fire using Machine Learning Algorithm",, IRJET , 2015
[16] Yosio Edemir Shimabukuro, Jukka Miettinen, René Beuchle, Rosana Cristina Grecchi,Dario Simonetti, and Frédéric Achard, "Estimating Burned Area in Mato Grosso, Brazil,Using an Object-Based Classification Method on a Systematic Sample of Medium Resolution Satellite Images",,IEEE,2015
[17] Rajasekar Umamaheshwaran, Wietske Bijker, and Alfred Stein, "Image Mining for Modeling of Forest Fires From Meteosat Images", IEEE Transactions On Geoscience And Remote Sensing, Vol. 45, No. 1, January 2007.
[18] Sarla More, and Durgesh Kumar Mishra "Multimedia Data Mining: A Survey", international journal of science, spirituality, Business and technology (ijssbt), vol. 1, no.1, march 2012
[19] Manjunath R, S. Balaji "Review and Analysis of Multimedia Data Mining Tasks and Models", international journal of innovative research in computer and communication engineering vol.2, special issue 2, may 2014
[20] Nizar hamadeh, alaa hilal, bassam daya, pierre chauvet," an analytical review on the most widely used meteorological models in forest fire prediction", IEEE 2015.
[21] Dan Liu,Yanrong Zhang," Research of Forest Fire Prediction Method" Advanced Science and Technology Letters Vol.53 ICE 2014
[22] Abhilash nunes, leroy dias, meena ugale, shalem pereira," optimized flame detection", international journal of computer applications (0975 – 8887) volume 113 – no. 15, march 2015
[23] Divya T.L, Dr. Vijayalakshmi M.N, "Prediction of Soil Erosion Depth Due to Increase in Forest fire Danger Rate by Data Mining ", IJCA-2011