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FIRE ACCIDENT DETECTION USING DEEP LEARNING

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ABSTRACT

From sprawling urbans to dense jungles, fire accidents create a significant threat to the planet. These might be prevented by Deploying fire detection systems, however the prohibitory value, false alarms, would like for dedicated infrastructure, and also the overall lack of strength of the current hardware and software-based detection systems have served as roadblocks during this direction. During this work, we have a tendency to endeavor to create a stride towards detection of fire in videos with the help of Deep learning. Deep learning is rising idea supported artificial neural networks and has achieved exceptional ends up in varied fields as well as computer vision. We have a tendency to arrange to overcome the shortcomings of the current systems and supply correct and precise system to sight fires as early as doable and capable of operating in varied environments thereby saving incalculable lives and resources.

Keywords: Fire Accidents, Fire Detection, Surveillance Video, Machine Learning, Deep Learning, Transfer Learning.

I. INTRODUCTION

Fire is one among the leading hazards endangering human life, the economy, and therefore the surroundings [1]. Because of the fast increase in fire accidents, each building or traveler vehicle for public transportation is provided with fire protection and fire bar systems. These systems consist primarily of point-type thermal and smoke detectors that require to be put in proximity of the fire; otherwise, they will simply fail while not detecting the fire. Additionally, these devices should be properly put in and positioned as they will be broken throughout the fire itself. Video-based fire detection is presently a customary technology because of image process, computer vision, and computer science. These systems have outstanding potential benefits over ancient ways, like a quick response and wide detection areas. Ancient smoke/fire sensors supported mensuration, thermal, or chemical detection will react inside many minutes, requiring an oversized quantity of fire/smoke to trigger AN alarm. Moreover, they can't offer info concerning fire location and fire size, and that they cannot work for outside scenes. The event of latest camera-based solutions improves the strength and responsibility of smoke and fire detection by filling the gap with previous systems. Cameras and television system (CCTV) systems area unit already put in for surveillance investigation functions in most human environments, like town streets, industry, public transportation. We have a tendency to aim to develop a classification model exploitation Deep learning and Transfer Learning to acknowledge fires in images/video frames, so making certain early detection and save manual work. Not like existing systems, this neither needs special infrastructure for setup like hardware-based solutions, nor will it want domain data and preventive computation for development.

II. METHODOLOGY

Method and analysis that is performed in your analysis work ought to be written during this section. an easy strategy to follow is to use keywords from your title in initial few sentences.

Existing System

Traditional smoke/fire sensors supported photometry, thermal, or chemical detection will react at intervals after several minutes, requiring an oversized quantity of fire/smoke to trigger alarm. Moreover, they cannot give data concerning fire location and fire size, and that they cannot work for outside scenes.

Disadvantages of Existing system

- Traditional opto-electronic fire detection systems have major disadvantages: demand of separate and infrequently redundant systems, fault-prone hardware systems, regular maintenance, false alarms and so on.
- Usage of sensors in hot, dirty industrial conditions is additionally insufferable. Thus, detection fires through surveillance investigation video stream are one in all the foremost possible, efficient resolution appropriate for replacement of existing systems while not the requirement for big infrastructure installation or investment.
- The existing video-based machine learning models trust heavily on domain information and have engineering to attain detection thus, to be updated to fulfill new threats.

Proposed System

- We aim to develop a classification model with the help of Deep learning and Transfer Learning to acknowledge fires in images/video frames, so thereby guaranteeing early detection and save manual work.
- Traditional Machine learning by the use of feature extraction yielded high accuracy and low false positive rate, nonetheless it needs large domain information i.e., regarding color model, color-space, patterns and motion vectors of flames.
- The ancient approach to feature engineering [4] is manual in nature. It involves handcrafting options incrementally with the help of domain information, a tedious, long, and erring method. The resultant model is depended on problem and won't perform well on new knowledge. Automatic feature engineering ([3][5]) improves upon this inefficient advancement by mechanically extracting helpful and substantive options from knowledge with a framework which will be applied to any problem, It not solely cuts down on the time spent, however creates options which will be taken and prevents knowledge outpouring. With transfer learning, rather than developing a model from scratch, we are able to begin from a pre-trained model with necessary fine-tunings. These models are often be imported directly from Keras. The usage of pre-trained models saves plenty of machine work, that otherwise, would need high finish GPU's. Inception V3, Inception-ResNet-V2 were found to be ideal algorithms for feature extraction as they showed promising results with high accuracy ([3]).

