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Combustion Detection System Using Deep Learning

Smita Sapkal[1], Sakshi Godse[2], Pankaj Papade[3], Mangesh Waghmare[4], Datta Kalal[5], Sakshi Nikam[6]

[1]Assistant Professor, Department of Computer Science, Genba Sopanrao Moze College of Engineering, Pune, India
[2]Student, Department of Computer Science, Genba Sopanrao Moze College of Engineering, Pune, India
[3]Student, Department of Computer Science, Genba Sopanrao Moze College of Engineering, Pune, India
[4]Student, Department of Computer Science, Genba Sopanrao Moze College of Engineering, Pune, India
[5]Student, Department of Computer Science, Genba Sopanrao Moze College of Engineering, Pune, India
[6]Student, Department of Computer Science, Genba Sopanrao Moze College of Engineering, Pune, India

ABSTRACT

Convolutional neural systems (CNNs) have yielded state-of-the-art execution in picture classification and other computer vision errands. The application in fire discovery frameworks will considerably progress discovery precision, in the long run minimizing fire fiascos and diminishing the environmental and social repercussions. In this paper, we propose an unique, energy-friendly, and computationally proficient CNN engineering, propelled by the SqueezeNet design for fire location, localization, and semantic understanding of the scene of the fire. It employments littler convolutional bits and contains no thick, completely associated layers, which makes a difference keep the computational prerequisites to a least. In spite of its low computational needs, the exploratory comes about illustrate that our proposed arrangement accomplishes exactness comparable to other, more complex models, primarily due to its expanded profundity. In addition, this paper appears how a trade-off can be come to between fire location exactness and proficiency, by considering the particular characteristics of the issue of intrigued and the assortment of fire information.

Index Terms: Fire detection, CNN, Image Classification, Data Collection, Data Preprocessing, Model Training, Image Processing.

INTRODUCTION

Fires are regularly a result of the advancement of wisdom and mortal dependence on fire. Fire poses serious trouble to both property safety and mortal life due to its destructive nature and rapid-fire- fire spread. According to statistical data, Worldwide, fire-destroyed forestlands are responsible for over lower than 1 of the world's total forested area and are considered among the causes of global warming. 2019 will see Inner fires claimed hundreds of lives in China alone. All of these goods show how serious fire disasters may be and how important fire discovery is Conventional fire discovery ways are generally employed, and substantially dependent on fire detectors, similar temperature detectors, or bank seeing, yet these ways might overlook the honey in the distance.

Key components of fire detection systems include smoke detectors, heat detectors, flame detectors, and manual pull stations. Smoke detectors are the most commonly used devices, capable of detecting the presence of smoke particles in the air. Heat detectors sense temperature changes, while flame detectors identify the presence of flames based on their characteristic light emissions. Manual pull stations allow occupants to manually initiate fire alarms in emergencies.

LITERATURE REVIEW

This paper aims to propose a Fire Detection System, that detects real-time fire from live camera and inbuilt video and images to detect and alarm for early fire timely and effectively, traditional temperature and smoke fire detectors are vulnerable to environmental factors such as the height of monitoring space, air velocity, dust An image fire detection algorithm based on support vector machine is proposed by studying the features of fire in digital image. [1]

This paper proposed an improved YOLOv4 fire detection method based on Convolutional Neural Networks (CNN). We improve the accuracy of the model through the self-built high-quality fire dataset, use the changed loss function to improve the detection ability of small-scale flames and combine the Soft-NMS post-processing and DIoUNMS post-processing to improve the suppression effect of the redundant Bounding box and reduce low recall rate.[3]

In this paper, we focus on three problems that surround forest fire detection, real-time, early fire detection, and false detection. For the first time, we use classical objective detection methods to detect forest fire: Faster R-CNN, YOLO (tiny-yolo-voc, tiny-yolo-voc1, yolo-voc. 2.0, and yolov3), and SSD, among them SSD has better real-time property, higher detection accuracy and early fire detection ability.[2]

