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System For Fire Management

Noundru Ganesh
PG scholar, Department of MCA, CDNR collage, Bhimavaram, Andhra Pradesh.
A.Naga Raju
(Assistant Professor), Master of Computer Applications, DNR collage, Bhimavaram, Andhra Pradesh.

ABSTRACT
Detection of forest fire should be quick and accurate as forests are the important sources to lead a vital life on earth. Detection of fire can be extremely difficult using existing methods of smoke sensors installed and they are slow and cost inefficient, so in order to avoid large scale fires, detection from visual scenes is required. In this work detection of fire in an image is done by extracting features using Deep learning algorithm and with those features as input to machine learning algorithm, a model is build with the help of different machine learning algorithms like Random Forest, Support Vector Machine, XGBoost and K-Means Clustering. Using these algorithms the data sets are classified into fire and non fire images to build the model and the test data of the data set is provided as input for getting the validation accuracy of the model. Then comparison is done among machine learning algorithms to find which algorithm provides more accuracy. To test the accuracy of the fire presence classification evaluation metrics are used in the model and find that accuracy of CNN-RF and CNN-XGBOOST are 98.53% which is greater than accuracy of CNN-SVM 97.06%.

INTRODUCTION

Forest fires are a ubiquitous and vital component of the Earth's system and it is a year-round worldwide phenomenon that happens each month. According to the current estimate of the annual worldwide area burned is around 420 Mha, which is more than the area of India. Grasslands and savannas account are the areas most affected by forest fires. People start over 90% of forest fires, and flash of lightning is to blame for most of the leftover ignitions. Humans may suffer severe effects from forest fires, directly through fatalities and community devastation or indirectly through smoke and ash inhalation.

Early fire prediction and identification are crucial to limit damage and reduce firefighting efforts. Millions are spent annually on fire management efforts to reduce or stop forest fires [3]. Therefore, it is essential to comprehend forest fires and their triggers and to improve forest fire prediction in several vital areas of forest fire management.

Two main measures are to be taken to prevent forest fires. The first is forest fire incidence prediction, which essentially forecasts the forest fire eruption likelihood earlier in its early ignition by modeling the relationship between the fire risk and significant factors, for example, fuel content or weather conditions. The second measure is forest fire detection, which involves identifying and locating existing active fires. The primary goal is to offer precise localization and a fire alarm early, before the fire spreads over a vast region and becomes uncontrollable.

Although fire activity can be measured on various scales (centimeters to kilometers, seconds to millennia), it does face some limitations. For instance, combustion and fire formerly are physicochemical processes that may be effectively signified at relatively fine scales in mechanistic models [4]. Nevertheless, the capacity to resolve important physical processes and availability of input data and the quality frequently constrain such models [5]. Furthermore, due to restraints associated with present processing capacity, it is impossible to use physical models to influence research and fire management at bigger and longer scales that are occasionally required in near real-time. Thus, forest fire management and science strongly rely on creating empirical and statistical models. For meso-, synoptic-, strategic-, and global-scale phenomena [6], the value of which is contingent on their capacity to capture the frequently complicated and nonlinear interactions between variables of interest, in addition to data availability, including data quality

LITERATURE SURVEY

Fire-Net: A Deep Learning Framework for Active Forest Fire Detection

Forest conservation is crucial for the maintenance of a healthy and thriving ecosystem. The field of remote sensing (RS) has been integral with the wide adoption of computer vision and sensor technologies for forest land observation. One critical area of interest is the detection of active forest fires. A forest fire, which occurs naturally or manually induced, can quickly sweep through vast amounts of land, leaving behind unfathomable damage and loss of lives. Automatic detection of active forest fires (and burning biomass) is hence an important area to pursue to avoid unwanted catastrophes.

Title: Improving Nocturnal Fire Detection With the VIIRS Day–Night Band

Year: 2016

Author: Thomas N. Polivka, Jun Wang, Luke T. Ellison, Edward J. Hyer, and Charles M. Ichoku

The basis method for this is that pixels with visible light emission and relatively pronounced BT4 signatures are likely to be fires (or volcanoes in some cases). Initially, FILDA and AFARP begin nearly the same by screening out invalid pixels such as clouds and bad data, although FILDA does not exclude water pixels. An added step for FILDA is also filtering out pixels with a solar zenith angle less than 100◦, fully removing all twilight areas and thus focusing on the fire detection at night only. Afterward, the overlap correction is applied, and the DNB is collocated with the M-bands.

