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Forest Fire Detection Using Deep Learning With Neural Network

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ABSTRACT

Forest fire is real threat to our lives, environment and surroundings. It is predicted that forest fire could destroy more than half of world's forest bytheyear2030.Theonlyefficient wayt o minimize the forest fire damage is adopt early fire detection mechanisms. Thus, forest firedetectionmechanismshavingalotoffocusonseveralresearchcentersanduniversitiesaroundtheworld. Currently, there exists many simple fire detection sensor and live monitoring systems, buttheyaredifficulttoapplyinvastareaslikeforests,duetodelayinresponse,continuousmaintenance, low accuracy, high cost and other issues.[1-5] Here, image processing based has beenused due to several reasons such as quick development of digital cameras technology, the cameracan cover vast areas with maximum distance with best results, the response time and accuracy ofimage processing methods is better than that of the existingsystems, and the total cost of theimageprocessingwithdeeplearningislowerthansensorsystem.Stillaccurateforestfiredetectionalgorithmremaina complicatedissue,because,fewobjectshavethesimilarfeaturesoffire,whichgives false message or alarm. In this paper a new image processing forest fires detection method,which is of four stages is used. Here the first step is, to detect moving regions by backgroundsubtractionalgorithm.Then,fire locations can be found using RGB colorspace. Thirdly, aoriginal fire and fire like objects can be easily differentiated by feature extraction. At last, convolutionalneural network algorithm is used to differentiate either real fire or non-fire. The final experimentresultverifies that theproposed method works effectivelyand identifies theforest fire.[6-10]

IndexTerms—Convolutionalneuralnetwork,Deeplearning,ForestFiredetection,Imageprocessing

1. INTRODUCTION

The forests as a whole are heavily affected by human activity. The rapid growth ofincreasing the population and urbanization has led to the outbreak of forest regions. Forest fire isanaturalhazardtotheenvironmentandtheinterferenceoftheatmospheresystem;theenvironmentaffects living organisms. Satellite imagery also provides a fire monitoring, management, anddamage assessment tool for compliance with burn areas to understand a favorable fire range.Satelliteimagereferstotheabilityofimagesfromdatasetimagestakeninaremoteareatoreceivespecificinformati on[11-14].

Forest fire is real threats to our lives, environment and surroundings. It is predicted thatforest fire could destroymore than half of world's forests by the year 2030. The only efficientway to minimize the forest fire damage is adopt early fire detection mechanisms. Thus, forest firedetectionmechanismshavingalotoffocusonseveralresearchcentersanduniversitiesaroundtheworld. Currently, there exists many simple fire detection sensor and live monitoring systems, buttheyaredifficulttoapplyinvastareaslikeforests,duetodelayinresponse,continuousmaintenance,lowaccuracy, highcost and otherissues.

The satellite sensor is used to capture the forest fire image, but it has an increasing rangeof time resolution and space of the forest area.[15- Satellite images also gave a fire-monitoring tool,management, and finding the damaged tool for compliance with burn areas to understand afavorable fire range. The principle of classifying this fire, such as materials from the original fire,is to check the color consistency. The proposed algorithm has rectified this problem and reducesthe error. It not only detects fires but also distinguishes fires such as fire and materials. Theparametersthatwereadoptedinourproposedsystemoperationtoanalyzetheforestfire,thresholdvalue,thedetection ofmatrixvalue, and thedifferential matrixvalueofthe system.

Forest fire is a natural disaster that occurs frequently in our earth, it destroys wildlife andlarge size of forest. It leads to drastic loss of human, animal lives, beautiful natural resources andnaturalproperties.Theforestfirealsohavenotableeffectsonclimatechange.Nowadaysthisissuehas become more severe when comparing to preceding years. The major reason for forest fire ishuman intrusion into forest. It is highly necessary to detect and avoid fire at its starting state toavoidspreadingoffiretolargeareas.Existingfiredetectionmethodsusemechanicaldeviceslikesensors or humans to check forest fire. The most commonly used fire and smoke detectiontechniques are generally based on temperature variation, sampling of particles and transparencytest.