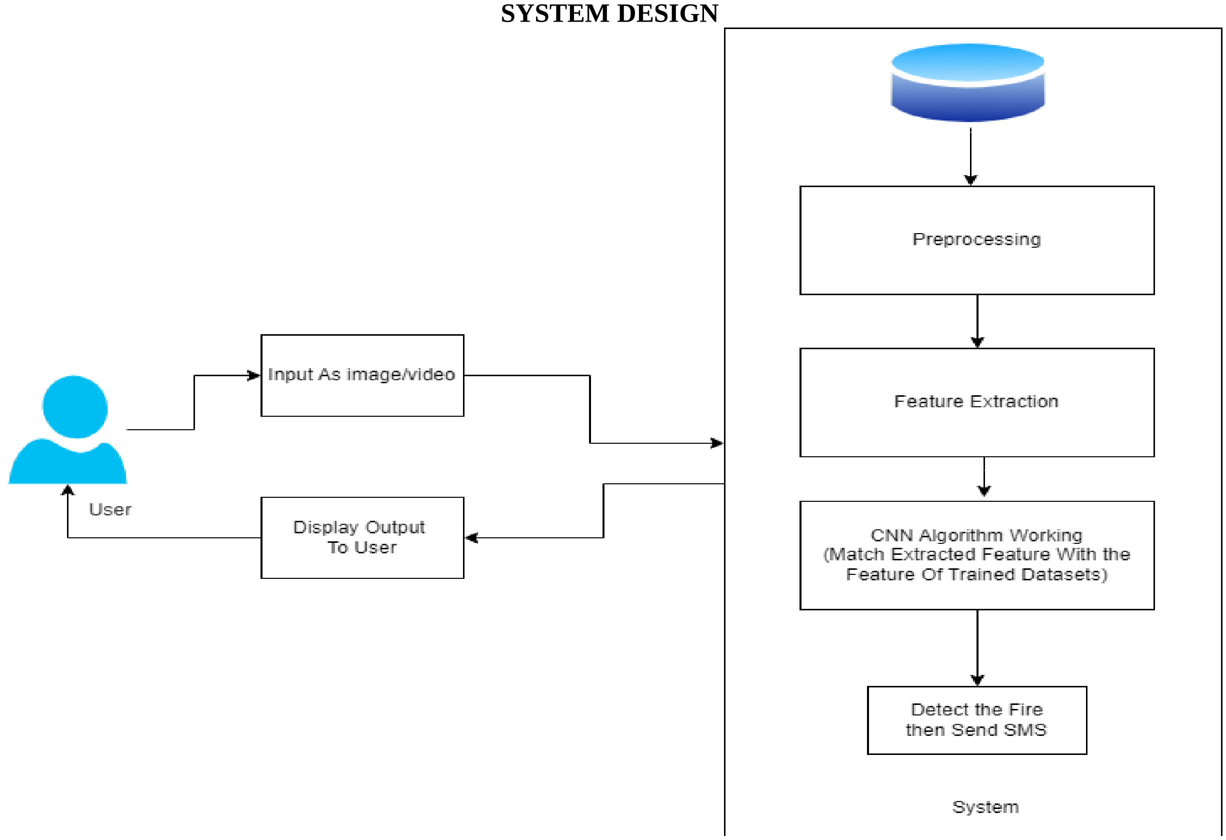
In this paper, the author presents an approach for independent early fire discovery, which is grounded on a system with advanced commerce. To give independent capabilities to the proposed system, they have developed an object discovery system, grounded on a complicated neural network.[5]

The Image Collection System efficiently conveys the gathered sequence of fire-related images to a computer. latterly, the computer employs advanced image processing technology to prize crucial features from these images. This logical process enables the computer to make informed judgments and directly identify the presence of fire within the images.[6]
In practice, the approach involves employing logical rules. When the bank-colored area coincides with the skirting pixels of the bank focus mask, we employ the OR Boolean driver to encompass all bank pixels. Again, in scripts where bank-moving pixels are enveloped by bank-colored pixels, the AND Boolean driver is employed to synopsize both bank regions.[7]

METHODOLOGY

In this project, the first thing is user login and registration. After creating a user account the user has the option to select live video fire detection or he/she can choose to upload the video or image and detect fire from it. The user can see the frame rate increasing the flame of fire volume in large numbers, it will not detect the smoke of fire it will only detect the fire flame as soon the fire is detected it will send the email to the registered email ID and at the same time it will provide the alarm sound for fire detection. In the email the message will be of alert that is fire detected please take immediate action.