Title: Efficient Deep CNN-Based Fire Detection and Localization in Video Surveillance Applications

Year: 2018

Author: Khan Muhammad, Student Member, IEEE, Jamil Ahmad , Student Member, IEEE, Zhihan Lv , Member, IEEE, Paolo Bellavista , Senior Member, IEEE, Po Yang , Member, IEEE, and Sung Wook Baik , Member, IEEE

The embedded processing capabilities of smart cameras have given rise to intelligent CCTV surveillance systems. Various abnormal events such as accidents, medical emergencies, and fires can be detected using these smart cameras. Of these, fire is the most dangerous abnormal event, as failing to control it at an early stage can result in huge disasters, leading to human, ecological and economic losses. Inspired by the great potential of CNNs, we propose a lightweight CNN based on the SqueezeNet architecture for fire detection in CCTV surveillance networks. Our approach can both localize fire and identify the object under surveillance.

Title: Spatio-Temporal Flame Modeling and Dynamic Texture Analysis for Automatic Video-Based Fire Detection

Year: 2013

Author: Kosmas Dimitropoulos, Panagiotis Barmpoutis and Nikos Grammalidis

We proposed an algorithm for real time videobased flame detection. By modeling both the behavior of the fire using various spatio-temporal features and the temporal evolution of the pixels' intensities in a candidate image block through dynamic texture analysis, we showed that we can have high detection rates, while reducing the false alarms caused by fire-colored moving objects. The use of spatiotemporal consistency energy increases the robustness of the algorithm by exploiting prior knowledge about the possible existence of fire in neighboring blocks from the current and previous video frames. Experimental results with thirty seven videos containing actual fire and moving fire colored objects showed that the proposed algorithm outperforms existing flame detection algorithms.

EXISTING SYSTEM

Forest fire detection images are based on fire images and non-fire images. It detects the fire accrued area in the forest. Forest fire detection in a particular area is tough to detect. The existing system detects the low level accuracy of performance based on fire occurred in the forest. The existing system doesn't effectively classify and detect the fire in area of the forest.

DISADVANTAGES

- No comparison is made between the accuracies of several algorithm
- The overall classification accuracy was found to be the same irrespective of the kernel types.
- Occurrence of errors are more in single Feed Forward Neural Network with large no. of hidden neurons
- Processing building the model requires fast and efficient processors which is cost consuming

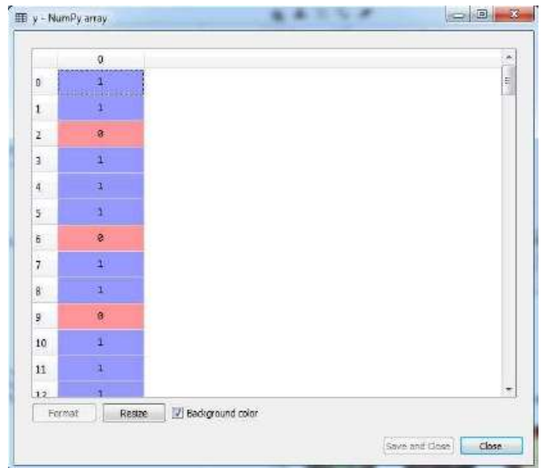
PROPOSED SYSTEM

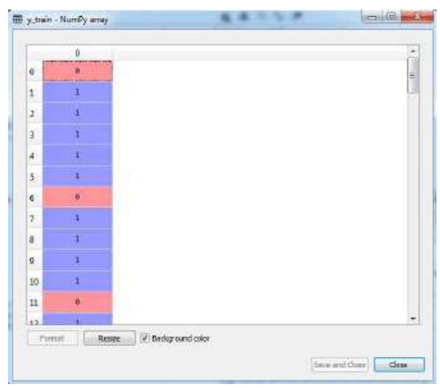
The proposed model is introduced to overcome all the disadvantages that arise in the existing system. This system will increase the accuracy of the deep neural network results by classifying the forest fire image dataset using Deep learning algorithm. It enhances the performance of the overall classification results. In preprocessing method we are doing segmentation process to identify the fire accrued area. Detecting the forest fire from segmented images is to find the accuracy more reliable.

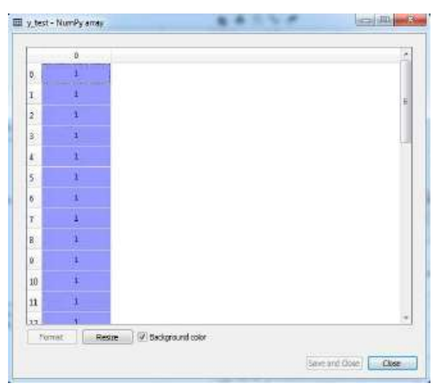
ADVANTAGES

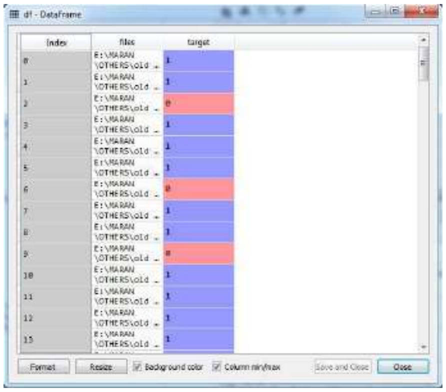
- High performance.
- Segmentation process is easy to identify fire in the forest.
- Convolutional Neural Network is used to find the accuracy more reliable.

