Emerging methods for early detection of forest fires

LITERATURE SURVE

Surapong Surit, Watchara Chatwiriya [8] 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.

Fire detection using infrared images for UAV-based forest fire surveillance

Unmanned aerial vehicle (UAV) based computer vision system, as a more and more promising option for forest fires surveillance and detection, is now widely employed. In this paper, an image processing method for the application to UAV is presented for the automatic detection of forest fires in infrared (IR) images. The presented algorithm makes use of brightness and motion clues along with image processing techniques based on histogram-based segmentation and optical flow approach for fire pixels detection. First, the histogram-based segmentation is used to extract the hot objects as fire candidate regions. Then, the optical flow method is adopted to calculate motion vectors of the candidate regions. The motion vectors are also further analyzed to distinguish fires from other fire analogues. Through performing morphological operations and blob counter method, a fire can be finally tracked in each IR image. Experimental results verified that the designed method can effectively extract and track fire pixels in IR video sequences.

An adaptive threshold deep learning method for fire and smoke detection

This paper proposes a novel method for fire and smoke detection using video images. The ViBe method is used to extract a background from the whole video and to update the exact motion areas using frame-by-frame differences. Dynamic and static features extraction are combined to recognize the fire and smoke areas. For static features, we use deep learning to detect most of fire and smoke areas based on a Caffemodel. Another static feature is the degree of irregularity of fire and smoke. An adaptive weighted direction algorithm is further introduced to this paper. To further reduce the false alarm rate and locate the original fire position, every frame image of video is divided into 16×16 grids and the times of smoke and fire occurrences of each part is recorded. All clues are combined to reach a final detection result. Experimental results show that the proposed method in this paper can efficiently detect fire and smoke and reduce the loss and false detection rates.

Learning-Based Smoke Detection for Unmanned Aerial Vehicles Applied to Forest Fire Surveillance

Forests are potentially and seriously threatened by fires which have caused huge damages and losses of life and properties every year. In general, it is easier to detect smoke than fire in its early stage. Developing an effective and safe smoke detection method is thereby critical for early forest fire fighting and preventing the fire developing into uncontrollable. This paper presents a learning-based fuzzy smoke detection approach intended to achieve an effective and early forest fire detection, while greatly reduce the negative impacts from clouds in the sky, illumination variations, and changes of forest features. First, a fuzzy-logic based smoke detection rule is designed for detecting and segmenting smoke regions in the visual images captured by the camera onboard an unmanned aerial vehicle (UAV). The differences of each two components of red, green, and blue (RGB) model and intensity in hue, saturation, and intensity (HSI) model of images are chosen as inputs of a fuzzy logic rule, while the smoke likelihood is selected as its output. Then, an extended Kalman filter (EKF) is further employed for reshaping the inputs and output of the fuzzy smoke detection rule on-line. It is expected to provide the smoke detection method with additional regulating flexibility adapting to variations of environmental conditions and reliable automatic detection performance. Next, the morphological operation is also adopted to remove imperfections induced by noises and textures distorted nonconvex/concave segments. Finally, extensive studies on several sets of images containing smoke under distinct environmental conditions are conducted to validate the proposed methodology.

Convolutional Neural Network-Based Deep Urban Signatures With Application to Drone Localization

Most commercial Small Unmanned Aerial Vehicles (SUAVs) rely solely on Global Navigation Satellite Systems (GNSSs) - such as GPS and GLONASS - to perform localization tasks during the execution of autonomous navigation activities. Despite being fast and accurate, satellite-based navigation systems have typical vulnerabilities and pitfalls in urban settings that may prevent successful drone localization. This paper presents the novel concept of "Deep Urban Signatures" where a deep convolutional neural network is used to compute a unique characterization for each urban area or district based on the visual appearance of its architecture and landscape style. Such information is used to identify the district and subsequently perform localization. The paper presents the methodology to compute the signatures and discusses the experiments carried out using Google maps and Bing maps, with latter used to simulate footage captured by SUAVs at different altitudes and/or using different camera zoom levels. The results obtained demonstrate that Deep Urban Signatures can be used to successfully accomplish district-level aerial drone localization with future work comprising accurate localization within each identified district.

