International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161
Available at http://inpressco.com/category/ijcet

Research Article

Design and evolution of fire detection system with accuracy enhancement

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Received 10 Nov 2020, Accepted 10 Dec 2020, Available online 01 Feb 2021, **Special Issue-8 (Feb 2021)**

Abstract

The video surveillance machine has come to be a essential element within the security and safety of towns. The Video surveillance has become a important component within the towns, because clever monitoring cameras established with clever video analytics techniques can display and pre-alert device by means of capturing bizarre interest together with fire occasions. The modern day international is completely beneath CCTV for make the various areas comfy. The video recorded is unable to find out hearth detection at early stage of hearth occasion. After event happen this video sequence is used to find out causes of an occasion/fire but trouble is after occasion passed off we're not able to keep loss by way of that event or twist of fate, so there's need to such gadget is able to assist us in early event detection and pre-alert generation gadget. Purpose behind these proposed paintings is to invent pre-alert technology machine without any hardware in addition to sensor. Accuracy of this proposed device approx. 85% or extra which is better than current machine.

Keywords: *Closed Circuit Television (CCTV), Intelligent Video Surveillance (IVS), Conventional Neural Network (CNN).*

Introduction

Fire alarms are essential due to the fact they are able to provide you with an early sign to fireplace occasions that would be saving plenty of lives. A fireplace alarm indicators may be very critical to make you alert when you are napping. The proposed paintings go to locate hearth throughout surveillance the usage of Convolution neural networks (CNNs). However via imposing hearth alert device is its miles very critical to get accurate alert so lowering fake fee of alarms. The accuracy at once influences on human lives. So it's far very vital venture of implementation in surveillance networks. Video surveillance device has become an important element in the protection and safety of modem cities. Recent years, an increasing number of video surveillance devices are deployed as the increasing needs on public security and clever city. Now a day's million tracking cameras were geared up for surveillance systems in throughout global. So we are going to enforce awareness on video surveillance by giving video contents containing early hearth occasions detection. We are going to overcome current drawbacks of submit research strategies of video surveillance systems through providing pre alert generation machine. Our work is based totally on system getting to know strategies for video evaluation with better overall performance and occasion detection with benefits of alert generation.

Objective and Scope

1. To introduce a of fire detection machine for surveillance films with the assist of conventional neural network (CNN).
2. To stumble on the hearth in a video collection this is captured via CCTV Web Cam.
3. To generate the pre-alarm when any fireplace event come across in gadget and store the loss from hearth.
4. Accuracy of this proposed machine approx.85-90% or more is higher than existing device i.e. 80%.
5. To avoid the false alarm and make powerful surveillance machine.

Motivation

The motive behind proposed work is to invent video content examination for fire recognition and alert generation. The main motive to implement fire recognition system is to provide real time fire detection framework to reduce loss due to fire events. The advantage of current implementation is to give highly accurate fire recognition system based on video contents reduces hardware and sensor costs.

Problem Statement

The contemporary international is absolutely under CCTV for make the various areas comfy. The video recorded is used to discover if fire (atypical pastime detection). After event came about these video series is used to discover reasons of an occasion/fireplace however trouble is after occasion happened we're not able to store loss by means of that event or accident, so there's need to such device is capable of assist us in early occasion detection and pre-alert generation device. Reason behind this proposed implementation is to invent pre-alert generation gadget without any hardware in addition to sensor. Accuracy of this proposed device approx.85-ninety% or greater is higher than existing system.

Literature Survey

Ying-li Tian et.al [1] introducing the increasing need for sophisticated surveillance systems and the move to a digital infrastructure has transformed surveillance into a large scale data analysis and management challenge. Smart surveillance systems use automatic image understanding techniques to extract information from the surveillance data. While the majority of the research and commercial systems have focused on the information extraction aspect of the challenge, very few systems have explored the use of extracted information in the search, retrieval, data management and investigation context. The IBM smart surveillance system (S3) is one of the few advanced surveillance systems which provides not only the capability to automatically monitor a scene but also the capability to manage the surveillance data, perform event based retrieval, receive real time event alerts thru standard web infrastructure and extract long term statistical patterns of activity. The IBM S3 is easily customized to fit the requirements of different applications by using an open-standards based architecture for surveillance.

