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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 paper. 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 paper, 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 eigen values (angular second moment, entropy moment and reciprocal differential moment) were calculated as the discriminate 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.

INTRODUCTION

Forest as an important part of the terrestrial ecosystem, is indispensable resource for human survival and social development. However, forest fire poses a extrenely serious threat to forest resources which is one of three major forest disasters. 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. 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, sensor network monitoring and video-based forest fire monitoring. 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) monitoring platforms are gradually winning attentions from worldwide scholars. Multirotor 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.

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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.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, static and dynamic characteristic analysis, video image segmentation as well as Spatial temporal and Dynamic Texture Features.However, above methods can only process video materials under static underground with fixed monitoring range and distance. These methods are not dynamic, and the recognition results can hardly meet the practical monitoring requirement of forest fire. Yuan. presented the application to UAV for automatic detection of forest fires in infrared images 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 paper to automatically identify forest fire. contribution of the present study included: addressing the problem of image background discontinuity and improving the accuracy of forest fire recognition.

PROBLEM STATEMENT

Forest as an important part of the terrestrial ecosystem, is indispensable resource for human survival and social development. However, forest fire poses a extremely serious threat to forest resources which is one of three major forest disasters. According to the survey results, the annual average times of forest fire in China is more than 10.000. burning up the forest areas of 1 million hectares about 8% the national forest area. Therefore, scientific and effective detection of forest fire is an important prerequisite for solving this problem.

SCOPE

Design and advise on new buildings and buildings undergoing refurbishment with regards to fire safety measures. Their role is to help protect life, property and the wider environment from risk of fire and to help ensure that projects meet industry codes and legislative requirements.

OBJECTIVE

The most important objective in fire surveillance is early and reliable detection and localization of the fire. The data collected through different sensors located at different locations and information will be sent to Arduino Uno placed in various places and that focuses on the origins of wildland fire and it's relationship to the environment that surrounds it, both living and non-living.

LITERATURE SURVEY

G. Lewis S, Clarke M. Forest plots: trying to see the wood and the trees proposed Forest plots show the information from the individual studies that went into the meta-analysis at a glance.They show the amount of variation between the studies and an estimate of the overall result.Forest plots, in various forms, have been published for about 20 years.During this time, they have been improved, but it is still not easy to draw them in most standard computer packages.

Turner D, Lewis M, Ostendorf B. Spatial indicators of fire risk in the arid and semi-arid zone of Australia.The main aim of this project is integrate the monitoring and assessment of ecological and environmental indicators with management practices. The journal provides a forum for the discussion of the applied scientific development and review of traditional indicator applications as well as for theoretical, modelling and quantitative approaches such as index development. Research into the following areas will be published. All aspects of ecological and environmental indicators and indices.

- New indicators, and new approaches and methods for indicator development, testing and use.
- Development and modelling of indices, e.g. application of indicator suites across multiple scales and resources.
- Analysis and research of resource, system- and scale-specific indicators.

• Methods for integration of social and other valuation metrics for the production of scientifically rigorous and politically-relevant assessments using indicator-based monitoring and assessment programs.

Adab H. Using Probabilistic Methods to Evaluate Landfire Hazard proposed the probability distribution analysis reveals the effect of physiographic and anthropogenic on landfire hazard. The analysis of physiographic factors represented that most fires happened on flat areas because of the human activities concentrate in flat areas. Therefore landfire hazard probability for the flat areas reached to 100 percent probability of occurring. The behavior of slope on hotspot density showed that gentle slopes are more exposure to fire than steep slopes. 80 percent of landfire hazard probability is determined by less than 2.5 degree that means no landfire hazard in steep slopes. Most fires also occurred in low land area and fire occurrences did not detect in high land area with higher than 1600 meters above sea level. The physiographic factors signified that most fires were occurred in near to roads and settlement areas. The fire hazard probability is low where the areas are far away from human activities and population density.

Many models have been applied for fire hazards mapping such as index-based methods (AHP, Ranking, and Rating), Statistical methods (Logistic Regression), and training/membership-based methods (Neural Network and Fuzzy set).These are common and more interesting methods to map fire hazards. But there are a few studies about using probabilistic methods in these issues. This study is consistent with the idea that prescribes fire hazard by probabilistic methods. Probability distributions are assigned and used to determine the possible of landfire hazard. Elevation, slope, aspect, distance from road, and vicinity to settlement were used to explain the role of five factors on landfire hazard. Certain types of variables follow specific distributions so different and the best probability distribution was fitted on the parameters. This study shows that probability distribution functions can be used to identify the role of physiographic and anthropogenic factors on landfire hazard.

