International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

EFFICIENT DEEP CNN-BASED FIRE DETECTION AND LOCALIZATION IN VIDEO SURVEILLANCE APPLICATIONS

Suthari Uma Maheshwari[1], M.Pooja[2], M.Naipunya[3] ,Ms Veena Kumari[4]
Department of Computer Science and Engineering, Stanley College of Engineering and Technology for Women, Telangana, India

Abstract.

Convolutional neural networks (CNN) have yielded state-of-the-art performance in image classification and other computer vision tasks. Their application in fire detection systems will substantially improve detection accuracy, which will eventually minimize fire disasters and reduce the ecological and social ramifications. However, the major concern with CNN-based fire detection systems is their implementation in real-world surveillance networks, due to their high memory and computational requirements for inference. In this work, we propose energy-friendly, and computationally efficient CNN architecture, inspired by the Squeeze Net architecture for fire detection, localization, and semantic understanding of the scene of the fire. It uses smaller convolutional kernels and contains no dense, fully connected layers, which helps keep the computational requirements to a minimum. Despite its low computational needs, the experimental results demonstrate that our proposed solution achieves accuracies that are comparable to other, more complex models, mainly due to its increased depth. Moreover, the paper shows how a trade-off can be reached between fire detection accuracy and efficiency, by considering the specific characteristics of the problem of interest and the variety of fire data. In this work, financially savvy fire discovery CNN engineering is proposed for observation recordings. To adjust the productivity and precision, the model is tweaked thinking about the idea of the objective issue and fire information. Fire dataset is used and deep learning algorithm named CNN is used for predicting the fired and non-fired image. If it is fired, an alert message is sent to Gmail for four Departments, performance of the proposed system is analyzed in terms of accuracy, precision, recall, F-measure, sensitivity and specificity.

Keywords: Convolutional Neural Networks, Deep Learning, Fire Detection, Fire Localization, Fire Disaster, Image Classification, Surveillance Networks, Squeeze Net Architecture, Efficiency, Training and Testing Sets.

1. Introduction

1.1 About Project

Using smart surveillance systems, various abnormal events such as road accidents, fires, medical emergencies, etc., can be detected at early stages, and the appropriate authority can be autonomously informed. A fire is an abnormal event which can cause significant damage to lives and property within a very short time.

The main causes of such disasters include human error or a system failure which results in severe loss of human life and other damage. According to an annual disaster report, fire disasters alone affected 494 000 people and resulted in a loss of $3.1 billion in 2015. In order to avoid such disasters, it is important to detect fires at early stages utilizing smart surveillance cameras.

Two broad categories of approach can be identified for fire detection: 1) traditional fire alarms and 2) vision sensor-assisted fire detection. Traditional fire alarm systems are based on sensors that require close proximity for activation, such 55 as infrared and optical sensors. To overcome these limitations, numerous vision sensor-based methods have been explored by researchers in this field these have the advantages of less human 7 interference, faster response, affordable cost, and larger surveillance coverage.

1.2 Objectives of the Project

The main objectives of this process are,

- To detect fire using deep CNN algorithm.
- To send alert message to Gmail once fire is detected.
- To implement the deep learning algorithm.
- To enhance the performance analysis.
- To Design and Implement Fire Accident Protection System.
- Their main function is to quickly identify a developing fire and alert building occupants and emergency response personnel before extensive damage occurs.

This project mainly concentrates on the fire detection using convolutional neural network to provide proper and accurate information about the actual incident happen when we feed the neural network. Some of the things which we focus mostly is on the detection of the fire using layers of the CNN, an alert email to different protection managements like Hospital, Fire Station, Disaster Management and Police Station from the effected organization, call alert is also sent.

1.3 Scope of the Project

- Our approach can both localize fire and identify the object under surveillance.
- Furthermore, our 552 proposed system balances the accuracy of fire detection and the size of the model using fine-tuning and the Squeeze Net Architecture, respectively.
- We conduct experiments using two benchmark datasets and verify the feasibility of the proposed 666 system for deployment in real CCTV networks. It is based on Future Real time Detection CCTV Camera Wise.
- This model can be trained with more videos so that the model and validation accuracy increases. This can lead to a great number of correct detections.

- The model can also be trained to predict how severe the fire is and helps to plan the appropriate path. This model can also be extended to find the various fire accidents which helps in control of the disasters.