Weihua Xu et. al. [2] introducing the measure of human activity video information is expanding quickly because of the development of interactive media information, which builds the issue of how to process the enormous number of human activity recordings efficiently. Along these lines, we devise a novel methodology for human activity closeness estimation in the distributed environment. The efficiency of human action similarity estimation depends on feature descriptors. Existing element descriptors, for example, Local Binary Pattern and Local Ternary Pattern can just separate surface data however can't acquire the item shape data. To determine this, we present another element descriptor, in particular Edge based Local Pattern descriptor (ELP). ELP can concentrate article shape data other than surface data and ELP can likewise manage power fluctuations. In addition, we investigate Apache Spark to perform include extraction in the disseminated condition. At long last, we present an observational adaptability assessment of the undertaking of extricating highlights from video datasets.

Shaoqing Ren et.al [3] introducing best in class object recognition systems rely upon area proposition calculations to speculate object areas. Advances like SPPnet and Fast R-CNN have diminished the running time of these discovery systems, uncovering area proposition calculation as a bottleneck. In this work, we present a Region Proposal Network (RPN) that offers full-picture Convolutional highlights with the recognition arrange, along these lines empowering almost without cost district recommendations. A RPN is a completely Convolutional arranges that at the same time predicts article limits and abjectness scores at each position. RPNs are prepared start to finish to create high quality district recommendations, which are utilized by Fast R-CNN for location. With a basic substituting streamlining, RPN and Fast R-CNN can be prepared to share Convolutional highlights.

Shin-Juh Chen [4] state that fire detection systems located in aircraft cargo compartments are currently based only on smoke detectors. They generate about 200 false alarms per year for U.S. registered aircraft. The number of false alarms is growing as more planes are outfitted with smoke detectors and air travel expands. Moreover, the survivability of an aircraft in a fire scenario depends on the early detection of the fire. A fire detection system is developed based on the simultaneous measurements of carbon monoxide, carbon dioxide, and smoke. The combination of the rates of rise of smoke and either carbon monoxide or carbon dioxide concentration provides a potential fire alarm algorithm to increase the reliability of aircraft smoke detectors, and to reduce the time to alarm. The fire detection system with the alarm algorithm detected fires that were not alarmed by smoke sensors, and alarmed in shorter times than smoke sensors operating alone.

Khan Muhammad et.al [5] paper proposes a secure surveillance framework for IOT systems by intelligent integration of video summarization and image encryption. Firstly, an efficient video summarization method is used to extract the informative frames using the processing capabilities of visual sensors. When an event is detected from key frames, an alert is sent to the concerned authority autonomously. As the final decision about an event mainly depends on the extracted key frames, their modification during transmission by attackers can result in severe losses. To tackle this issue, we propose a fast probabilistic and lightweight algorithm for the encryption of key frames prior to transmission, considering the memory and processing requirements of constrained devices which increase its suitability for IOT systems.

Qingjie Zhang et.al [6] proposed a deep learning method for forest fire detection. They train both a full image and fine grained patch fire classifier in a joined deep Convolutional neural networks (CNN). The fire detection is operated in a cascaded fashion, i.e. the full image is first tested by the global image-level classifier, if fire is detected, the fine grained patch classifier is followed to detect the precise location of fire patches. Our fire patch detector obtains 97% and 90% detection accuracy on training and testing datasets respectively. To facilitate the evaluation of various fire detectors in the community, we build a fire detection benchmark. According to our best knowledge, this is the first one with patch-level annotations.

Jeany Son et.al [7] proposed Quadruplet Convolutional Neural Networks (Quad-CNN) for multi-object following, which figure out how to partner object discoveries crosswise over edges utilizing quadruplet misfortunes. The proposed systems consider target appearances together with their transient adjacencies for information affiliation. In contrast to traditional positioning misfortunes, the quadruplet misfortune implements an extra imperative that makes transiently contiguous identifications more firmly situated than the ones with enormous transient holes. We likewise utilize a perform various tasks misfortune to mutually learn object affiliation and bouncing box relapse for better limitation. The entire system is prepared start to finish. For following, the objective affiliation is performed by mini-max mark engendering utilizing the measurement gained from the proposed system. We assess execution of our multi-object following calculation on open Witticism Challenge datasets, and accomplish extraordinary outcomes.

