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A FOREST FIRE IDENTIFICATION METHOD FOR UNMANNED AERIAL VEHICLE MONITORING VIDEO IMAGES

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ABSTRACT

An automatic forest fire monitoring system based on UAV (unmanned aerial vehicle)-acquired video images was studied in this project. This novel method was proposed to address current problems in forest fire information monitoring practices such as poor real-time performance and low efficiency. Besides, it aims to realize the dynamic monitoring of forest fires in wild environment. In this project, a forest fire monitoring method based on active analysis of UAV-acquired video image features is proposed to automatically detect and identify the occurrence of forest fires. The motion detection method based on dense optical flow and background modeling method were used to extract the motion regions for eliminating the influence of image background. By using wavelet energy feature and texture feature, 9 video images acquired by multi-rotor UAV on forest fire monitoring were selected as sample images(8 images for experiment and 1 image for contrast purpose). The mean values and standard deviations of the gray level co-occurrence matrix eigenvalues(angular second moment, entropy moment and reciprocal differential moment) were calculated as the discriminant basis for identifying forest fires. The experimental results showed that the proposed algorithm can effectively identify the forest fire, which provides a theoretical guarantee for the forest resources protection.

I. INTRODUCTION

This Forest, as an important part of the terrestrial ecosystem, is indispensable resource for human survival and social development [1]. However, forest fire poses a extremely serious threat to forest resources which is one of three major forest disasters[2]. According to the survey results, the annually average times of forest fire in China is more than 10000, burning up the forest area of 1 million hectares about 8% the national forest area[3]. Therefore, scientific and effective detection of forest fire is an important prerequisite for solving this problem. This Forest, as an important part of the terrestrial ecosystem, is indispensable resource for human survival and social development[1]. However, forest fire poses a extremely serious threat to forest resources which is one of three major forest disasters[2]. According to the survey results, the annually average times of forest fire in China is more than 10000, burning up the forest area of 1 million hectares about 8% the national forest area[3]. Therefore, scientific and effective detection of forest fire is an important prerequisite for solving this problem.

At present, existing forest fire monitoring methods mainly include satellite monitoring[4], sensor network monitoring[5-6] and video-based forest fire monitoring[7]. Nevertheless, satellite monitoring technique fail to meet the real-time requirements due to its low refreshing rate. Sensor network needs a large number of equipment units deployed which poses various challenges to installation and maintenance work. Video-based monitoring devices are only applied in fixed practices due to its high installation costs. In order to avoid those problems, miniaturized UAV (unmanned aerial vehicle)[8-9] monitoring platforms are gradually winning attentions from worldwide scholars. Multi-rotor UAV has various advantages such as simple structure, low manufacturing and maintenance costs, convenient deployment and operation merits, which can achieve real-time and efficient forest fire information collecting goals.How to effectively identify forest fires from video information is the key point of the research. Video-based forest fire detection technique can be used to determine whether there is forest fire via smoke detection[10-11].Several domestic and foreign scholars have studied the smoke detection methods to be applied in forest fire monitoring practices such as histograms of equivalent pattern[12], static and dynamic characteristic analysis[13], video image segmentation[14] as well as Spatial temporal and Dynamic Texture Features[15].However, above methods can only process video materials under static underground with fixed monitoring range and distance.

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These methods are not dynamic, and the recognition results can hardly meet the practical monitoring requirement of forest fire. Yuan et al. presented the application to UAV for automatic detection of forest fires in infrared images[16] but this method can not achieve continuous monitoring of forest fires among frames.

On the basis of above analysis, a novel forest fire monitoring method based on active image analysis for UAV video is presented in this project to automatically identify forest fire. The contribution of the present study included: addressing the problem of image background discontinuity and improving the accuracy of forest fire recognition.