2. Literature Survey

2.1 Existing System

There are many researches previously experimented on the fire detection using different categories and considerations of the fire like HSB color, Greyscale, comparison between different CNN algorithms like GoogLeNet, SqueezeNet, AlxeNet etc. In which accuracy, precision etc., are compared at various segments and a final CNN model is decided to use to detect the fire at various circumstances. CNN is only considered in traditional works without considering additional layers. Accuracy is ineffective which important parameter that requires high focus.

Only occurrence and non-occurrence of fire is detected, while, alert message is not considered. Types of detectors like fire alarms, fire detectors, smoke detectors etc., are used to detect fire but are not that accurate. All these detectors are just used to detect whether the fire is currently existing or not beyond that no action is taken automatically, everything should be done manually and takes lot of time to get implemented which causes lot of damage by the time.

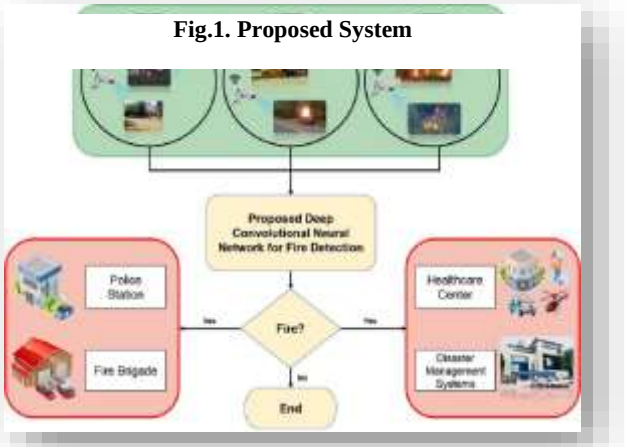
2.2 Proposed System

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

Fire detection using hand-crafted features is a tedious task, due to the time-consuming method of features engineering. It is particularly challenging to detect a fire at an early stage in scenes with changing lighting conditions, shadows, and fire-like objects; conventional low-level feature-based methods generate a high rate of false alarms and have low detection accuracy. To overcome these issues, we investigate deep learning models for possible fire detection at early stages during surveillance. Taking into consideration the accuracy, the embedded processing capabilities of smart cameras, and the number of false alarms, we examine various deep CNNs for the target problem.

In proposed system, we have Image and video dataset considered in the proposed work. The proposed structure and approve its appropriateness for fire location in video reconnaissance framework. Fire dataset is used and deep learning algorithm named CNN is used for predicting the fired and non-fired image. If it is fired, an alert mail is sent to Gmail for Four Departments, call alert is also sent.

Fig.1. Proposed System



International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

3. Proposed Architecture

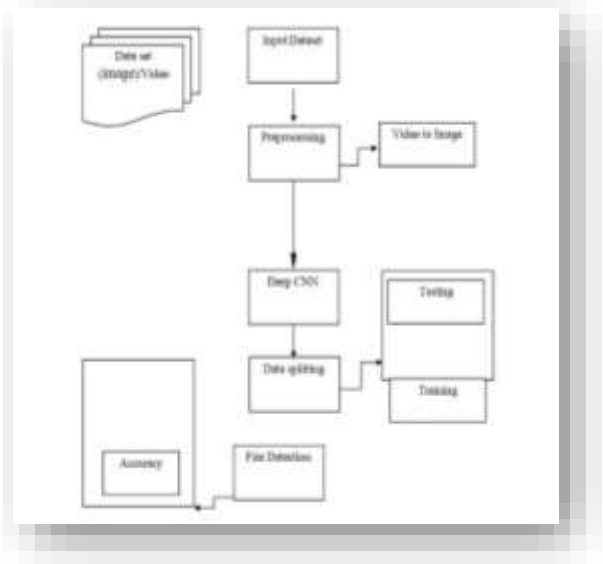


Fig.2. System Architecture

3.1 Flow Diagram

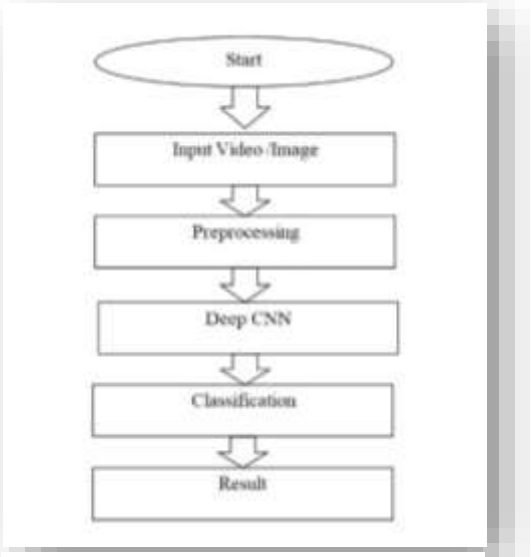


Fig.3 Flow Diagram

4. Implementation

4.1 Algorithm

4.1.1 SQUEEZNET CNN MODEL

SqueezeNet is the name of a deep neural network for computer vision that was released in 2016. SqueezeNet

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

was developed by researchers at Deep Scale, University of California, Berkeley, and Standford University. In designing SqueezeNet, the authors' goal was to create a smaller neural network with fewer parameters that can more easily fit into computer memory and can more easily be transmitted over a computer network.

