**Emerging Methods For Early Detection Of Forest Fires**

**Abstract**

Natural disasters have always been mankinds contant companion since time immemorial. Forest fire is one such disaster which when occur at large scale not only destroys the flora , fauna, vegetation of the forest but also puts the life of human being and animals at a very high risk. In the recent past years, managing this type of crisis. a large scale fire has become a very difficult and challenging task. Things that are common in most of the foprest fire that occur at large scale are loss of life loss of vegetation ,loss of flora and fauna and communication failure. Therefore a comprehensive survey on the existing forest fire detection and monitoring mechanism is highly desied This article is aimed at providing a birds eye view of these existing detection and monitoring mechanism for forest fires

**Introduction**

Forest fires are a major environment issue, creating economic and ecological damage while endangering human lives there are typically about 100,000 wildfitres. It is difficult to predict and detect forest fire in a sparsely populated forest area and its more difficult if the prediction is done using ground based methods like Camera or video based approach. Satellites can be an important source of data prior to and also during the fire due to its reliability and enffiency. The various real time forest fire detection and prediction approaches with the goal of informing the local fire authorities.

**Literature survey:**

Forest fires break out in India from November-May every year due to various natural and anthropogenic reasons including accumulation of inflammable materials such as dry leaves, twigs, pine needles, etc.

This is 2.7 times more than the fires reported between November 2019 and June 2020. This includes large, continuous and repeated forest fires.

The country has seen this increase after a decrease in forest fire counts in the last two most recent forest seasons — November 2018-June 2019 and November 2019-June 2020.

[Odisha reported the maximum fires among all states](https://www.downtoearth.org.in/news/environment/odisha-recorded-the-most-forest-fires-in-india-last-season-78129)(51,968), followed by Madhya Pradesh (47,795) and Chhattisgarh (38,106).

[Uttarakhand recorded the sixth-highest fire](https://www.downtoearth.org.in/news/climate-change/climate-crisis-uttarakhand-may-see-forest-fires-round-the-year-74926) counts in the country; incidences were up 28.3 times this forest fire season compared to last.

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Surapong Surit, Watchara Chatwiriya proposed a method to detect fire by smoke detection in video. This approach is based on digital image processing approach with static and dynamic characteristic analysis. The proposed method is composed of following steps, the first is to detect the area of change in the current input frame in comparison with the background image, the second step is to locate regions of interest (ROIs) by connected component algorithm, the area of ROI is calculated by convex hull algorithm and segments the area of change from image, the third step is to calculate static and dynamic characteristics, using this result we decide whether the object

detected is the smoke or not. The result shows that this method accurately detects fire smoke.

P. Piccinini, S. Calderara, and R. Cucchiara proposed a method based on the wavelet model and a color model of the smoke. The proposed method exploits two features: the variation of energy in wavelet model and a color model of the smoke. Smoke is detected based on the decrease of energy

ratio in wavelet domain between background and current. The deviation of

the current pixel color is measured by the color model. Bayesian classifier is used to combine these two features to detect smoke

**Project Objectives**

### [Fire detection systems](https://amzn.to/3235qA2) are designed to discover fires early in their development when time will still be available for the safe evacuation of occupants. Early detection also plays a significant role in protecting the safety of emergency response personnel. Property loss can be reduced and downtime for the operation minimized through early detection because control efforts are started while the fire is still small. Most alarm systems provide information to emergency responders on the location of the fire, speeding the process of fire control.

### Project Flow

* The user interacts with a web camera to read the video.
* Once the input image from the video frame is sent to the model, if the fire is detected it is showcased on the console, and alerting sound will be generated and an alert message will be sent to the Authorities.

**Feature.**

**Data Collection**

Artificial Intelligence is a data hunger technology, it depends heavily on data, without data, it is impossible for a machine to learn. It is the most crucial aspect that makes algorithm training possible. In Convolutional Neural Networks, as it deals with images, we need training and testing data set. It is the actual data set used to train the model for performing various actions.

**Image Preprocessing**

Image Pre-processing includes the following main tasks

* Import ImageDataGenerator Library.
* Configure ImageDataGenerator Class.
* Applying ImageDataGenerator functionality to the trainset and test set.