A Deep Learning Based Object Identification System for Forest Fire Detection

Forest fires are still a large concern in several countries due to the social, environmental and economic damages caused. This paper aims to show the design and validation of a proposed system for the classification of smoke columns with object detection and a deep learning-based approach. This approach is able to detect smoke columns visible below or above the horizon. During the dataset labelling, the smoke object was divided into three different classes, depending on its distance to the horizon, a cloud object was also added, along with images without annotations. A comparison between the use of RetinaNet and Faster R-CNN was also performed. Using an independent test set, an F1-score around 80%, a G-mean around 80% and a detection rate around 90% were achieved by the two best models: both were trained with the dataset labelled with three different smoke classes and with augmentation; Faster R-CNNN was the model architecture, re-trained during the same iterations but following different learning rate schedules. Finally, these models were tested in 24 smoke sequences of the public HPWREN dataset, with 6.3 min as the average time elapsed from the start of the fire compared to the first detection of a smoke .

A UAV-based Forest Fire Detection Algorithm Using Convolutional Neural Network

With the new development in Unmanned Aerial Vehicle (UAV) in recent years, UAV equipped with color and infrared cameras becomes a new tool for carrying out the forest fire detection and fighting missions due to its advantages of low price, high maneuverability, and easy use. In order to detect a potential fire in its early stage, a UAV-based forest fire detection method using a convolutional neural network method is proposed in this paper. The effectiveness of the proposed fire detection algorithm is verified by using simulated flames in an indoor experimental testbed.

A Deep Learning Based Forest Fire Detection Approach Using UAV and YOLOv3

Unmanned aerial vehicles (UAVs) are increasingly being used in forest fire monitoring and detection thanks to their high mobility and ability to cover areas at different altitudes and locations with relatively lower cost. Traditional fire detection algorithms are mostly based on the RGB color model, but their speed and accuracy need further improvements. This paper proposes a forest fire detection algorithm by exploiting YOLOv3 to UAV-based aerial images. Firstly, a UAV platform for the purpose of forest fire detection is developed. Then according to the available computation power of the onboard hardware, a small-scale of convolution neural network (CNN) is implemented with the help of YOLOv3. The testing results show that the recognition rate of this algorithm is about 83%, and the frame rate of detection can reach more than 3.2 fps. This method has great advantages for real-time forest fire detection application using UAVs.

Early Forest Fire Detection Using Drones and Artificial Intelligence

Forest and urban fires have been and still are serious problem for many countries in the world. Currently, there are many different solutions to fight forest fires. These solutions mainly aim to mitigate the damage caused by the fires, using methods for their early detection. In this paper, we discuss a new approach for fire detection and control, in which modern technologies are used. In particular, we propose a platform that uses Unmanned Aerial Vehicles (UAVs), which constantly patrol over potentially threatened by fire areas. The UAVs also utilize the benefits from Artificial Intelligence (AI) and are equipped with on-board processing capabilities. This allows them to use computer vision methods for recognition and detection of smoke or fire, based on the still images or the video input from the drone cameras. Several different scenarios for the possible use of the UAVs for forest fire detection are presented and analyse in the paper, including a solution with the use of a combination between a fixed and rotary-wing drones.

Autonomous drone hunter operating by deep learning and all-onboard computations in GPS-denied environments

This paper proposes a UAV platform that autonomously detects, hunts, and takes down other small UAVs in GPS-denied environments. The platform detects, tracks, and follows another drone within its sensor range using a pre-trained machine learning model. We collect and generate a 58,647-image dataset and use it to train a Tiny YOLO detection algorithm. This algorithm combined with a simple visual-servoing approach was validated on a physical platform. Our platform was able to successfully track and follow a target drone at an estimated speed of 1.5 m/s. Performance was limited by the detection algorithm's 77% accuracy in cluttered environments and the frame rate of eight frames per second along with the field of view of the camera.

A data mining approach to predict forest fires using meteorological data

Forest fires are a major environmental issue, creating economical and ecological damage while endangering human lives. Fast detection is a key element for controlling such phenomenon. To achieve this, one alternative is to use automatic tools based on local sensors, such as provided by meteorological stations. In effect, meteorological conditions (e.g. temperature, wind) are known to influence forest fires and several fire indexes, such as the forest Fire Weather Index (FWI), use such data. In this work, we explore a DataMining (DM) approach to predict the burned area of forest fires. Five different DM techniques, e.g. Support Vector Machines (SVM) and Random Forests, and four distinct feature selection setups (using spatial, temporal, FWI components and weather attributes), were tested on recent real-world data collected from the northeast region of Portugal. The best configuration uses a SVM and four meteorological inputs (i.e. temperature, relative humidity, rain and wind) and it is capable of predicting the burned area of small fires, which are more frequent. Such knowledge is particularly useful for improving firefighting resource management (e.g. prioritizing targets for air tankers and ground crews. Constraint-