Lei Z, Lu J. Distributed coverage of forest fire border based on WSN is all about an innovative design and development process is presented for a Wireless Sensor Network (WSN) prototype aimed at detecting and monitoring forest fires at the Guanguiltagua Park located in the Metropolitan District of Quito (DMQ), capital of Ecuador. Every year the city of Quito is affected by recurrent forest fires, especially in summer time where high temperatures and soil dryness contribute to the propagation of fire in areas with vast vegetation. As a result to this problem, a WSN technological solution was created to address this problem which can detect forest fires in real-time sending alerts immediately to the end user. This prompt response helps to attenuate the impact of forest fires such as loss of human lives, loss of large areas of vegetation, economic loss and environmental contamination. The WSN prototype described in this document uses hardware, software, communication protocols, topology and functionality focused on optimizing its end results. The system is based on measuring continuously three types of gases, which are present in a combustion process such as CO_2, CO and CH_4. In addition to these sensors, environment temperature and humidity, as well as GPS location data is provided; this data is transmitted via wireless communications toward a graphical interface where the sensors data will be interpreted and statistical information can be generated. Finally, through a WSN prototype validation process, it is demonstrated that such prototype provides an efficient and reliable method to detect and monitor forest fires in a short amount of time.

Jadhav P., Deshmukh V., et al. Forest fire monitoring system based on Zig-Bee wireless sensor network , compared with the traditional techniques of forest fire detection, a wireless sensor network paradigm based on a ZigBee technique was proposed. The proposed technique is in real time, given the exigencies of forest fires. The architecture of a wireless sensor network for forest fire detection is described. The hardware circuitry of the network node is designed based on a CC2430 chip. The process of data transmission is discussed in detail. Environmental parameters such as temperature and humidity in the forest region can be monitored in real time. From the information collected by the system, decisions for fire fighting or fire prevention can be made more quickly by the relevant government departments. ZigBee wireless sensor network system includes sensornodes, gateways (routers) and a monitoring host computer. To decrease the loss of energy and data packets, a clustertree network topology structure is applied in this design. Sensor nodes fitted with microprocessors of low processing capacity are distributed randomly in the forest and nearby areas to collect fire monitoring parameters such as relative humidity and atmospheric temperature (Zenon and Fady, 2005). Depending on the part the different sensor nodes play inthe whole network, they are divided into three categories:ordinary bottom nodes, cluster heads and network coordi-nators. Data collected is transmitted to its own cluster headby an ordinary bottom node. A cluster head mainly han-dles data fusion and data packet transmission. Via the cluster head, data collected by ordinary bottom nodes in the cluster can be fused and transmitted to the nearest network coordinator and data packets transmitted by the network coordinator can be broadcast to related clusters. A network coordinator mainly deals with basic network management functions such as network configuration,equipment registration and access control. Data informa-tion can be transmitted to routers by wireless communica-tion. When receiving data, routers establish a localdatabase and then transmit the data to the monitoring hostcomputer via internet, which provides a decision-makingbasis for forestry or fire prevention departments.

Liu L Y, Fan X J. The Design of System to Texture Feature Analysis Based on Gray Level Co-Occurrence Matrix is about computing, a grayscale digital image is an image in which the value of each pixel is a single sample. The displayed image of this type of image consists of a gray color, where it varies for black at the weakest intensity and white at the most vigorous intensity, but the color variations differ very much.Grayscale images are often a calculation of the light intensity of each pixel in a single band electromagnetic spectrum. In this study, the data source is an RGB image of type .jpg. The image is converted to the function contained in Matlab2019a, namely, the rgb2gray() function. The gray-level scaling is a trade-off between reducing the disparity and retaining sufficient information to identify the iris. Therefore, the gray-level scaling is essential to improve identification performance. This study used the adaptive histogram equalization (AHE) method [26–28] for image improvement. It shows the results of the conversion process of RGB iris images to grayscale iris images and the enhancement of iris images using the AHE method.

EXISTING SYSTEM

The project which has already done by using machine learning algorithms such as Convolutional Neural Network (CNN) which is used to recognize the fire which is taken place in the forest at any point of time.It takes input as image and image pre-processing will be done accordingly. CNN is all about predicting the motion of the fire and detecting at what area the fire is being occurred.An automatic forest fire monitoring system based on UAV(unmanned aerial vehicle)-acquired images was studied in this project.The main drawback of this project is it only takes input as images and it needs more time & more work should be done to detect the fire in the forest, while we are on the detecting the fire by images almost all the forest will be drained in fire and there will be no chance to protect the forest at that point of time.In order to solve this problem we came up with some of the other deep learning models to detect the foest fire.

