EMERGING METHODS OF EARLY DETECTION OF FOREST FIRES

ABSTRACT

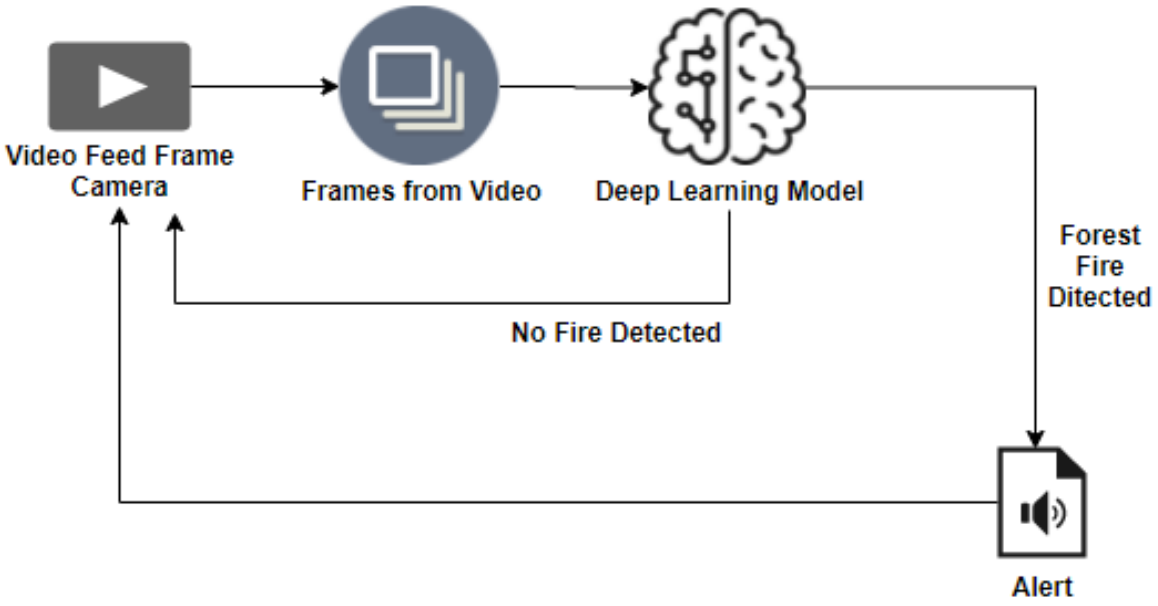
From sprawling urbans to dense jungles, fire accidents pose a major threat to the world. These could be prevented by deploying fire detection systems, but the prohibitive cost, false alarms, need for dedicated infrastructure, and the overall lack of robustness of the present hardware and software-based detection systems have served as roadblocks in this direction. In this work, we endeavor to make a stride towards detection of fire in videos using Deep learning. Deep learning is an emerging concept based on artificial neural networks and has achieved exceptional resultsin various fields including computer vision. We plan to overcome the shortcomings of the present systems and provide an accurate and precise system to detect fires as early as possible and capable of working in various environments thereby saving innumerable lives and resources.

INTRODUCTION

Fire accidents pose a serious threat to industries, crowded events, social gatherings, and densely populated areas that are observed across India. These kinds of incidents may cause damage to property, environment, and pose a threat to human and animal life. According to the recent National Risk Survey Report, Fire stood at the third position overtaking corruption, terrorism, and insurgency thus posing a significant risk to our country's economy and citizens. The recent forest-fires in Australia reminded the world, the destructive capability of fire and the impending ecological disaster, by claiming millions of lives resulting in billions of dollars in damage.

SYSTEM ARCHITECTURE

The passive components of the system include data preprocessing, feature engineering, model selection scripts which were used to train and develop machine learning model. Source/input data which is in the form of videos is split into frames and preprocessed to convert it into a format that is suitable to be fed as input to pre-built models for feature extraction. The deep learning model returns a feature vector which is also known in transfer learning terminology as bottleneck features. In the next stage, the bottleneck features are passed through a classification model to obtain the result, which may be either fire of Non-fire. The classification model was built through training using the training data set.



METHODOLOGY

The model is divided into two parts

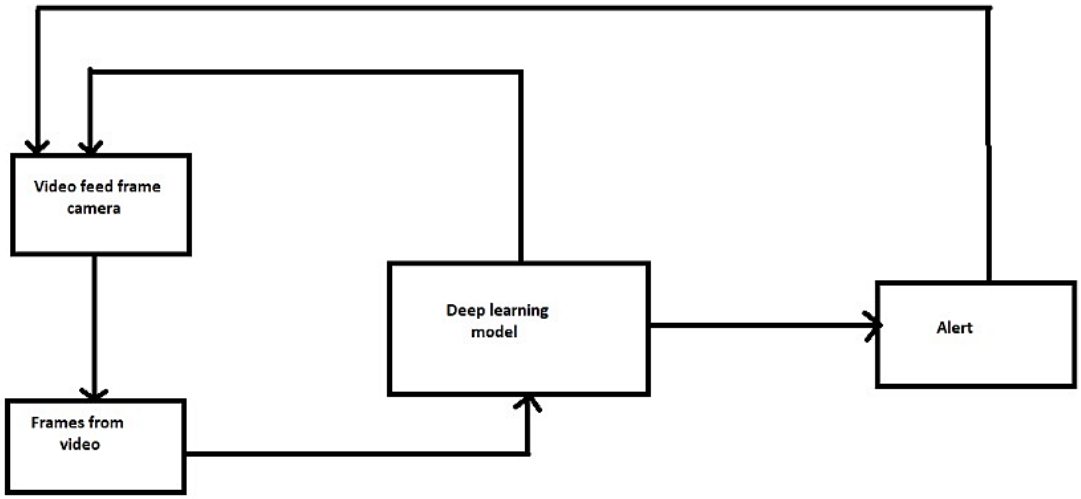
1. Data Collection and Pre-processing.
2. Building fire detection model by Transfer Learning.

