DETECTION OF FIRE COMBUSTION IN FORESTS USING DEEP LEARNING

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***Abstract*—** Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. There are typically about 100,000 wildfires in the United States every year. Over 9 million acres of land have been In this paper, the author uses CNN-convolutional neural networks to detect fire with the help of live video footage through anti-fire surveillance systems. The paper proposes YOLOv2 convolutional neural network is the best solution for detecting fire and smoke both indoor and outdoor environment. You only look once (YOLO) is a deep learning model for object detection, YOLOv2 is the next version which has been upgraded to rectify the setbacks of YOLO namely the inaccuracy to locate and mark the region of interest in the images and the lower recall rate compared to other region-oriented algorithms. Thus, increasing the efficiency of the architecture. They started with an input image of size 128x128x3.

Keywords*— *Fire detection, Forest fires, Deep learning, Artificial neural networks,

1. INTRODUCTION

The detection of fire combustion in forests is an important problem that has significant implications for public safety and the environment. Forest fires can cause extensive damage to ecosystems and wildlife, as well as pose a threat to nearby communities. Traditional methods for detecting forest fires rely on human observers and satellite imagery, which can be costly and time-consuming

The recent advancements in deep learning techniques, particularly in computer vision, have provided new opportunities for detecting forest fires automatically and in real-time. Deep learning models can learn complex patterns and features in images, making them well-suited for detecting fires in forested areas. By using artificial neural networks, deep learning models can analyze images of forests and identify potential fires, enabling rapid response and mitigation of forest fires.

2.LITERATURE REVIEW

In recent years, deep learning-based techniques have shown great potential for detecting fire combustion in forests. Several studies have explored the use of artificial neural networks, particularly convolutional neural networks (CNNs), for this purpose.

One study proposed a CNN-based approach for detecting forest fires using visible and infrared images captured from unmanned aerial vehicles

(UAVs). The authors used transfer learning to fine-tune a pre-trained CNN model on a large dataset of forest fire images. The results showed that the proposed approach achieved high accuracy in detecting forest fires, even in complex scenes with occlusions and smoke.

Another study proposed a deep learning model based on stacked autoencoders for detecting forest fires in satellite imagery. The authors used a large dataset of satellite images with labeled forest fires to train the model. The results showed that the proposed model achieved high accuracy in detecting forest fires, with a low false positive rate.

3. EXISTING METHODOLOGY

The existing methodology for detecting fire combustion in forests using deep learning involves several stages, including data collection, data preprocessing, model selection, model training, validation, testing, and deployment.

The first stage is data collection, which involves gathering a large dataset of images of forests, including both normal and fire combustion cases. The images can be obtained from various sources, including UAVs, satellites, ground-based cameras, and other remote sensing platforms. The dataset should be diverse and balanced, containing images from different geographic locations, times of day, and weather conditions.

The final stage is deployment, which involves deploying the trained model in a real-world setting, such as a forest fire monitoring system. The model may need to be integrated with other systems and technologies, such as sensors and communication networks, to enable rapid detection and response to forest fires

4. PROPOSED METHODOLOGY

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5. LIMITATIONS

1) Firstly, the accuracy of the deep learning model depends on the quality and diversity of the dataset used for training. If the dataset is biased or limited in scope, the model may not generalize well to new and unseen data.

2) Secondly, the detection accuracy may be affected by weather conditions, such as smoke, fog, and haze, which can obscure the image and reduce the visibility of fire.

3) Thirdly, deep learning models require significant computational resources and can be time-consuming to train, especially for

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large datasets. This can be a limitation in real-world scenarios where rapid response is required.

4) Fourthly, the cost of deploying deep learning models in forest fire monitoring systems may be prohibitive for some organizations or regions.