Fig1:Forestfiredetection

2. EXISTINGMETHODOLOGIES

The existing systems of forest fire detection methods are monitoring through naked eyemethod, sensor based detection of smoke and fire and in rare case machine learning is used toidentifyfire.Herethemajordisadvantageisaccuracy. Evenmachinelearningalgorithmcan trainonly few dataset so there is a high possibility of false alert, this may led to loss of naturaldestructionandlossoflives.Duetocomplexbackgroundoftheimageandlargesizeoftheforestcertaindifficulties havebeen faced in traditional orexistingmethods.

SENSORS

Nowadays sensor has been used in most of the cases in fire detection methods. Here themajordisadvantageisitsaccuracyandreliability.Becausesensorbasedsystemscannotbeappliedtothevastareaslike forestitcanbeonlysuitableforsmallregion.Alsothereisachanceofdamageof sensor during forest fire. The sensor is able to detect the fire when it is too close to the fireotherwise it does not give any alarm. There also may be a chance of false alarm due to hightemperature.So it will not be agood solution for firedetection.

MACHINELEARNINGBASEDSYSTEM

This system replace sensor fire detection system, because of the rapid development

ofadvancementintechnology.Thissystem givesslightaccurateresultthansensorbasedsystembutit is less when compared to deep learning because machine learning can be efficient only forsmallerareasandithastheabilitytotrainsmallerdataset.Soitisnotapplicableincaseof monitoringvastareas likeforests.

3. PROPOSEDMETHODOLOGIES

Inourproposedmethodwehaveusedimageprocessingalongwithdeeplearningmethod.Here CNN algorithm is used for accurate results.The images can be taken from CCTV cameraandpreprocessing steps has been done to eliminate the noises in images, to extract color featuresandsegmentofthefireregions.Ithasbeenpassedthroughfourlayersinwhichinputlayerisusedto process the input, max pooling layer is used to set the condition for fire, fully connected layeris used to match the given input image with the set of trained images and output layer is used toprocesstheoutputandshowsoutputinthescreen.Finallyitclassifythepixelsusingdeeplearningalgorithm and categorize the result as fire, smoke and neutral image also it sends mobile alert tocorrespondingauthorities with high accuracy.