PROPOSED SYSTEM:

The proposed system for forest fire detection using wireless sensor networks and machine learning was found to be an effective method for fire detection in forests that provides more accurate results. In the fight against forest fires, the automatic fire detection system through thermal analysis is the most efficient solution. This type of systems allows early detection, location and monitoring of forest fires.Here we will be using CNN (Convolutional Neural Network) as well as YOLO(You Only Look Once) to detect forest fire.The main use of using YOLO is that this is pre-trained & tested method and by using this method we will definetly get more accuracy than CNN.Videos are taken as input and also images.So,proposed system will be more accurate than existing system.

METHODOLOGY

Traditional video-based forest fire monitoring equipments are usually fixed cameras that are deployed on the top of a mountain, 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 paper proposed a novel forest fire detection method based on image active analysis to address these limitations.

The key steps of the algorithm are presented as follows:

1) Unmanned aerial vehicle (UAV) is used for real-time video acquisition, and then the image is extracted by frame from acquired monitoring video.

2) The extracted image is detected by dense optical flow algorithm if there is a moving object in the direction of 0°-90°.

3) Extract motion area. Using the Codebook method to conduct background modeling work, then background difference will be completed.

4) Color feature recognition.

5) Wavelet energy feature and texture feature recognition.

Multi-rotor UAV is widely used to monitor the forest fire and the state of UAV is mostly in motion during the cruise monitoring process. The optical flow method can calculate the speed of moving objects by detecting the change of image pixels intensity with time. We adopted dense optical flow algorithm which can be used to detect forest fire in UAV video image. In this algorithm, a point-by-point registration method for image matching is used to calculate the offset of all feature points for UAV video image extracted by frame.

Each pixel in the image has a displacement in the X direction and Y direction, and the Munsell color system is used to express the motion velocity and direction of the object in the image. The motion detection results of the forest fire are shown in Figure 3.

a. Previous frame image

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b. Current frame image

The different colors in figure represent different directions of movement, and the color depth indicates the movement speed. In this paper, the sampling frequency is reduced to meet the requirement of real-time monitoring, in which the sampling interval is selected as 2 seconds per frame.

c. Dense optical flow effect

Figure 3. Motion detection result

Motion area extraction

As for the motion area detected in last section, Codebook background modeling method is used to extract motion area. Current observed value of a pixel are compared with the previously that.If two values are close, the pixel is modeled as a disturbance under this color, which in turn produces a set of colors related to that pixel. This method created a codebook structure for each pixel of the current image.

Static feature recognition

After the motion area is extracted, we proceed with smoke recognition in the image to determine whether there is forest fire. The smoke that diffuses around would cover and blur the partially picture background due to air flow, which smooth the edge and texture of the image. The high frequency information of the picture can reflect the change of edge and texture. Therefore, this paper adopted the discrete wavelet transform energy and texture features to fuse the forest smoke image.

