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Developing an Integrated Computer Vision Image Processing Technique to raise an Early Alarm for Fire Detection

Ariz Abbas Naqvi

Department of Liberal Arts, Aligarh Muslim University, Aligarh, India

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ABSTRACT

In Computer Vision and image classification task, convolutional neural networks (CNNs) have demonstrated high performance. Their use in fire detection systems will make detection much more accurate, reducing the number of fire disasters and their ecological and social effects. However, implementation in real-world surveillance networks of CNN-based fire detection systems poses the greatest risk due to their high inference memory and computational requirements. An original, energy-efficient, and computationally efficient design is presented in this paper.

Squeeze Net-inspired CNN architecture for fire detection, localization, and semantic comprehension of the fire scene. The experimental results show that our proposed solution achieves accuracies comparable to those of other more complex models, primarily due to its increased depth, despite its low computational requirements. Because it doesn't have any dense, fully connected layers and uses smaller convolutional kernels, its computational requirements are reduced.

This paper also shows how fire detection efficiency and accuracy can be traded off by taking into account the particulars of the problem at hand and the variety of fire data.

INTRODUCTION

The rate of forest fire reports has increased annually due to human causes and the dry climate. Numerous detection methods have been extensively studied to be put into practice to avoid a terrible fire disaster. Due to their low cost and simple installation, sensors are used in most traditional methods [1–3]. These systems can't be used outside because fire materials and the environment can affect the flame's energy and the burning process, which could lead to false alarms. Since closed-circuit television (CCTV) surveillance systems are now available in many public places and can assist in capturing fire scenes, the visual-based approach of image or video processing is more reliable for detecting fire. The combination of fire's static and dynamic properties, like color information and texture, motion orientation, etc., have been the primary focus of research into various methods for detecting fire in colour video scenes. A high rate of false alarms is caused by the fact that colour-based detection methods primarily rely on selected threshold values, which need to be improved by removing the dynamic characteristics of fire from a video sequence. However, those systems are still not practical in large-scale, difficult-to-reach areas like remote and wild forests, where the system's configuration and upkeep are challenging.

METHODOLOGY

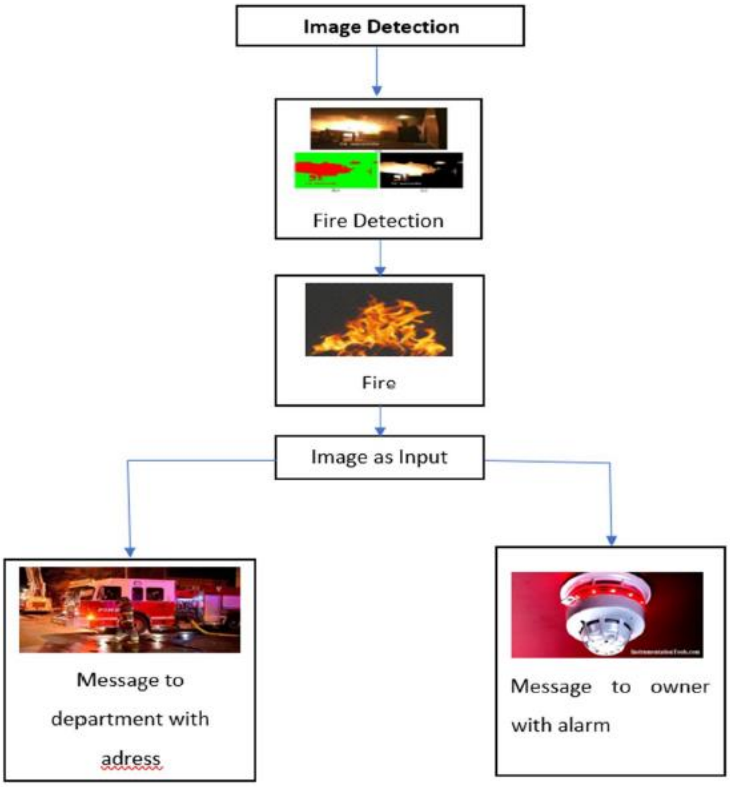
1) Method: Pre-processing Although geometric transformations of images, such as rotation, scaling, and translation, are classified as pre-processing methods here due to their similarity to image resizing, converting images to grayscale, and image augmentation, the objective of pre-processing is an enhancement of the image data that eliminates unintentional distortions or enhances some important image features for subsequent processing.