4.1.2Fire Module

- A Fire module is comprised of**: a squeeze convolution layer,feeding into an expand layer that has a mix of 1×1 and 3×3 convolution filters.**
- There are three tunable dimensions (hyperparameters) in a Fire module: s1×1, e1×1, and e3×3.
- s1×1: The number of 1×1 in squeeze layer.
- e1×1 and e3×3: The number of 1×1 and 3×3 in expand layer.

4.1.3 SqueezeNet Architecture

4.2 Code

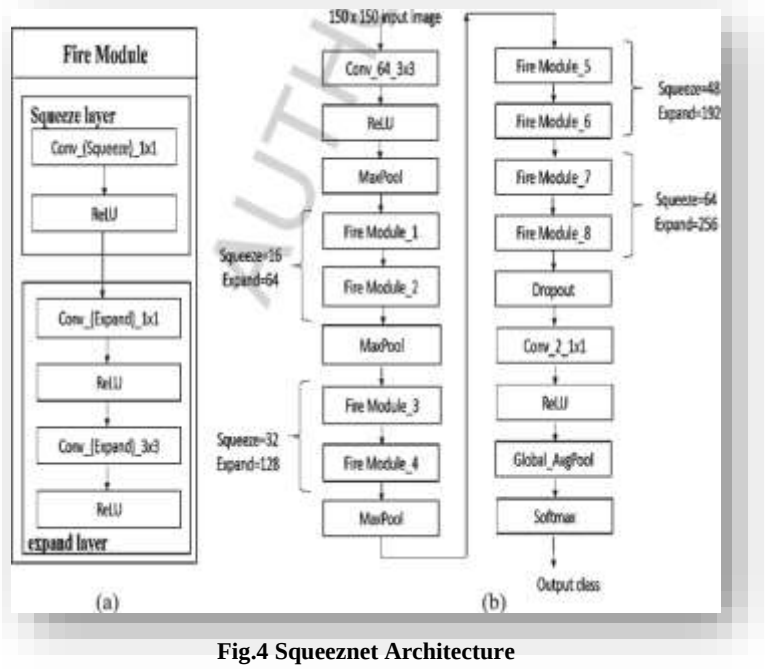


Fig.4 Squeeznet Architecture

Implementation

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

Python 3.7. Python is broadly utilized universally and is a high-level programming language. It was primarily introduced for prominence on code, and its language structure enables software engineers to express ideas in fewer lines of code.

Anaconda3 5.3.1. Anaconda is a free and open-source appropriation of the Python and R programming for logical figuring like information science, AI applications, large-scale information preparing, prescient investigation, and so forth. Anaconda accompanies in excess of 1,400 packages just as the Conda package.