Based Measures for DNA Sequence Mining using Group Search Optimization Algorithm

DNASM, incorporating prefix span, length and width constraints and group search optimization. The complete mining process is comprised into following vital steps: 1) applying prefix span algorithm, 2) length and width constraints, 3) Optimal mining via group search optimization (GSO). We first present the concept of prefix span, which detects the frequent DNA sequence. Based on this prefix tree, length and width constraints are applied to handle restrictions. completeness of the mining result. The experimentation is carried out using DNA sequence dataset, and the evaluation with DNA sequence dataset showed that the 3s-DNASM system is good for sequence mining. The simulation results illustrated that when min_support=4, the number of DNA sequence mined only 29 patterns by 3s-DNASM system, and in this case prefix span mined about 2168 patterns.

Unmanned Aerial Vehicle (UAV) based Forest Fire Detection and monitoring for reducing false alarms in forest-fires

The primary sources for ecological degradation currently are the Forest Fires (FF). The present observation frameworks for FF absence need supporting in constant checking of each purpose of the location at all time and prime location of the fire dangers. This approach gives works on preparing UAV (Unmanned Aerial Vehicle) aeronautical picture information as indicated by the prerequisites of ranger service territory application on a UAV stage. It provides a continuous and remote watch on a flame in forests and mountains, all the while the UAV is flying and getting the elevated information, helping clients maintain the number and area of flame focuses. Observing programming spreads capacities, including Fire: source identification, area, choice estimation, and LCD module. This paper proposed includes (1) Color Code Identification, (2) Smoke Motion Recognition, and (3) Fire Classification algorithms. Strikingly, the use of a helicopter with visual cameras portrayed. The paper introduces the strategies utilized for flame division invisible cameras, and the systems to meld the information acquired the following: Correctly, the current FF location stays testing, given profoundly convoluted and non-organized conditions of the forest, smoke hindering the flame, the movement of cameras mounted on UAVs, and analogs of fire attributes. These unfavorable impacts can truly purpose either false alert. This work focuses on the improvement of trustworthy and exact FF recognition algorithms which apply to UAVs. To effectively execute missions and meet their relating execution criteria examinations on the best way to diminish false caution rates, increment the possibility of profitable recognition, and upgrade versatile abilities to different conditions are firmly requested to improve the unwavering quality and precision of FF location framework.

Autonomous quadcopter for product home delivery

This paper represents Quadcopter (QC) as a low-weight and low-cost autonomous flight capable Unmanned Aerial Vehicle (UAV) for delivering parcel ordered by online by using an android device as its core on-board processing unit. This QC by following Google map can locate and navigate destination. This paper demonstrates the QCs capability of delivering parcel ordered by online and coming back to the starting place. The promising result of this method enables future research on using QC for delivering parcel.

A Deep Learning Framework for Active Forest Fire Detection

Forest conservation is crucial for the maintenance of a healthy and thriving ecosystem. The field of remote sensing (RS) has been integral with the wide adoption of computer vision and sensor technologies for forest land observation. One critical area of interest is the detection of active forest fires. A forest fire, which occurs naturally or manually induced, can quickly sweep through vast amounts of land, leaving behind unfathomable damage and loss of lives. Automatic detection of active forest fires (and burning biomass) is hence an important area to pursue to avoid unwanted catastrophes. Early fire detection can also be useful for decision makers to plan mitigation strategies as well as extinguishing efforts. In this paper, we present a deep learning framework called Fire-Net, that is trained on Landsat-8 imagery for the detection of active fires and burning biomass. Specifically, we fuse the optical (Red, Green, and Blue) and thermal modalities from the images for a more effective representation. In addition, our network leverages the residual convolution and separable convolution blocks, enabling deeper features from coarse datasets to be extracted. Experimental results show an overall accuracy of 97.35%, while also being able to robustly detect small active fires. The imagery for this study is taken from Australian and North American forests regions, the Amazon rainforest, Central Africa and Chernobyl (Ukraine), where forest fires are actively reported.