Tong Xiao et.al [8] states existing individual re-recognizable proof benchmarks and techniques mostly center around coordinating trimmed passerby pictures among inquiries and competitors. Be that as it may, it is unique from genuine situations where the explanations of passerby bouncing boxes are inaccessible and the objective individual should be looked from a display of entire scene pictures. To close the hole, we propose another profound learning structure for individual pursuit. Rather than separating it into two separate undertakings—walker location and individual re-recognizable proof, we together handle the two perspectives in a solitary convolutional neural system. An Online Instance Matching (OIM) misfortune capacity is proposed to prepare the system viably, which is adaptable to datasets with various characters. To approve our methodology, we gather and comment on an enormous scale benchmark dataset for individual hunt. It contains 18, 184 pictures, 8, 432 personalities, and 96, 143 walker bouncing boxes. Investigations demonstrate that our system beats other separate approaches, and the proposed OIM misfortune capacity merges a lot quicker and better than the ordinary Softmax.

Proposed Methodology

In a proposed system, we are proposing experiment on the fire detection and pre-alarm generation. The current work is totally depends on accuracy factor of video processing and correct alert generation over existing false alarm rate. In a proposed system, we are going to overcome existing drawbacks of fire alert systems and existing techniques of video surveillance systems by providing pre alert generation system. Our work is based on machine learning techniques for video analysis on fire video sequences with better accuracy over pre work and fire detection with advantages of alert generation.

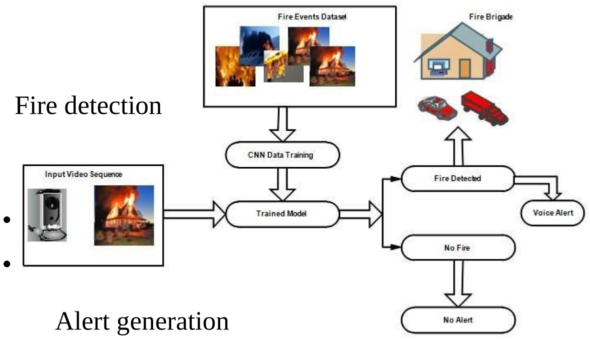


Fig.1 Block Diagram of Proposed System

A. Architecture

We are going to develop following modules:

The development of video processing solutions has become one of the most popular use cases for Convolution neural networks. A CNN can recognize emotions, gestures, speech, and handwriting, detect and classify objects, and detect and recognize actions in the video. In our project, we defined Fire detection as classifying fire and no fire based on a series of regions of interest (ROIs) for an fire sequence of images. However, there are many challenges in using CNNs for recognizing and detecting fire from the video. Recently, we worked on a project where the major goal was to detect a fire frame in a video stream. While working on this project, we are facing a few major challenges:

1. Finding a balance between accuracy and performance
2. Working with real time fire video sequences. Nowadays, detecting fire from video remains one of the most challenging tasks in terms of both accuracy and performance. For detecting fire in real time video, it's crucial to deal with spatial features of images (what object recognition methods do) as well as temporal ones.

B. Algorithms

Convolutional Neural Network (CNN):-
In proposed work we are using CNN which takes video frames as a input. After getting frames from video it will processed using image processing techniques for feature evaluation. We extract different features from those images regardless of their events in it consists. By using a series of mathematical functions we are

going to identify the fire events. Every layer in CNN has capability to find out weights of images by using matrix evaluations which converts input to output with valuable functions. Layers of CNN used to identify fire events from extracted frames and give prediction by preserving high accuracy and less time. The expression of pooling is to constantly decrease the dimensionality to limits the number of factors and calculation in the network. This limits the time of training and maintains over fitting problem. The max Pooling extracts out the largest pixel value out of a feature. While pooling average is calculated f or the average pixel value that has to be evaluated.

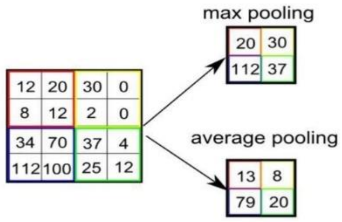


Fig. Pooling Layer

Step 1- Input fire and no fire video's
Step 2- Frame extraction from video
Step 3- Image processing by using open-cv
Step 4- Feature Extraction from images
Step 5- Model generation
Step 6- Fire event recognition
Step 7- Alert generation in the form of voice

Four main layer working approach of CNN explained below:

a) Convolutional Layer

We are going to extract different features of frames like pixel weight matrix calculations by using feature kernels. Perform mathematical convolutions on frames, where every function uses a unique filter. This outcome will be in different feature maps. Atthe end, we will collects all of these feature maps and draft them as the destination output matrix of the convolution layer.