5. Result

Fig .5 Fire Image

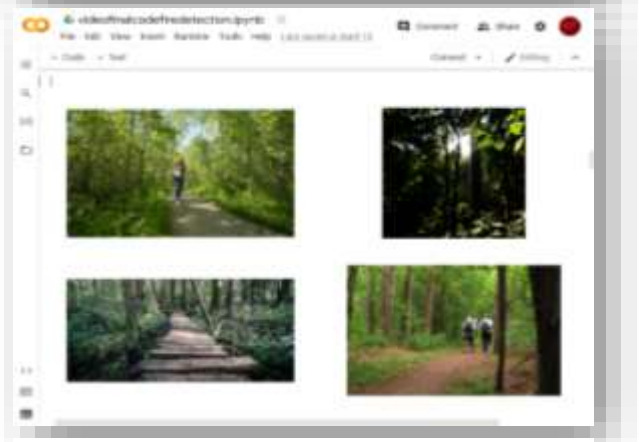


Fig.6 Non-Fire Images

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

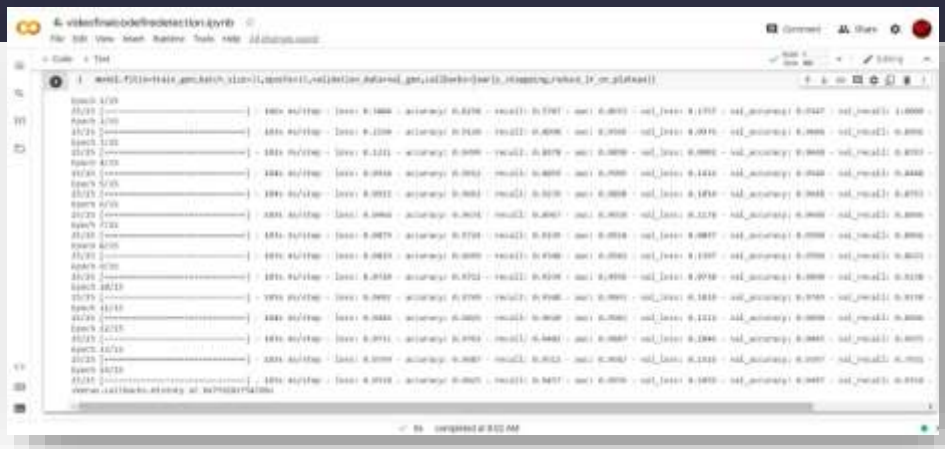


Fig.7 Model Fitting in Fire Module

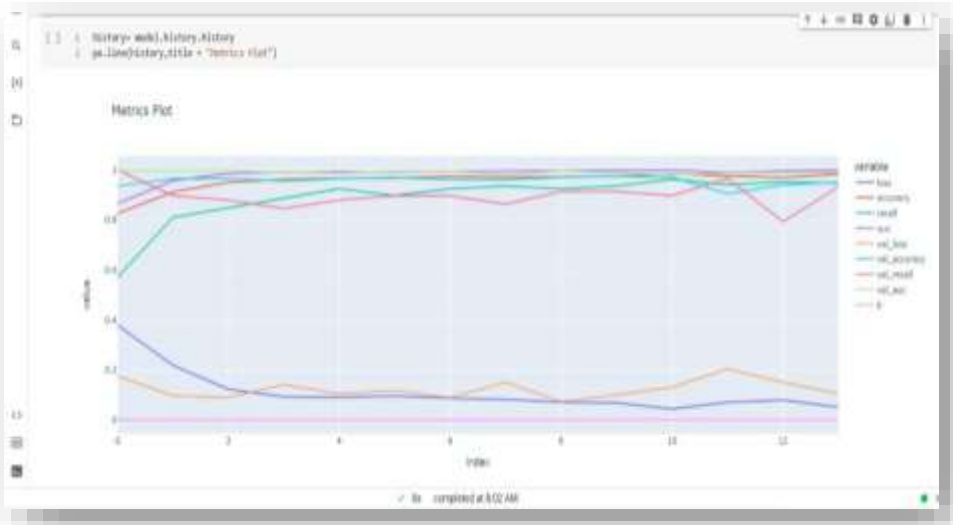


Fig.8 Metric plot for Squeezenet Model

Fig.9 Alarm Alert

International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

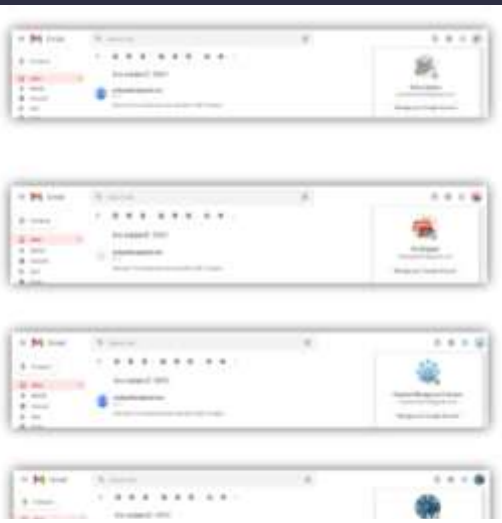


Fig.10 Gmail Alerts

Fig.11 Call Alert

6. Conclusion

To identify and localize objects, there exist many methods with a trade-off in speed performance and accuracy of result. Fire is one of the risky occasions which can bring about extraordinary misfortunes on the off chance that it isn't controlled on schedule. This requires the significance of growing early fire location frameworks. Hence, in this examination article, we propose a practical fire location CNN engineering for reconnaissance recordings. Fire is one of the dangerous events which can result in great losses if it is not controlled on time. This necessitates the importance of developing early fire detection systems. Therefore, in this research article, we propose a cost-effective fire detection CNN architecture for surveillance videos. The model is inspired from GoogleNet architecture and is fine-tuned with special focus on computational complexity and detection accuracy. Through experiments, it is proved that the proposed architecture dominates the existing hand-crafted features based fire detection methods as well as the AlexNet architecture based fire detection method. Although, this work improved

the flame detection accuracy, yet the number of false alarms is still high and further research is required in this direction. This will enable the video surveillance systems to handle more complex situations in real-world.