Benefits

Here we can detect fire through surveillance videos.

III. MODELING AND ANALYSIS

Now a days, computer vision and digital camera technologies are developing rapidly. Therefore, innovative fire detecting methods are proposed. The main use of deep learning is it can extract features automatically which improves the state-of-art in classifying image detection and object detection methods.

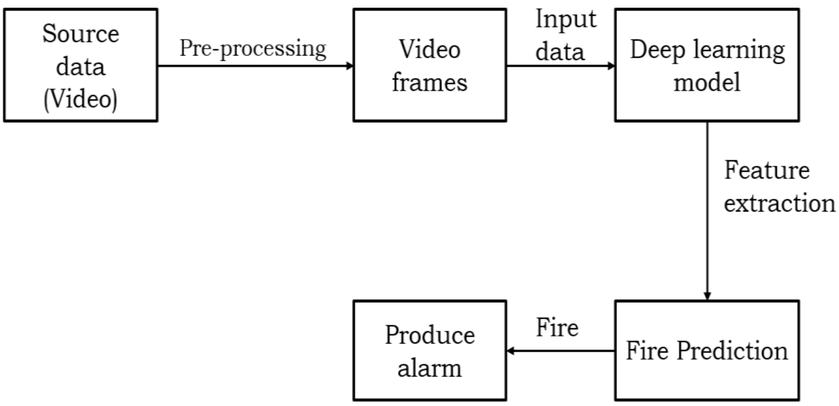

Figure 1: Architecture

In the first step, the source data that is in form of videos are split into frames. Then the frames are preprocessed and converted into specific format which can be used as input for already built models and used for feature extraction. The features which are returned by deep learning model are passed through a model which classifies and produces the results. The result will be either fire or non-fire.

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Algorithm

We use standard InceptionV3 model and customize it. A complex model is capable of learning the complex features from the images. Inception v3 is an image recognition model that has been shown to attain greater than 78.1% accuracy on the ImageNet dataset. The model itself is made up of symmetric and asymmetric building blocks, including convolutions, average pooling, max pooling, concatenations, dropouts, and fully connected layers. Batch normalization is used extensively throughout the model and applied to activation inputs. Loss is computed using SoftMax.

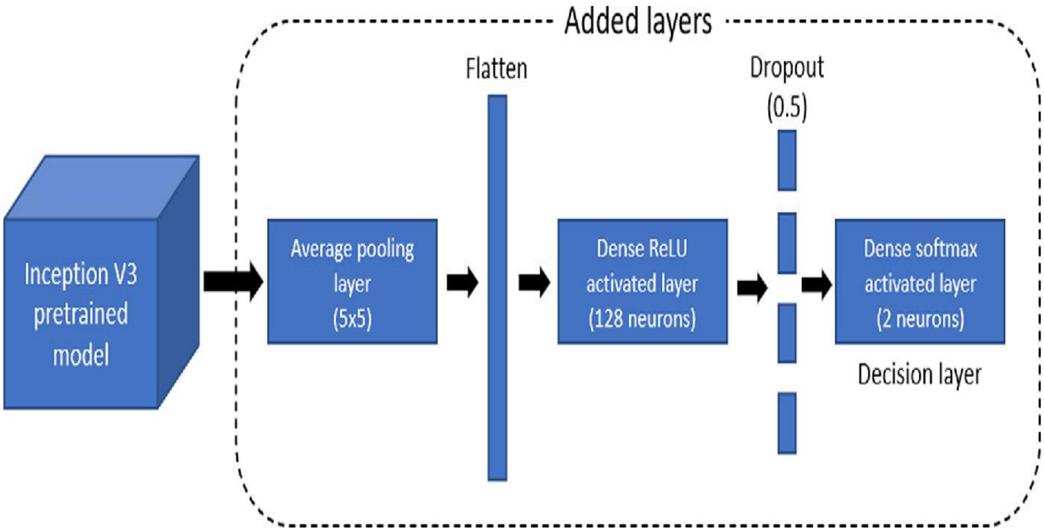

Figure 2: Model Flow chart

In this paper, Inceptionv3 model was used which is from Keras API. At the top of InceptionV3 model two layers are added. Then a global spatial average pooling layer was added and next 2 dense layers and 2 dropout layers was added. Dropout layer was added to reduce overfitting. At the end, SoftMax dense layer was added for 2 classes.