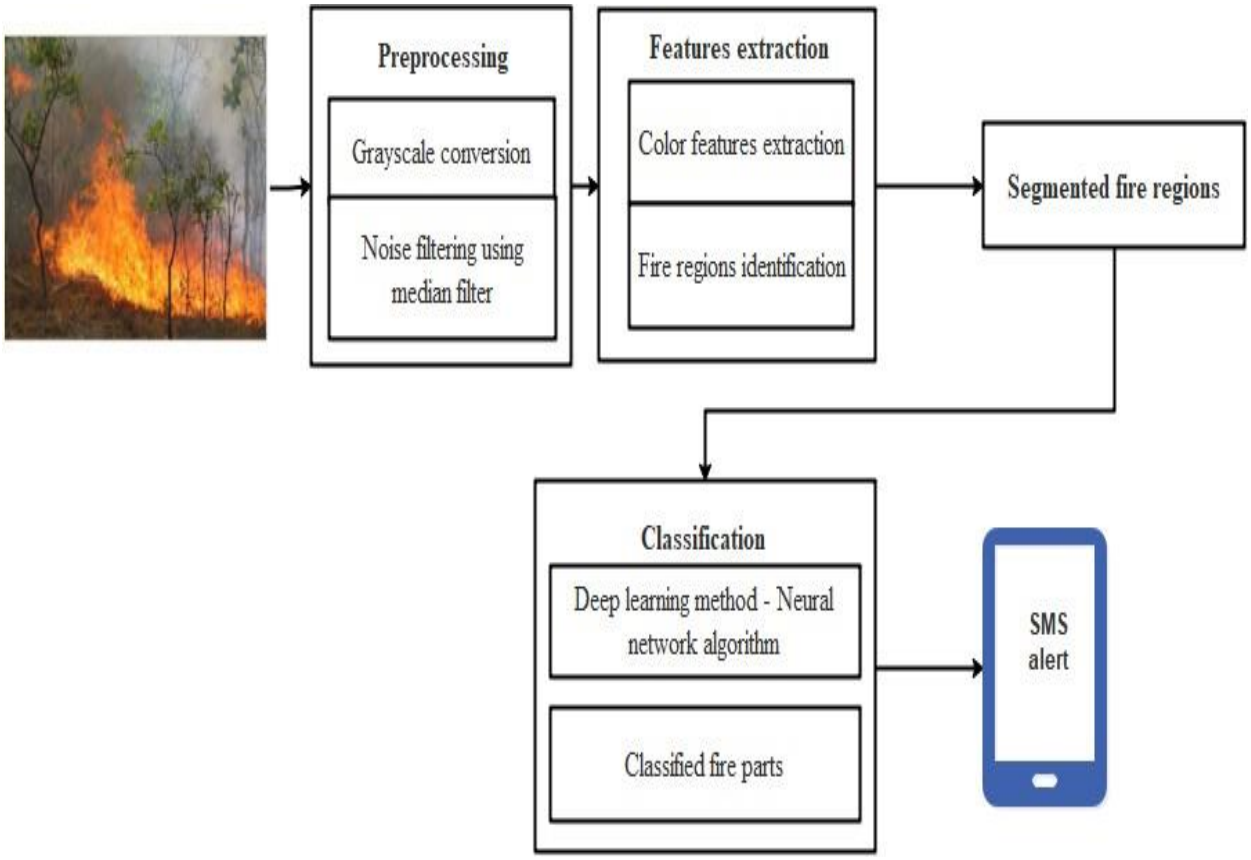


Fig2:Proposed Framework

IMAGEACQUSITION

In this module, we can upload the image or videos which are captured from CCTVfootages in forest. If the input is video means, convert the videos into frames or if the input isimagesmeans, it can beanyformat or size

PREPROCESSING

In this module, convert the RGB image into gray scale and also implement medianfilteringalgorithm to remove thenoises in images

FEATURESEXTRACTION

In this module, extract the features related to color or shape features.Based on thesefeatures,wecan extract thefireregions from images.

CLASSIFICATION

Finally classify the image regions using deep learning algorithm. And then improvetheaccuracyinclassification

ALERTSYSTEM

Inthismodule,sendalerttotheauthorityintermsofSMSatthetimeoffiredetection.
Itcan beuseful toprovideearlierdetection.

4. ALGORITHM

The Convolution Neural Network(CNN) is an algorithm in deep learning especiallyused in video processing and image processing. It is similar to neurons in human brain such thatevery layer is sequentially with the next layer. It have five different layers with filters. The inputlayer is used to process the input, max pooling layer is used to set the condition for fire, fullyconnected layer is used to match the given input image with the set of trained images and outputlayer is used to process the output and shows output in the screen. Here max pooling layer andfully connected layer are known as hidden layers because the process behind these layers are notvisible. It uses feed forward technique. The process of extraction is that first the input image isfeed into the system and a part of the input image is taken as pixel and it extracts the edges andpasstothenextlayerandthesameprocesscontinuesforupcominglayersandfinallythelastpixelismatched withthetrained imageusingfullyconnectedlayer andgivesthefinal output.

WhereLearningrateasrate,numberofmaximumiterationasmaxIter,minimumerrorasminErr,training batches as trainBatch, batch size respectively as batchSize;According to a1 and a5;computea2, a3,a4, x1, x2.
Randomly generate the weights $\theta$of the CNN;cnnModel=InitCNNModel(θ,[n1–5]);
Iter=0;error =+inf;
whileerr>minErranditer<maxIterdoerr=0;
for batch = 1 to BATCHEStraining
do[$\nabla\theta J(\theta)$,$J(\theta)$]=cnnModel_train(TrainData,TrainLabel),and θshouldbeupdated;
error =error+mean($J(\theta)$);
endforerror=error/trainBatch;Iter++;
endwhile
Saveparameters $\theta$of theCNN.