7. Future Scope

- Our approach can both localize fire and identify the object under surveillance. Furthermore, our 662 proposed system balances the accuracy of fire detection and the size of the model using fine-tuning and the Squeeze Net architecture.
- We conduct experiments using two benchmark datasets and verify the feasibility of the proposed 666System for deployment in real CCTV networks.
- It is based on Future real time Detection CCTV Camera.
- This model can be trained with more videos so that the model and validation accuracy increases. This can lead to a great number of correct detections.

- The model can also be train to predict how severe the fire is and helps to plan the appropriate path. It can also be extended to find various fire accidents which helps in control of disasters.

1. *8. References*

2. [1] K. Muhammad, R. Hamza, J. Ahmad, J. Lloret, H. H. G. Wang, and S. W. Baik, "Secure Surveillance Framework for IoT systems using Probabilistic Image Encryption," IEEE Transactions on Industrial Informatics, vol. PP, pp. 1-1,2018.
3. [2] K. Muhammad, J. Ahmad, and S. W. Baik, "Early Fire Detection using Convolutional
4. Neural Networks during Surveillance for Effective Disaster Management,"
5. Neurocomputing, 2017/12/29/2017.
6. [3] J. Choi and J. Y. Choi, "An Integrated Framework for 24- hours Fire Detection," in
7. European Conference on Computer Vision, 2016, pp.463-479.
8. [4] H. J. G. Haynes, "Fire Loss in the United States During 2015,"http://www.nfpa.org/,2016.
9. [5] C.-B. Liu and N. Ahuja, "Vision based fire detection," in Pattern Recognition, 2004.
10. ICPR 2004. Proceedings of the 17th International Conference on, 2004, pp. 134-137.
11. [6] B. U. Töreyin, Y. Dedeoglu, U. Güdükbay, and A. E. Cetin, "Computer vision based
12. method for real-time fire and flame detection," Pattern recognition letters, vol. 27, pp.
13. [7] N. Dalal and B. Triggs, “Histograms of Oriented Gradients for Human Detection,” IEEE CVPR, vol. 1, pp. 886–893, 2005, doi: 10.1109/CVPR.2005.177.
14. [8]C. Szegedy, W. Liu, Y. Jia, and P. Sermanet, “Going Deeper with Convolutions,”

15. Kishor Kumar Reddy, Anisha P R and Narasimha Prasad L V, "A Novel Approach for Detecting the Bone Cancer and its Stage based on Mean Intensity and Tumor Size", International Conference on Recent Researchers in Applied Computer Science, 2015.
16. Kishor Kumar Reddy, Anisha P R and Narasimha Prasad L V, "Detection Of Thunderstorms Using Data Mining and Image Processing", IEEE International Conference on the Applications of the Digital Information and Web technologies, Chennai, India, February 2014, pp. 226-231.
17. Narasimha Prasad, Kishor Kumar Reddy and Ramya Tulasi Nirjogi, "A Novel Approach for Seismic Signal Magnitude Detection Using Haar Wavelet", IEEE International Conference on Intelligent Systems, Modelling and Simulation, Malaysia, January 2014, pp. 324-329.
18. Sainath P, Kishor Kumar Reddy C, Osman Ali Syed and Venugopal S, "Improving The Efficiency Of Software Development Through Software Augmentation Isochronism Model", IEEE International Conference on Green Computing, Communication and Conservation of Energy, Chennai, India, December 2013, pp. 877-882.
19. Narasimha Prasad L V, Shankar Murthy P, Kishor Kumar Reddy C, "Analysis of Magnitude for Earthquake Detection using Primary Waves and Secondary Waves," IEEE ICHCI Conference, Chennai, India, August 2013.
20. Kishor Kumar Reddy C, Anisha P R, Narasimha Prasad L V, "Remote Sensing Of Snow Wrap Using Clustering And Wavelet Transform," IEEE ICHCI Conference, Chennai, India, August 2013.
21. Narasimha Prasad, Kishor Kumar Reddy and Ramya Tulasi Nirjogi, "A Novel Approach for Seismic Signal Magnitude Detection Using Haar Wavelet", International Journal of Simulation Systems, Science & Technology, 2014.
22. (http://ijssst.info/Vol-15/No-3/data/3857a324.pdf)