Pooling

c) Flattening

Generally here we put the pooled feature into a single column as a sample input for further layer (transform the 3D matrix data to 1D matrix data)

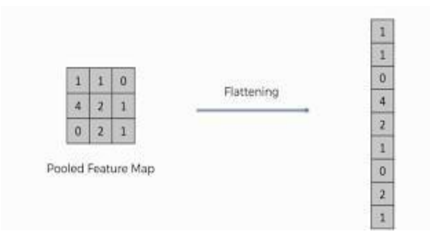


Fig. Flattening Matrix

d) Fully Connection

A fully connected layer has full co nnections of Neurons to all nodes in the previous layer. The fusion of more neurons to evaluates accurately.

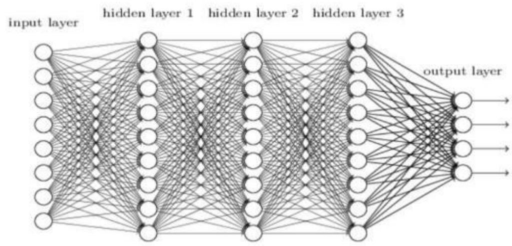


Fig. Fully Connected Layer

Mathematical Model

System Description:

- Mathematical Model:

Let us consider S as a system for Fire detection from video data.

S={F,I,O,e}

- INPUT: Identify the inputs F= f1, f2, f3 ....., fn— F as set of fire events dataset.
- I= i1, i2, i3 Sets of inputs fire videos
- O= o1, o2, o3 Set of outputs from the function sets,
- e = End of the program.

S1= I, F, O

- I = input video uploaded by the User, i.e. fire or no fire
- O = Output of voice alert
- F = Functions implemented to get the fire detection, i.e.

Classification in two main category fire and no fire.

Notation:- • U=users
- R=Classification result C1=Fire detected (R1)
- C2= No Fire detected (R2)

S={s, e, X, Y, Φ } Where,

1. s = Start of the program.
2. Log in to system.
3. Upload video and get result in the form of fire detected.
4. X = Input of the program. i.e.F1, f2
5. 5. Y = Output of the program i.e. C1,C2
6. e = End of the program.

Comparative Results

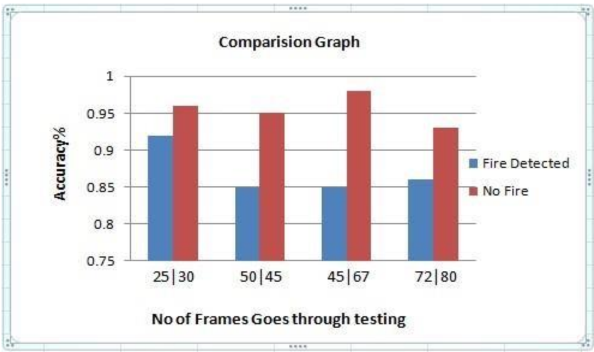
In our experimental setup, as shown in table 8.1, the total numbers of fire and no fire video frames were tested. These frames go through fire detection framework by following feature extraction using our image processing module. Then our trained model of fire detection get classifies the video into fire and no fire categories.

Table1 8.1: Classification of fire

Sr. No	Category	Number of Frames
1	Positive Frames	750
2	Negative Frames	250

Results

From above data, as shown in graph 9.1, the numbers of frames goes through test module some of found fire detected, some of found no fire.



Graph 9.1: Classification of fire videos

In our experimental setup, as shown in graph 9.1, the total numbers of frames were 414. These frames were then divided into Two subcategories; among which 25,50,45,72 found Fire detected and 30,45,67,80 found No Fire respectively We classified video data into fire and no fire categories based on accuracy factor which is our main motive.

Conclusion

We have proposed Fire detection and prevention systems based on video surveillance and achieved higher accuracy rate nearly 95%. We have implemented monitoring technique for saving cost of hardware. We solved existing problem by giving best result over post-event recognition by our pre-event recognition and alert generation work.

We are developed fire detection and alert generation system for saving losses due to fire events. All our implementation based on video sequences with promising solution by early fire detection and alert generation using machine learning approaches.

Future Scope

In this system, We analyzed fire detection using CNN and machine learning technologies and achieved high accuracy and generated alert in the form of voice. In future work we would work for real time video data with CCTV attachment.

Acknowledgment

This work is supported in Fire detection system of any state in India. Authors are thankful to Faculty of Engineering and Technology (FET),Savitribai Phule Pune University,Pune for providing the facility to carry out the research work.

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