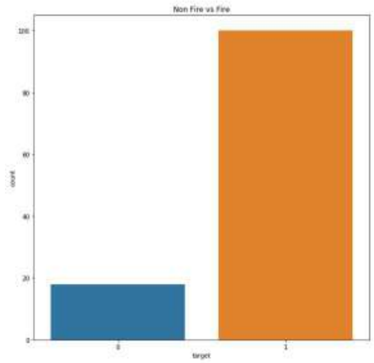
SCREEN SHOTS

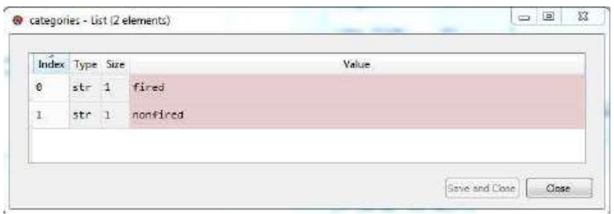






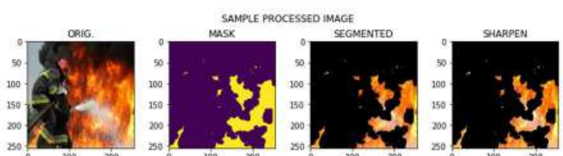


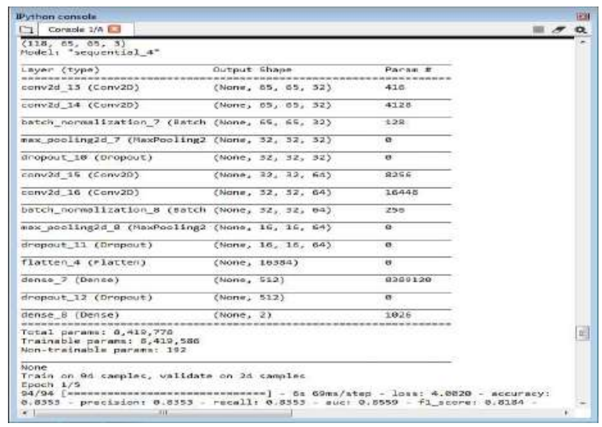


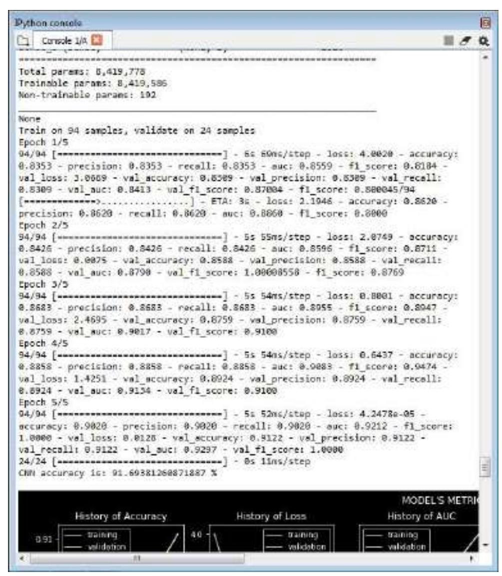


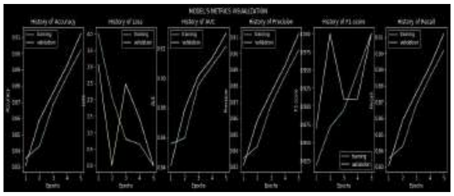

```
Number of images with fire : 100
Number of images with nonfire : 18
2
2it [00:00, 666.61it/s]
fired -> 100
nonfired -> 18
```

SAMPLE IMAGES

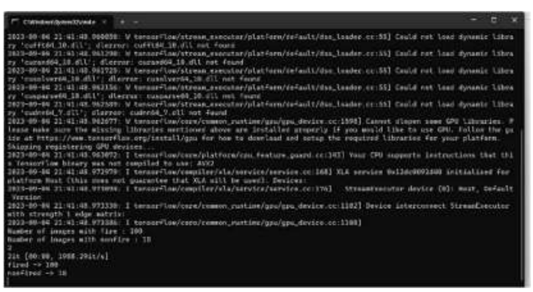








Output of the project



CONCLUSION

In **Convolutional Neural Network Long Short Term Memory (CNN)** used for the improvement of satellite image-based forest fire detection methods is proposed. The ability to merge information has been shown to measure both the computational effects and the spatial magnitude of the forest fire detection images. The importance of using satellite image properties, unique types of advance research, and other Commonly used techniques are advised to define the progressive development of satellite image analysis. Test results show that the proposed model works well in terms of accuracy of fire detection; it gives a low false-positive rate in large locations. This model outlines various studies of satellite image classification techniques and procedures. The improved system can be further developed by using natural-scale expansion calculation investigations.

References

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