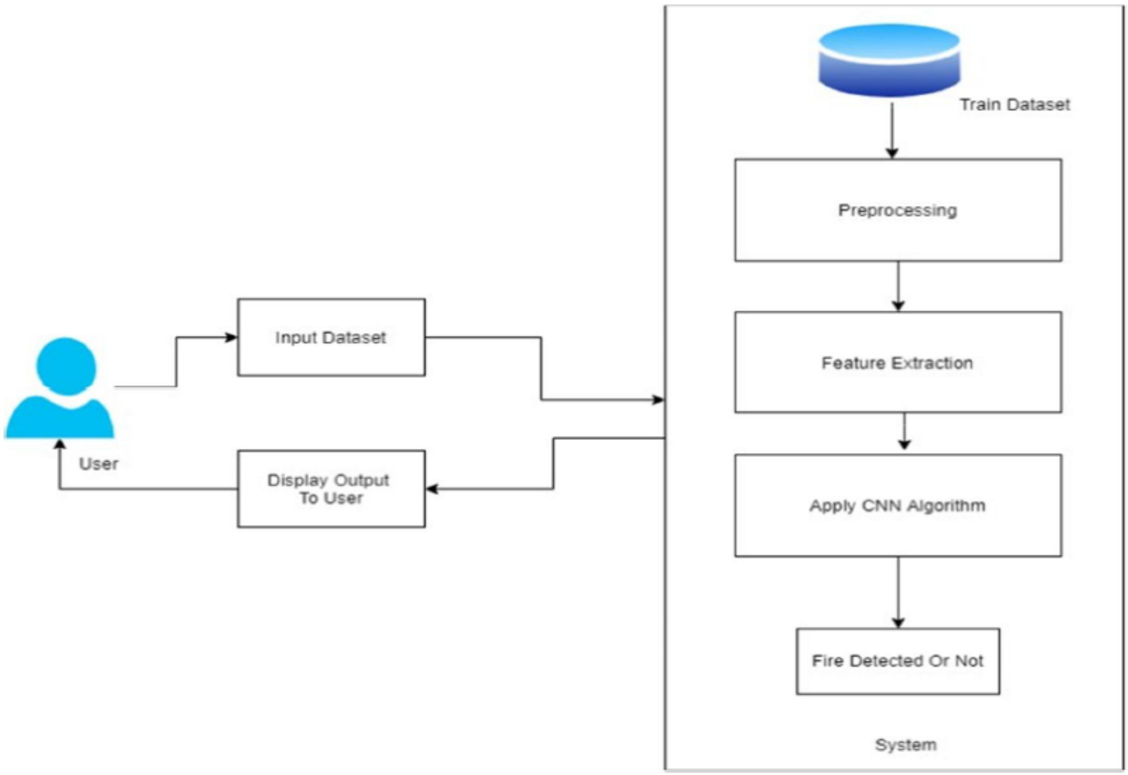
2) Detection of Images: The proposed fire pixel classification algorithm is detailed in this section. The proposed algorithm's flow chart is depicted in the figure. Due to its simplicity and effectiveness, the rule-based colour model method has been used. YCbCr and the RGB colour space are used for this. Seven criteria have been established to determine whether a pixel is a fire. We classify a pixel as belonging to the fire class if it complies with these seven requirements.

3) Extraction of Features: The process of converting raw data into numerical features that can be processed while preserving the information in the original data set is referred to as feature extraction. It produces superior results compared to applying machine learning directly to the raw data.

4) Detection of Fire: We took two consecutive images from video frames. After employing two fundamental techniques, edge detection and colour detection, we determine the probable area of the fire pixel. Next, we compare the RGB value of the corresponding pixel between frames 1 and 2. If the values differ, the motion detector will display motion and provide the operator with the resulting output.