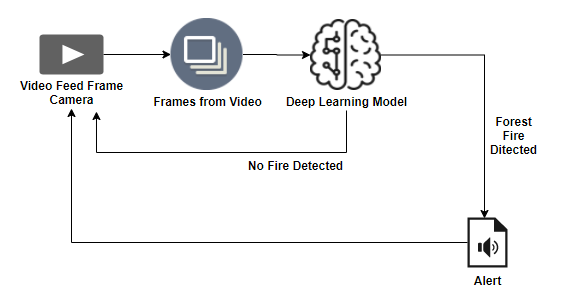
The ImageDataGenerator accepts the original data, randomly transforms it, and returns only the new, transformed data.

The dataset images are to be preprocessed before giving it to the model.

**Methodology**

The neural network model is to be built by adding different network layers like convolution, pooling, flattening, dropout and neural layers.

In this milestone, we start building our model by:

1.Initializing the mode

2.Adding Convolution layers

3. Adding Pooling layers

4.Flatten layer

5.Full connection layers which include hidden layers

At last, we compile the model with layers we added to complete the neural network structure.

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###### **Fire Detection in the Forest Region**:

A classic UAV can autonomously fly over the forest area and detect the forest fire and yaw around the burning forest fire area. The UAV is well equipped with IR sensors, a 12K camera for image accretion, and the onboard CPU, which can broadcast the real-time video of the forest fire to the ground station using the signals that are used for remote navigation. The ground station would diagnose and take necessary measures to stop the forest fire. In parallel, the ground station can also control the UAV by sending the operational commands.

The onboard CPU has good computation power to perform the forest fire detection using YOLOv4 tiny, which has good detection speed with well-grounded accuracy . The YOLOv4 tiny model is divided into two layers, that is, the feature extraction layer and the processing layer. The feature extraction layer is the combination of the DarkNet and ResNet, similar to the feature-like pyramid network that has the convolutional layer, batch-normalization layer, and leaky ReLU layer. The problem of overfitting is shut out using batch normalization. The combination of the convolutional layer, batch-normalization layer, and leaky ReLU layer is called CBL. The combination of the convolutional layer, batch-normalization layer, and mish activation function is called CBM. The structure of CBL and CBM

###### **Prediction of the Possibility of Forest Fire:**

When UAV is patrolling over the forest region, it observes for the forest fire; if the fire is found, it drifts to that affected area and broadcasts all the data to the ground station and then helps the people extinguish the fire. If there is no fire in the forest, then UAV tries to find the possibilities of forest fire in that region. In general, forest fire is caused either by man-made errors or natural errors. The man-made errors that lead to forest fire are campfires that are not completely turned off, used and thrown mosquito coils, the smoked cigarettes remain, and tribal traditions related to fire. The natural causes that lead to forest fire are lightning , combustion of dry vegetation, and volcanic activities. UAV predicts the occurrence of forest fire based on any of the above-stated situations . UAV finds the possibilities of fire such as oxygen, fuel, and heat , while it is patrolling and transmits the results to the ground station.

##### **3D Modeling of Forest Fire** :

3D modeling of the forest-fire-affected area helps the ground station to diagnose and analyzes the situation for extinguishing the fire and helps know the direction of the forest fire; this information is very crucial and reduces the time of extinguishing. Existing techniques for forest fire modeling are empirical and enhancement of the modeling is needed [36]. The motivation for generating a 3D forest fire model is from photogrammetric research, which enables us to generate 3D models from images with high accuracy. In this work, much effort is spent on the creation of 3D images and LiDAR.

###### **Construction of 3D Forest Fire Modeling :**

The spatial resection technique of photogrammetry is used to estimate the position of the trees in the forest by measuring evenly distributed feature points across the 2D images of the forest. The recovery of positions of tress from various directions is called “relative orientation.” Many works have been done using pixel correspondence from scaled tree positions. Recent developments have been made to generate 3D models using the 2D images using LiDAR for outdoor 3D modeling. In this work, we have adopted some of the techniques from . Unlike well-designed interior images, outdoor areas such as forest, farms, and parks contain many objects. Due to relative positioning constraints for data acquisition, sampling of the surfaces is difficult using the traditional methods. Orientation of the images and distance between the tress and other objects can be easily done using LiDAR. To deal with the inconsistency of the data bottom-up approach is used. LiDAR-generated 2D images are collected perpetually from the LASER while flying in forest areas at a high speed.

**Conslusion:**

Fire detection systems increase response times, as they are able to alert the correct people in order to extinguish the fire. This thus reduces the amount of damage to the property. Fire detection systems can be connected to sprinklers that will automatically respond when a fire is detected.