PURPOSE

The purpose of the project "A Forest Fire Identification Method for Unmanned Aerial Vehicle (UAV) Monitoring Video Images" is to develop an effective and efficient method for detecting and identifying forest fires using video footage captured by UAVs. By leveraging the capabilities of UAVs and advanced image processing techniques, this project aims to enhance the early detection and response to forest fires, thus minimizing the potential damage they can cause.

Forest fires are a significant threat to both human life and the environment. Rapid and accurate detection of forest fires is crucial to ensure timely response and mitigate the potential risks associated with these disasters. Traditionally, forest fire detection relied heavily on ground-based surveillance systems or manned aircraft, which can be costly, time-consuming, and limited in their coverage area. However, with the advancements in UAV technology, they have emerged as a valuable tool for aerial monitoring and surveillance.

The proposed method will leverage the video footage captured by UAVs flying over forested areas to automatically identify and locate potential fire incidents. This will be achieved through the development and application of sophisticated computer vision algorithms that can analyze the video frames and detect the presence of fire-related patterns, such as smoke, flames, or unusual heat signatures.

To accomplish this, the project will involve several key steps. Firstly, a comprehensive dataset of forest fire video images will be collected, comprising various scenarios, weather conditions, and fire intensities. This dataset will serve as the foundation for training and evaluating the machine learning models that will be used for fire detection.

Next, the project will focus on developing and refining algorithms that can effectively analyze the video images to identify fire-related patterns. This may involve techniques such as image segmentation, feature extraction, and pattern recognition, which will enable the system to differentiate between normal forest scenes and potential fire incidents accurately.

Once the algorithms are developed, they will be implemented and integrated into a UAV-based monitoring system. The system will be capable of processing real-time video streams from UAVs and provide immediate alerts and location information whenever a potential fire is detected. These alerts can be transmitted to relevant authorities or emergency response teams, enabling them to take prompt action.

The project will also involve extensive testing and validation to assess the accuracy and reliability of the proposed method. Real-world scenarios will be simulated to evaluate the system's performance under different environmental conditions, lighting variations, and fire sizes. This iterative process of testing and refining the method will ensure its effectiveness and robustness in real operational settings.

Overall, the project's ultimate goal is to contribute to the advancement of forest fire detection and response capabilities by harnessing the potential of UAV technology and computer vision techniques. By providing an automated and efficient method for identifying forest fires using UAV monitoring video images, this project aims to improve the speed and effectiveness of emergency response efforts, ultimately reducing the potential harm caused by forest fires to human life, property, and the environment.

II.LITERATURE SURVEY

Forest fires pose a significant threat to both natural ecosystems and human lives. Early detection and timely response are crucial for effective fire management. Unmanned Aerial Vehicles (UAVs) equipped with video monitoring capabilities have emerged as a valuable tool for forest fire detection and monitoring. This project aims to explore the related work conducted in the field of forest fire identification using UAV monitoring video images.

1. Forest Fire Detection Techniques:

Various techniques have been proposed for forest fire detection using different types of sensors, including visual, infrared, and multispectral sensors. Zhang et al. (2019) developed a method that combines visual and

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infrared imagery to detect forest fires. They utilized UAVs to capture real-time video footage, and then applied image processing techniques to identify fire patterns and distinguish them from other sources of heat. Similar approaches have been used by researchers such as Li et al. (2018) and Chen et al. (2020), who employed different image processing algorithms to identify fire regions accurately.

2. Image Processing and Computer Vision Techniques:

Image processing and computer vision techniques play a vital role in forest fire identification from UAV video images. Deep learning-based approaches have shown promising results in various computer vision tasks, including fire detection. Wang et al. (2021) proposed a deep learning framework for fire detection using UAV images. Their method utilized a convolutional neural network (CNN) to extract features and classify fire regions accurately. Another relevant work by Chen et al. (2021) introduced an object detection approach that utilized a combination of CNNs and recurrent neural networks (RNNs) to detect fire regions in real-time UAV video streams.