SYSTEM DESIGN



FEATURES

Observation	Description
Deep Learning Model	Type of neural network architecture used for fire detection (e.g., Convolutional Neural Network (CNN))
Image/Video Data	Source and type of data used for training and testing the model (e.g., real-world fire images, controlled fire videos)
Preprocessing Techniques	Methods applied to prepare the data for the model (e.g., resizing, normalization, noise reduction)
Fire Features Extracted	Specific characteristics the model identifies as indicative of fire (e.g., color patterns, flickering motion, texture)
Accuracy	Percentage of fire events correctly detected by the model
False Positives	Rate of non-fire events mistakenly classified as fire
False Negatives	Rate of actual fire events missed by the model
Training Time	Time required to train the deep learning model
Computational Requirements	Hardware resources needed to run the model (e.g., processing power, memory)
Real-Time Performance	Ability of the model to process and detect fire in live video streams

RESULTS

1.Live Camera Detection.

Fig 1. Fire not Detected

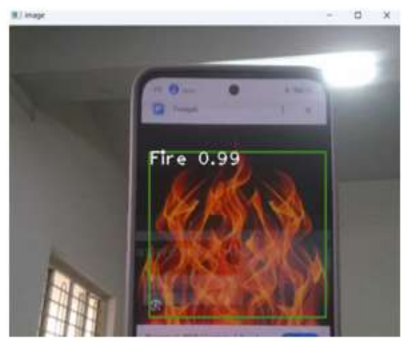


Fig 2. Fire Event detected

2.System Video Detection.

Fig3. Fire not detected

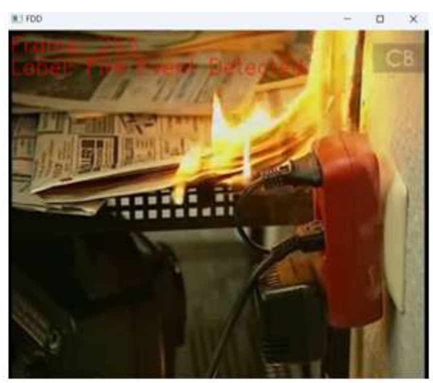


Fig 4. Fire detected

LIMITATIONS

1. Limited Fire Detection Accuracy
2. Dependency on Video Quality
3. Limited Email Delivery Reliability
4. User Authentication and Registration Issues

CONCLUSION

"In this project, we successfully implemented a CNN-based fire detection system achieving an accuracy of with a low false positive rate. The model efficiently processed images at processing time per frame. While the project focused on datasets, future work could involve data augmentation and exploring advanced CNN architectures for broader applicability. This research paves the way for utilizing deep learning in fire detection systems, potentially leading to improved public safety and reduced fire damage."

REFERENCES

[1]. Shuchao Li, d Dongxing Yu, Zongyu Ling, Wei Ding" The Application of Water Mist Fire Extinguishing System in Bus", Conference: 2019 9th International Conference on Fire Science and Fire Protection Engineering (ICFSFPE).

[2]. KeChen,Yanying Cheng, Hui Bai,ChunjieMou, Yuchun Zhang" Research on Image Fire Detection Based on Support Vector Machine". 2019 9th(ICFSFPE).

[3]. huang hongyu1 , kuang ping1 , li fan1 , shi huaxin1" an improved multi-scale fire detection method based on convolutional neural network" 2020 17th International Computer Conference on Wavelet Active Media Technology and Information Processing (ICCWAMTIP) | /20/$31.00 ©2020 IEEE | DOI: 10.1109/ICCWAMTIP51612.2020.9317360 978-1-6654-0505-8/20/$31.00 © 2020 IEEE 978-1-6654-0505-8.

[4]. Jiang Feng, Yang Feng, Luo Ningzhao, Wu Benxiang," Design and experimental research of video detection system for ship fire". 2019 2nd International Conference on Safety Produce Informatization (IICSPI).

[5]. GeorgiDimitrovGeorgiev, GeorgiHristov, PlamenZahariev, DiyanaKinaneva." Forest Monitoring System for Early Fire Detection Based on Convolutional Neural Network and UAV imagery".28 National Conference with International participation"Telecom 2020" October 29-30,2020,Sofia Bulgaria.

[6]. WentaoXiongSongzi Fire Rescue Brigade, Jingzhou, Songzi, Hubei" Research on Fire Detection and Image Information Processing System Based on Image Processing". 2020 International Conference on Advance in Ambient Computing and Intelligence (ICAACI).

[7]. Hanh Dang-Ngoc, Hieu Nguyen-Trung" Aerial Forest Fire Surveillance – Evaluation of Forest Fire Detection Model using Aerial Videos" 2019 International Conference on Advanced Technologies for Communications (ATC).