5. RESULT

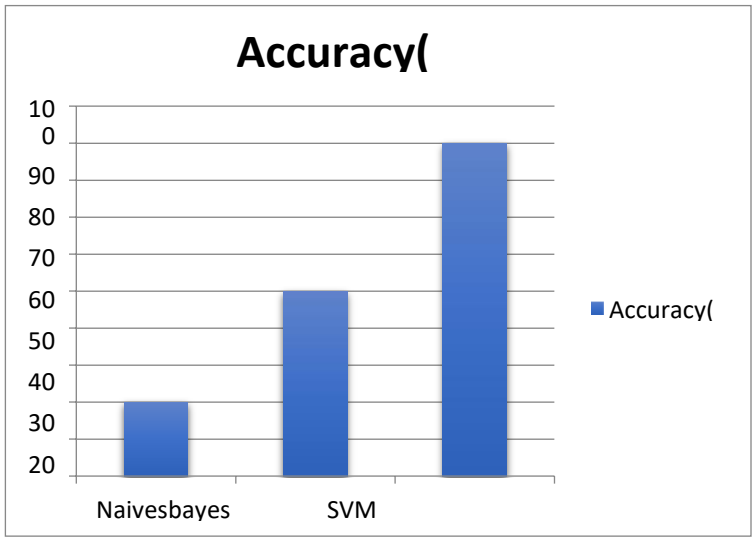
Theaccuracyis calculated from,

$$\frac{\text{no.oftruepositives+no.oftruenegatives}}{\text{no.oftruepositives+no.oftruenegatives+no.offalsepositives+no.offlasenegatives}} *100$$

Table1: AccuarcyTable

Algorithm	Accuracy(%)
Naivesbayes	20
SVM	50
CNN	90

Graph1: AccuracyGraph



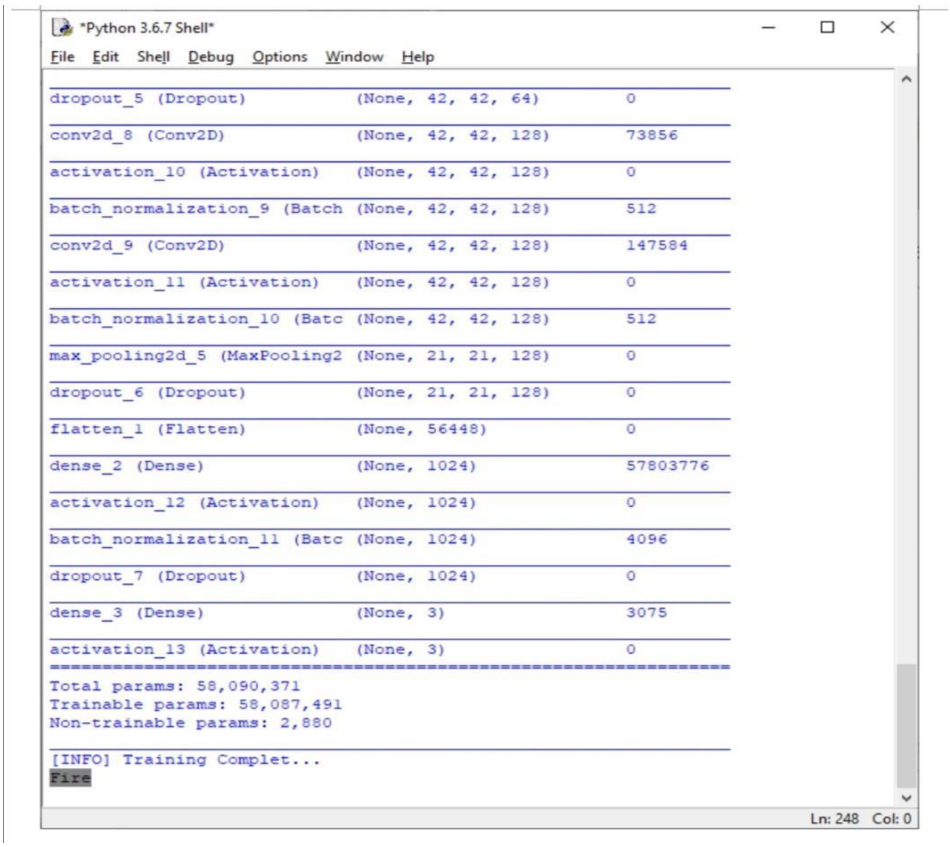


Fig3:Result

6. CONCLUSION

Thesystemwhichwepresentedinthispaperistheeasiestwayof identifyingforestfire.The natural resources and our lives are more important than anything else. This can be achievedby deep learning method as described in the above passage. So that it becomes an easy way topreventdestructionduetoforestfire.Wecancontrolitearlystagebeforespreadingtoalargearea.The proposed method has high accuracy rate and highly efficient when compared with existingmethods.

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