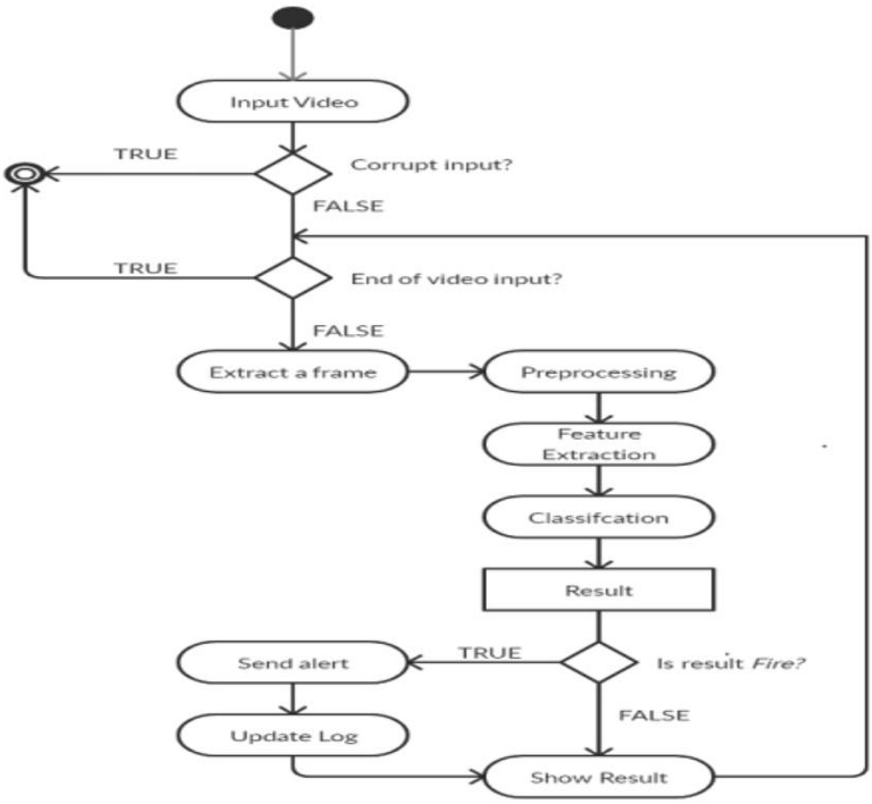

Figure 3: Activity Diagram

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3.1 Training model with data

The process of training model is divided into two parts

1. Data Collection and Pre-processing.
2. Building fire detection model by Transfer Learning.

In the first step, images were gathered for the problem statement. The dataset has 2 classes - fire and non-fire. The dataset is divided into train and test images. The dataset currently has 1000 fire images and 1000 that of non-fire sourced from google.

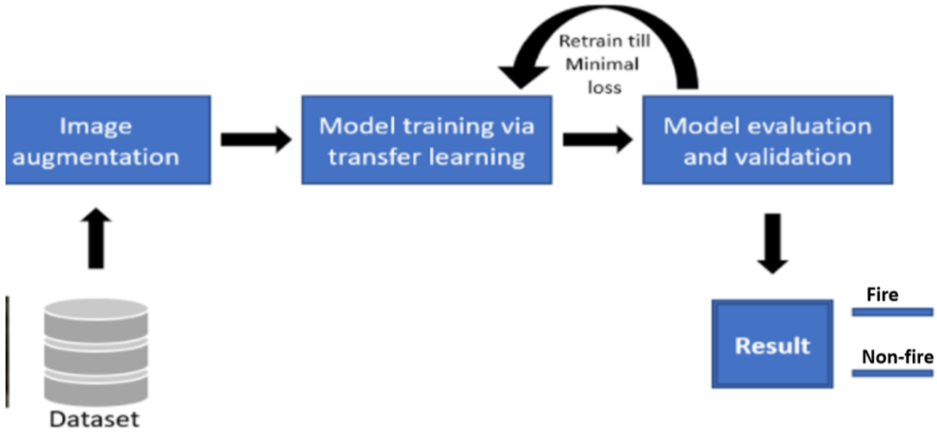

Figure 4: Training Diagram

In the second step, pre-trained model InceptionV3 was used to extract features from images. The model InceptionV3 was trained on very large-scale image classification problems. The convolutional layer acted as feature extractor and fully connected layers as classifiers. These models have learned on large number of images, they can learn new images and can extract its features. The last layer which is fully connected layer was removed. This will provide with a feature vector.