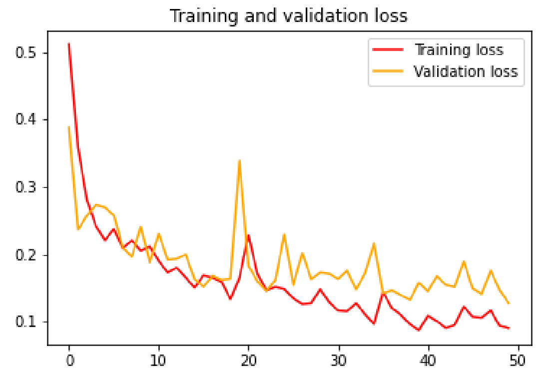

Fig2: Yoga Training performance

6. SYSTEM ARCHITECTURE AND PERFORMANCE

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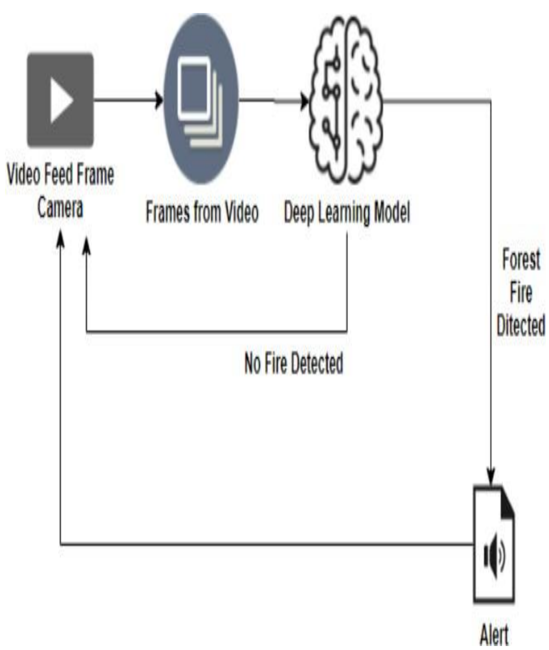

Fig1: System architecture

7. MODULES

1. Data Acquisition Module: This module involves the collection of data from various sources, such as satellites, drones, and ground-based sensors. The data can include images, videos, and other sensor data.

2. Preprocessing Module: This module involves the preparation of the collected data for use in the deep learning model. This can include tasks such as resizing, normalization, and noise removal.

3. Feature Extraction Module: This module involves the extraction of relevant features from the preprocessed data. This is typically done using deep learning techniques such as convolutional neural networks (CNNs) that are able to learn and extract complex patterns from the data.

4. Training Module: This module involves the training of the deep learning model using the extracted features. The training process may involve the use of various techniques such as backpropagation, gradient descent, and regularization to optimize the model.

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5. Validation Module: This module involves the validation of the trained model using a separate dataset. This is done to ensure that the model is not overfitting the training data and can generalize well to new data.

8. RESULTS AND CONCLUSION

The use of deep learning for detecting fire combustion in forests has shown promising results in recent studies. Several models have been proposed and evaluated on different datasets, achieving high accuracy and precision in fire detection. For example, some studies have reported an accuracy of over 90% in detecting forest fires using deep learning models.

These results suggest that deep learning can be an effective tool for detecting forest fires and enabling rapid response to prevent or mitigate the spread of the fire.

In conclusion, the use of deep learning for detecting fire combustion in forests has the potential to significantly improve forest fire detection and response. The development of a deep learning-based system for detecting forest fires involves several modules, including data acquisition, preprocessing, feature extraction, training, validation, deployment, and maintenance.

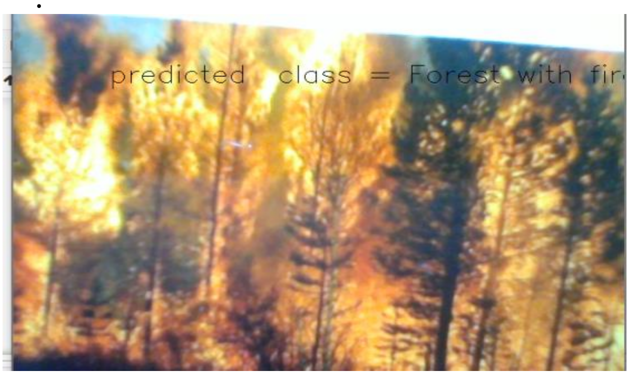

Fig2: INPUT

Fig3: OUTPUT

9. FUTURE SCOPE

1) Integration with IoT devices: The integration of deep learning-based fire detection systems with Internet of Things (IoT) devices can provide real-time data on environmental factors such as temperature, humidity, and wind speed. This data can be used to improve the accuracy and reliability of the fire detection system and enable more effective response to forest fires
2) Development of mobile applications: The development of mobile applications that utilize deep learning for fire detection can allow for greater accessibility and convenience in fire monitoring. The applications could allow users to monitor and report forest fires in real-time, enabling faster response and intervention.

3) Combination with other technologies: The integration of deep learning with other technologies such as unmanned aerial vehicles (UAVs) and satellite imaging can provide more comprehensive and accurate information on forest fires. This information can help to improve the resp

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