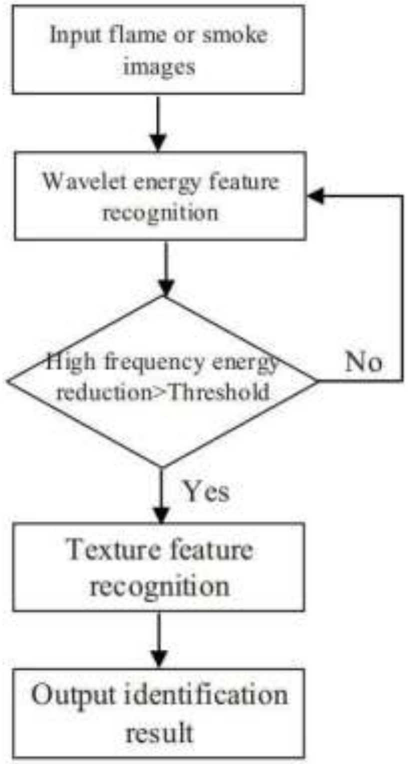

Fig.4. Recognition alogrithm flow

RESULTS

Fig.5. YOLO METHOD

Fig.6. Motion of fire is detected

Fig.7. Upload Videos

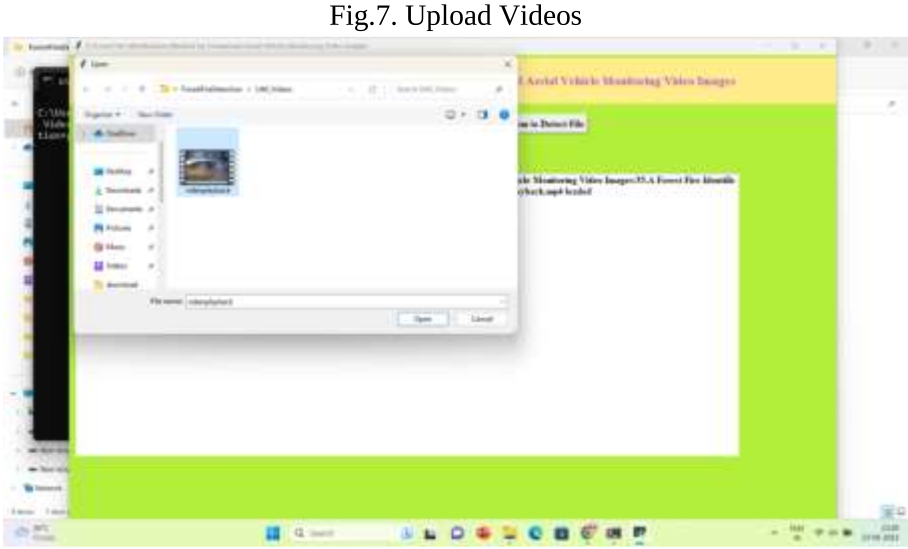

Fig.8. Seclection of Videos

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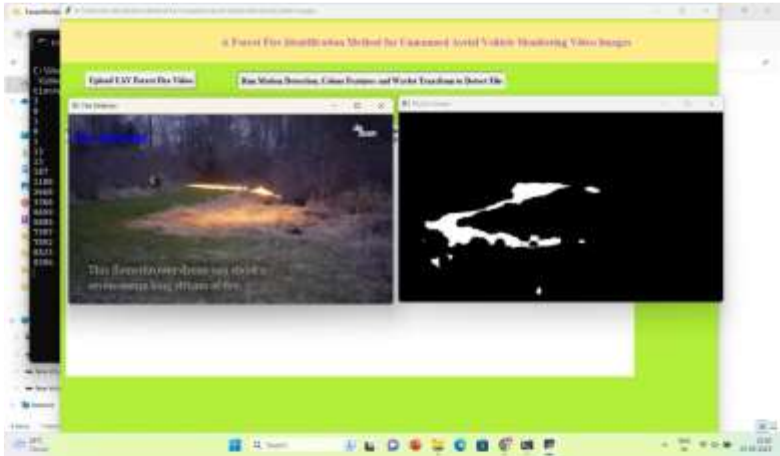

Fig.9. Motion of fire

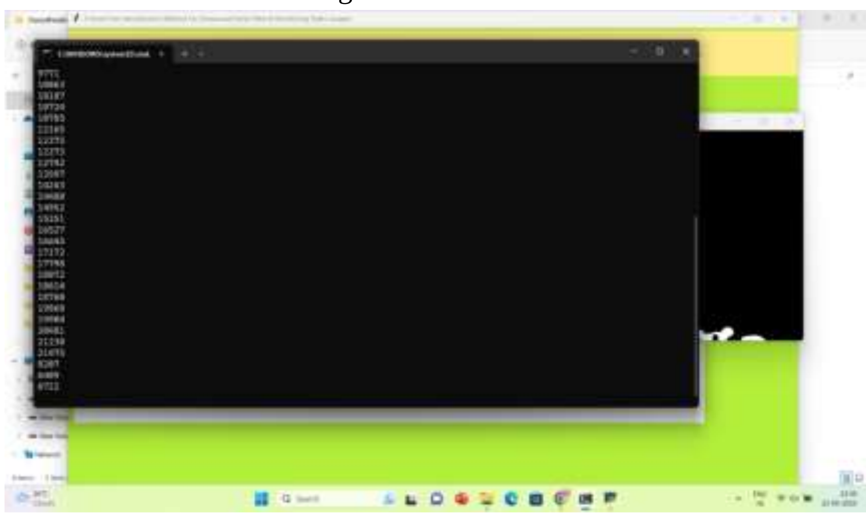

Fig.10. Movement of motion of fire

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 paper 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

Early detection and prediction will lower the count of forest fires in the entire world and save our planet Earth. In future, we can develop this model to minimize the energy consumption of all sensors and complete networks considering the node distribution among clusters using distributed sensing. In future we can insert some methodologies to track the locatiob by gps where the fire is detected and at what location as of now we are using for a particular forest , if we have initiated the gps then it will be more useful to track t& to detect the fofrest fire in early as possible. The only aim of this project is to protect our mother earth & natural resources which are present in the forest and last but not least there will be no cause of death of wild life by forest fire.

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