The main idea of Transfer Learning is to use a more complex but successful pre-trained Deep Neural Network model to transfer its learning to simplified problem. Instead of creating and training deep neural nets from scratch, we use the pre-trained weights of these deep neural net architectures which are trained on ImageNet Dataset and can use it for our own dataset.

3.2. Real-Time prediction

OpenCV was used to access webcam and to predict whether each frame contains fire or not. If a frame contains fire in it, frame color was changed to black and white.

IV. RESULTS AND DISCUSSION

Convolution Neural Networks can be used to detect fire in surveillance videos. Here pre-trained model InceptionV3 was used for training the data.

Sample images from dataset

The link for dataset is https://github.com/DeepQuestAI/Fire-Smoke-Dataset/releases/download/v1/FIRE-SMOKE-DATASET.zip

Fire

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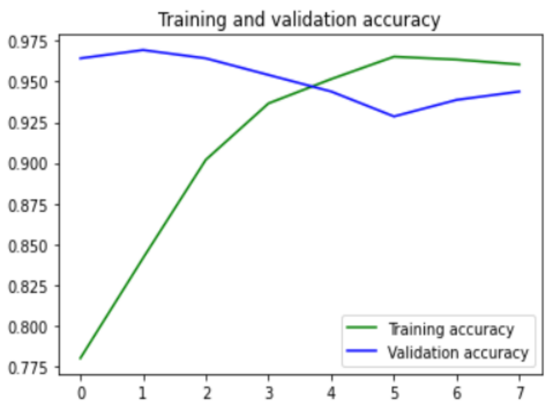
Non-Fire





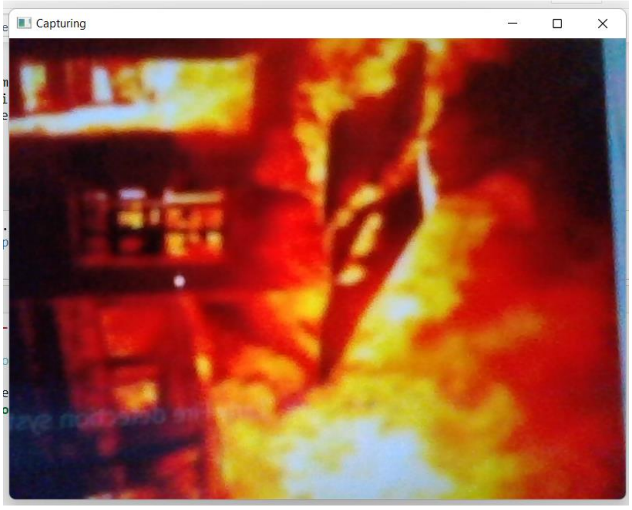
- The ImageDataGenerator function was used for our model. In this paper, the dataset contains images belonging to 2 classes. This model was trained in google colab.
- To generate more images for training, data augmentation techniques used are horizontal flipping and zooming.
- InceptionV3 model was imported from Keras API. The new layers are added on the top of the Inceptionv3.
- In this step, the layers which are added are only trained. These layers are randomly initialized. Here RMSprop optimizer was used.
- The top layers are trained for 20 epochs by freezing the first 249 layers of the model and trained the remaining layers. In this model, SGD optimizer was used and learning rate was 0.0001.
- Here, model was trained for another 10 epochs, and reached a training accuracy of 98.04% and training loss of 0.053.

The validation accuracy was 96% and validation loss was 0.108.



Output:

Now, our model is ready for real time testing. OpenCV module was used for predicting whether each frame contains fire or not. If a frame contains fire in it, frame color will be changed to black and white.



V. CONCLUSION

Smart cameras can be used to identify various suspicious incidents such as medical emergencies, accidents and fires. Out of these, fire is one of the most dangerous events, because if it failed to control it can lead to massive human life loss and huge disasters. Deep learning can be used to provide better way of approaching solution to this problem. With the help of Deep learning, we can build customized CNN, through which we can detect fire in videos and images at an early stage. In this paper, a model was proposed which can be used to detect fire in surveillance videos. Fair Fire detection accuracy of the model can be of great use to disaster management teams by managing fire disasters on time thereby preventing huge losses.

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