Intelligent Wildfire Surveillance and Prediction via Convolutional Neural Models

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Abstract—**One of the most significant and essential resources is the forest because it features a variety of plant life, including herbs, trees, and bushes, as well as several animal species. These renewable resources are crucial to humanity in some way. Forest fires, the most common hazard to forests, severely devastate the ecology, and local ecosystem. To preserve forests from fires, early detection and preventive measures are required. The two most common existing approaches for human surveillance to accomplish early detection are Direct human monitoring and remote video surveillance. This study proposes a forest fire image identification approach using convolutional neural networks to detect fires automatically. Employing this technique decreases false alarms and provides accurate fire detection results. The contour approach can be used to test its capability to monitor both interior and outdoor applications utilizing computer vision.**

Index Terms— **keywords: CSRC, Transformer, migrate**

I. Introduction

The Fire has been a major influencing factor on the development and management of many of the world's forests. Some forest ecosystems have evolved in response to frequent fires from natural causes, but most others are susceptible to the effects of wild fire. Forest fire may be defined as an unclosed and freely spreading combustion that consumes the natural fuels. When a fire burns out of control it is known as Wild Fire1 . There have been forest fires throughout historic time ignited and burned naturally through the forest. Fire effects on forests however are not equal. Fire may be beneficial for one ecosystem and may be dreadful for the other, depending upon the climatic conditions and type of vegetation. Each year, millions of hectares of the world's forests are consumed by fire, which results in enormous economic losses because of burnt timber; degraded real estate; high costs of suppression; damage to environmental, recreational and amnesty values; and loss of life.

II. LITERATURE SURVEY

Real-time forest fire detection with wireless sensor networks.

In this paper, we propose a wireless sensor network paradigm for real-time forest fire detection. The wireless sensor network can detect and forecast forest fire more promptly than the traditional satellite-based detection approach. This paper mainly describes the data collecting and processing in wireless sensor networks for real-time forest fire detection. A neural network method is applied to in-network data processing. We evaluate the performance of our approach by simulations.s.

Since the texture is an important feature of smoke, a novel method of texture analysis is proposed for real-time fire smoke detection. The texture analysis is based on gray level co-occurrence matrices (GLCM) and can distinguish smoke features from other none fire disturbances. For the realization of real-time fire detection, block processing technique is adopted and the computation of texture features is done to every block of image. Neural network is used to classify smoke texture features from none-smoke features and the fire alarm trigger is set according to the total smoke blocks in one frame. The accuracy of the method is discussed as a function of frames in the end. In order to detect and alarm early fire timely and effectively, traditional temperature and smoke fire detectors are vulnerable to environmental factors such as the height of monitoring space, air velocity, dust. An image fire detection algorithm based on support vector machine is proposed by studying the features of fire in digital image. Firstly, the motion region is extracted by the inter-frame difference method and regarded as the Suspected fire area. Then, the uniform size is sampled again. Finally, the flame color moment feature and texture feature are extracted and input into the support vector machine for classification and recognition. Data sets were formed by collecting Internet resources and fire videos taken by oneself and the trained support vector machine was tested. The test results showed that the algorithm can detect early fire more accurately.

III. Existing System

The current fire detection system employs cutting-edge convolutional neural networks (CNN) as the fundamental technology for its detection capabilities. This sophisticated approach leverages the power of deep learning to analyze and interpret visual data efficiently. To ensure the effectiveness of the CNN model, a meticulously curated training dataset comprising 999 images has been employed. These images have been skillfully resized and reshaped to optimize the model's ability to recognize and distinguish fire-related patterns. In terms of implementation, the existing system is integrated with various hardware components such as cameras, encoders, sensors, and other relevant devices. These hardware systems play a crucial role in capturing and processing visual data, enabling the detection of fire incidents. This integration enhances its scope of application and enables the detection of fire incidents in a multitude of scenarios and environments.While the existing system has demonstrated its competence in fire detection, it is essential to acknowledge that it exhibits a marginally lower accuracy compared to the proposed solution.