The first step is to gather video frames for the problem statement. The dataset has 2 classes - fire and nonfire. Positive samples consist of images with real fire. False Positives consists of images which have objects that look like fire but are not.False positives are easier to collect. Thus, we need to collect diverse video frames which will help better fire detection. The collected dataset is divided into train and test video frames.

SOFTWARE REQUIREMENTS

- PYTHON
- CNN
- IBM CLOUD
- IBM WATSON STUDIO
- OPEN CV
- DEEP LEARNING
- PYTHON-FLASK

USECASE DIAGRAM



PROPOSED FRAMEWORK

The proposed framework utilizes the advantages of a convolutional neural network. The CNN receives input, it is preprocessed and pools them using region of proposals. Then the region-based object detection algorithm in CNN classifies those proposals into fire and non-fire in the region of interest (ROI) with the help of convolutional layers.

EXISTING SYSTEM

The existing system for detecting fire are smoke alarms and heat alarms. The main disadvantage of the smoke sensor alarm and heat sensor alarms are that just one module isnot enough to monitor all the potential fire prone places. The only way to prevent a fire is to be cautious al the time. Even if they are installed in every nook and corner, it just is not sufficient for an efficient output consistently. As the number of smoke sensor requirement increase the cost will also increase to its multiple. The proposed system can produce consistent and highly accurate alerts within seconds of accident of the fire. It reduces cost because only one software is enough to power the entire network of surveillance.Research is active on this field by data scientists and machine learning researchers. The real challenge is to minimize the error in detection of fire and sending alerts at the right time.

LITERATURE SURVEY

1) Effective deep CNN-Based Detection and Localization in Video Survellience Application

Accidents caused by undiscovered fires have cost the globe a lot of money. The demand for effective fire detection systems is on the rise. Because of the system\'s inefficiency, existing fire and smoke detectors are failing. Analyzing live camera data allows for real-time fire detection. The fire flame features are investigated, and the fire is recognized using edge detection and thresholding methods, resulting in the creation of a fire detected model. It detects hazardous fires identified on the size, velocity, volume and the texture. In this paper we are proposing an emerging fire detection system based on Convolutional Neural Network. The model\'s experimental results on our dataset reveal that it has good fire detection capability and ability of detecting multi-scale fire in real-time.

2) Forest Fire Accident Detection Using Deep Learning

In this paper, we propose a novel system for detecting fire using Convolutional Neural Networks (CNN). Detection of fire can be extremely difficult using existing methods of smoke sensors installed in the buildings. They are slow and cost inefficient due to their primitive design and technology. This paper critically analyzes the scope of Artificial intelligence for detection and sending alerts with video from CCTV footages. This project uses self-built dataset containing video frames with fire.The data is then preprocessed and use the CNN to build a machine learning model.

3)Forest Fire Detection System Using Machine Learning

Nowadays, forest fires became one of the foremost important problems that cause damage to several areas around the world. The paper displays machine learning regression techniques for predicting forest fire-prone areas. The data set used in this paper is presented within the UCI machine learning repository that consists of climate and physical factors of the Montesinos park in Portugal. This research proposes three machine learning approaches, linear regression, ridge regression, and lasso regression algorithm with data set size 517 entries and 13 features for each row. This paper uses two versions, all features are included in the first, and 70% of the features were included in the second. The paper uses a training set which is 70% of the data set, and the test set is 30% of the data set. The accuracy of the linear regression algorithm gives more.

4)Information-Guided Flame Detection Based on Faster R-CNN

Due to the diversity of the shape and texture of flame, and interference objects that similar to flame in color, detecting the position of flame from images is a difficult task. To enable generic object detection methods to achieve better performance in flame detection tasks, a color-guided anchoring strategy is proposed that uses color features of the flame to limit the location of the anchor. To solve the problem of high false alarm rate when directly using generic object detection methods in flame detection, a global information-guided flame detection method is proposed, this strategy uses a parallel network to generate image global information. We use these two methods to improve Faster R-CNN (Regions with Convolutional Neural Network features) to perform the fire detection.

CONCLUSION

The scope of using video framesin the detection of fire usingmachine learning is challenging as well as innovative. If this system with less error rate can be implemented at a large scale like in big factories, houses, forests, it is possible to prevent damage and loss due to random fire accidentsby making use of the Surveillance systems. The proposed system can be developed to more advanced systemby integrating wireless sensors with CCTV for added protection and precision.The algorithm shows great promise in adapting to various environment.

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