5) Execution flow: When the module detects a fire, those images are passed to the module as input, and when the input matches the output, multithreading is used; One thread is set to output the message "Fire Detected......Fire Detected and beep signal with sound" to the owner and the address "Emergency...Emergency and Address (Shanti Niwas near JSPM College, Narhe, Pune)" to the fire department.





System Architecture

SYSTEM IMPLEMENTATION

A. Convolutional Neural Network (CNN)

1) In deep learning, a class of deep neural networks known as convolutional neural networks (CNNs) are used to analyse visual imagery. Convolution is the special method used in this. ConvNet, on the other hand, does not involve matrix multiplications when we think of neural networks.

2) There are four stages:

a) Convo 2D

b) Max Pooling

c) Flatten

d) CNNs with a fully connected network are used for image classification and recognition due to their high accuracy.

A huge dataset of videos of forest fires in various scene conditions has been used to investigate an aerial-based forest fire detection method. CNN employs a hierarchical model, building a network in the shape of a funnel before producing a fully connected layer in which all neurons are connected, and the output is processed.

CONCLUSION

The chromatic and motion features of a forest fire are extracted and corrected using the rule to identify the fire area to improve the detection rate. Second, smoke is extracted using our proposed algorithm to overcome the dense smoke nearly covering the fire. Our framework's robustness in aerial forest fire surveillance is demonstrated by its high detection accuracy and low false alarm rate.

REFERENCES

1. A. AAAlkhatib, (2013), Smart and Low Cost Technique for Forest Fire Detection using Wireless Sensor Network, *Int. J. Comput. Appl.*, vol. 81, no. 11, pp. 12–18.
2. J. Zhang, W. Li, Z. Yin, S. Liu, and X. Guo, (2009), Forest fire detection system based on wireless sensor network, *4th IEEE Conf. Ind. Electron. Appl. ICIEA 2009*, pp. 520– 523.
3. A. A. A. Alkhatib, (2014), A review on forest fire detection techniques, *Int. J. Distrib. Sens. Netw.*, vol. 2014, no. March, 2014.
4. P. Skorput, S. Mandzuka, and H. Vojvodic, (2016), The use of Unmanned Aerial Vehicles for forest fire monitoring, in *2016 International Symposium ELMAR*, pp. 93–96.
5. F. Afghah, A. Razi, J. Chakareski, and J. Ashdown, (2019), Wildfire Monitoring in Remote Areas using Autonomous Unmanned Aerial Vehicles, *IEEE INFOCOM WKSHPS: MiSARN 2019: Mission-Oriented Wireless Sensor, UAV and Robot Networking*
6. Hanh Dang-Ngoc and Hieu Nguyen-Trung, (2019), Evaluation of Forest Fire Detection Model using Video captured by UAVs, presented at the 2019 *19th International Symposium on Communications and Information Technologies (ISCIT)*, pp. 513–518.
7. C. Kao and S. Chang, (2003), An Intelligent Real-Time Fire-Detection Method Based on Video Processing, *IEEE 37th Annu. 2003 Int. Carnahan Conf. On Security Technol. 2003* Proc., 2003.
8. C. E. Premal and S. S. Vinsley, (2014), Image Processing Based Forest Fire Detection using

YCbCr Colour Model, *Int. Conf. Circuit Power Comput. Technol. ICCPCT*, vol. 2, pp. 87–95.

9. C. Ha, U. Hwang, G. Jeon, J. Cho, and J. Jeong, (2012), Vision-based fire detection algorithm using optical flow, *Proc. - 2012 6th Int. Conf. Complex Intell. Software Intensive Syst. CISIS 2012*, pp. 526–530.
10. K. Poobalan and S. Liew, (2105), Fire Detection Algorithm Using Image Processing Techniques, *Proceeding 3rd Int. Conf. Artif. Intell. Comput. Sci.*, no. December, pp. 12– 13.