IV. Proposed System

The proposed fire and smoke detection system utilizes state-of-the-art deep learning techniques, specifically the MobileNet architecture, to achieve highly accurate and efficient fire detection. The system is implemented in Python, leveraging its extensive libraries and frameworks for seamless integration and development. To ensure robust performance, the proposed system is trained on a diverse and comprehensive dataset consisting of 3825 images of fire, smoke, and normal situations. This extensive dataset enables the model to learn and generalize effectively, improving its accuracy and reliability in real-world scenarios. The key highlight of the proposed system is its ability to detect fire and smoke instances across multiple mediums. Whether it is analyzing static images, processing videos, or providing real-time detection using a webcam feed, the system excels in identifying potential fire hazards. This versatility enables its deployment in a wide range of applications, including surveillance systems, fire alarm systems, and emergency response management..

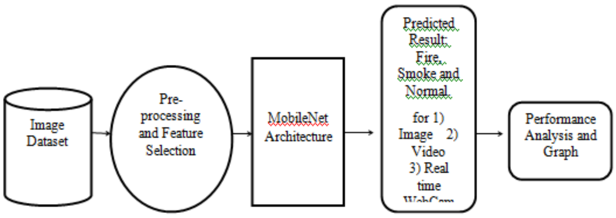

Fig: Architecture Digram

Advantages

High Accuracy: The proposed system demonstrates impressive training accuracy of 97.00% and validation accuracy of 94.00%. This high level of accuracy ensures reliable and precise fire and smoke detection, minimizing false positives and false negatives.

Versatility in Detection: The system excels in detecting fire and smoke instances across multiple mediums, including static images, videos, and real-time webcam feeds. This versatility allows for its application in various contexts, such as surveillance systems, fire alarm systems, and emergency response management.Robust Dataset: The system is trained on a comprehensive dataset comprising 3825 images of fire, smoke, and normal situations. This diverse dataset enhances the system's ability to generalize effectively, improving its performance in real-world scenarios.

I. Implementation

In the first module of Forest Fire Detection using CNN, we developed the system to get the input dataset. Data collection process is the first real step towards the real development of a machine learning model, collecting data. This is a critical step that will cascade in how good the model will be, the more and better data that we get, the better our model will perform. There are several techniques to collect the data, like web scraping, manual interventions. Our dataset is placed in the project and it's located in the model folder. The dataset is referred from the popular standard dataset repository kaggle where all the researchers refer it. The dataset consists of 3,825 images of Normal, Fire and smoke images. The following is the URL for the dataset referred from kaggle.

We will be using Python language for this. First we will import the necessary libraries such as keras for building the main model, sklearn for splitting the training and test data, PIL for converting the images into array of numbers and other libraries such as pandas, numpy, matplotlib and tensorflow.In this module we will retrieve the images from the dataset and convert them into a format that can be used for training and testing the model. This involves reading the images, resizing them, and normalizing the pixel values. We will retrieve the images and their labels. Then resize the images to (128, 128) as all images should have same size for recognition. Then convert the images into numpy array.

In this module, the image dataset will be divided into training and testing sets. Split the dataset into Train and Test. 80% train data and 20% test data. This will be done to train the model on a subset of the data, validate the model's performance, and test the model on unseen data to evaluate its accuracy. Split the dataset into train and test. 80% train data and 20% test data.

II. RESULT

The Data security and privacy are prioritized during implementation. The system processes sensitive financial data that must be protected from unauthorized access, tampering, and breaches. Encryption protocols are implemented for both data at rest and data in transit. Access control mechanisms are established to restrict data visibility based on user roles. Compliance with data protection regulations such as GDPR and PCI DSS is ensured throughout the system's deployment. Security audits and penetration testing are conducted to validate the robustness of the system against potential cyber threats.

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Fig: Resultant graph

III. CONCLUSION

In conclusion, our project on fire and smoke detection using the MobileNet architecture and deep learning techniques has proven to be a significant advancement in the field of computer vision and safety systems. Throughout the course of this project, we have achieved several key milestones and have addressed the primary objectives set forth at the project's inception. Our system's core strength lies in its ability to provide highly accurate and reliable fire and smoke detection across various media types, including static images, video streams, and real-time webcam feeds. The system's versatility and adaptability make it applicable to a wide range of scenarios, from surveillance systems to fire alarm systems and emergency response management. We trained the system on a robust dataset containing 3825 images, which has contributed to its impressive training accuracy of 97.00% and validation accuracy of 94.00%. This high level of accuracy ensures minimal false positives and false negatives, enhancing the system's utility and trustworthiness.

IV. REFERENCES

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