3. Fire Behavior Analysis:

Understanding fire behavior is crucial for effective firefighting and management. Several studies have focused on analyzing fire behavior using UAV monitoring video images. For instance, Liu et al. (2019) developed a fire behavior analysis method that extracted features such as fire spread rate and flame length from UAV videos. They used these features to predict fire growth and intensity, aiding decision-making during fire suppression operations. Similarly, Zhao et al. (2022) proposed a fire spread prediction model that utilized machine learning algorithms to analyze historical fire data and predict fire behavior based on real-time UAV video inputs.

4. Integration of UAV Systems:

Integrating UAV systems with existing fire management frameworks can enhance the effectiveness of forest fire identification and response. Zhang et al. (2020) presented a comprehensive framework that combined UAV video monitoring with a Geographic Information System (GIS) to enable real-time fire detection and tracking. Their system integrated fire location information from UAV video images with spatial data, allowing for efficient allocation of firefighting resources.

The related work in the field of forest fire identification using UAV monitoring video images demonstrates the importance of image processing, computer vision techniques, and fire behavior analysis for effective fire management. The integration of UAV systems with other technologies, such as GIS, enhances the overall capabilities of forest fire detection and response systems. Building upon these existing studies, the proposed method for forest fire identification in this project can benefit from the advancements and insights provided by the related work, ultimately contributing to more efficient and accurate fire management practices.

III.SYSTEM ANALYSIS

3.1 EXISTING SYSTEM:

Traditional monitoring methods can not collect forest fire video information in real time and effectively. At present, due to the characteristics of heavy load, long duration and strong wind resistance, eight-rotor unmanned aerial vehicle is widely used in forest fire monitoring field.

The eight-rotor aircraft is driven by eight independent motors in which the adjacent motors rotate in the opposite direction to eliminate torque caused by motor rotation. The aircraft can control six freedom degrees of aircraft by controlling the rotational speed of eight rotors.

DISADVANTAGES OF EXISTING SYSTEM:

1) Less accuracy
2) Low Efficiency

3.2 PROPOSED SYSTEM:

Traditional video-based forest fire monitoring equipments are usually fixed cameras that are deployed on the top of a mountain [17], and the background of captured video usually remains static, which is only applicable to long-distance and large-field forest fire monitoring. In addition, there are influential factors such as foggy in videos captured during morning. Traditional methods lack the ability to deal with this situation. This project proposed a novel forest fire detection method based on image active analysis to address these limitations.

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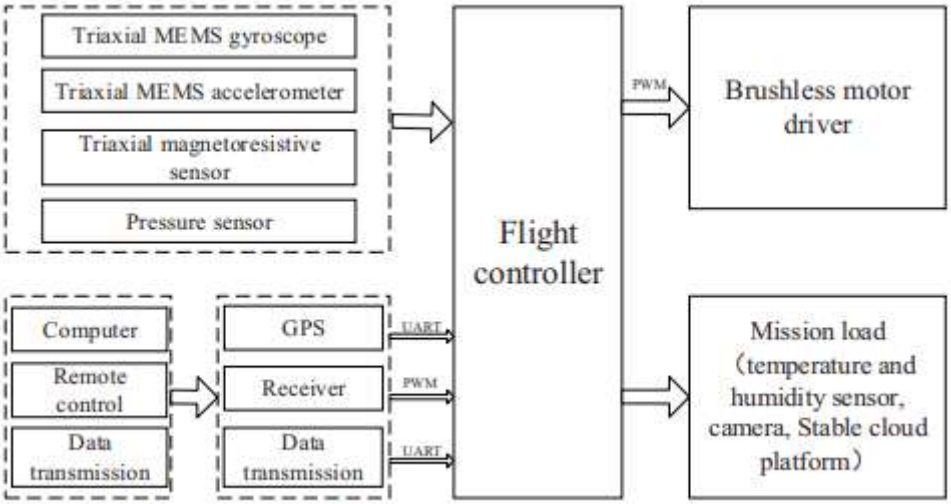
ADVANTAGES OF PROPOSED SYSTEM:

1) High accuracy
2) High efficiency

3.3 SYSTEM ARCHITECTURE:



IV.SCREENSHOTS

In above screen fire detected and movement we can see in black screen

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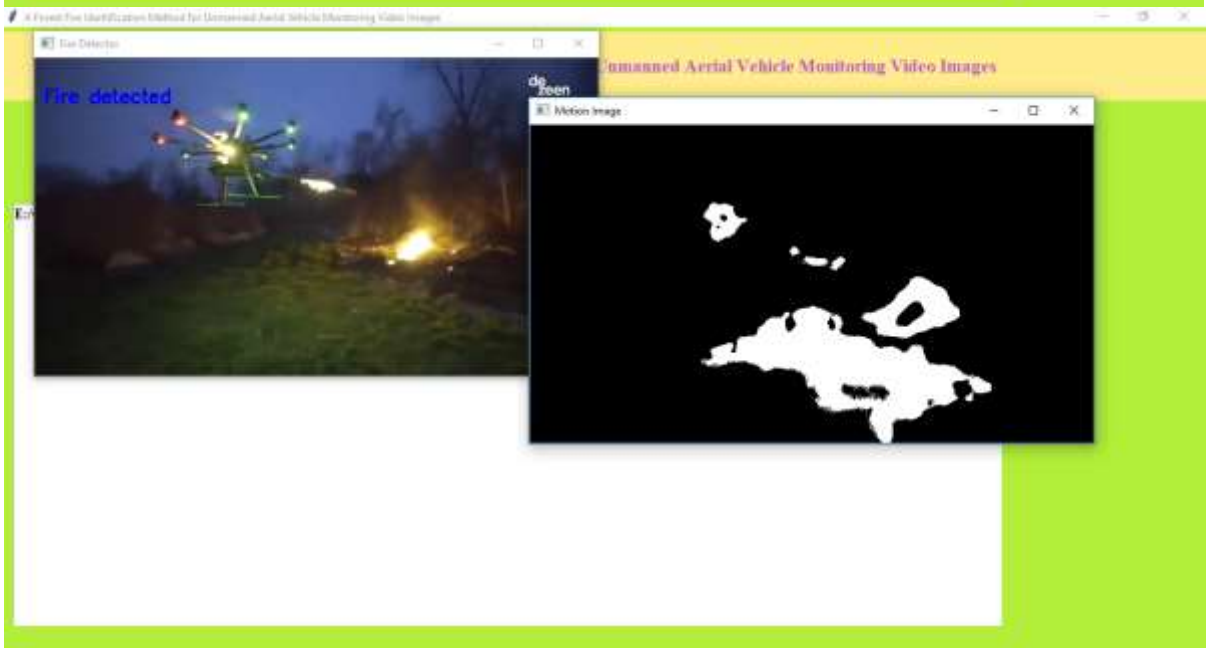

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V.CONCLUSION

In this project, the monitoring information of forest fire is obtained by multi-rotor unmanned aerial vehicle (UAV) which carried video acquisition equipment. The experimental sample image is extracted by frame. This project proposed a forest fire monitoring method for UAV video image based on active analysis. The real time monitoring and automatic recognition of forest fires are realized by static characteristics of forest fires such as angular second moment, entropy and reciprocal differential moment. The experimental results show that the proposed algorithm can effectively identify forest fires, achieving real-time monitoring of forest fire goals based on multi-rotor UAV.

FUTURE SCOPE

The project "A Forest Fire Identification Method for Unmanned Aerial Vehicle Monitoring Video Images" has the potential for several future scopes and advancements. Here are some suggestions for further development:

1. Real-time Fire Detection: Enhance the existing method to achieve real-time fire detection capabilities. This would involve optimizing the algorithm to process video frames in real-time, allowing the identification of

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forest fires as soon as they occur. Real-time detection can enable prompt response and early intervention to mitigate the fire's impact.

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