EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

TECHNOLOGY : ARTIFICIAL INTELLIGENCY

BATCH : B7-1A3E

TEAM LEADER : DHARANIDHARAN.L

TEAM MEMBER 1 : BARANIDHARAN.M

TEAM MEMBER 2 : LINGESWARAN.R

TEAM MEMBER 3 : VENKATESH.A

TEAM MEMBER 4 : TAMILPRAKASH.T

PAPER 1: Early Detection of Forest and Land Fires

Published Year : 2022

Author : Alya Faryanti Purbahapsari, and Irene B. Batoarung

Journal Name : KnE Social Sciences

Summary : Over the years, early detection of forest and land fires has been conducted using hotspot data provided by the National Institute of Aeronautics and Space (LAPAN), based on its interpretation of satellite images. The hotspot data have tremendously helped firefighting efforts and further enforcement. However, the system has several shortcomings, especially due to its inability to distinguish forest and land fires from other hot surfaces or fires caused by common human activities. Furthermore, this method also requires labor-intensive verification, and heavily relies on human factors for advanced analysis and validation. Recently, the DG of Law Enforcement of the Ministry of Environment and Forestry (DGLE MoEF) has been piloting a new approach through advancement in artificial intelligence, called Geospatial Artificial Intelligence (GeoAI). By utilizing recorded satellite image data from 2017 - 2019, the machine has been trained to recognize the pattern and tone of the image in burnt areas so that it can validate the presence of the burnt area based on the history of Sentinel-2 imagery for the past week at each cluster. DGLE MoEF found that the burnt area data processed by GeoAI has better accuracy than the hotspot count for forest and land fire identification.

PAPER 2: Forest Fire Smoke Detection

Published Year : 2022

Author : Yaowen Hu

Journal Name : Knowledge-Based Systems

Summary : Forest fires are a huge ecological hazard, and smoke is an early characteristic of forest fires. Smoke is present only in a tiny region in images that are captured in the early stages of smoke occurrence or when the smoke is far from the camera. Furthermore, smoke dispersal is uneven, and the background environment is complicated and changing, thereby leading to inconspicuous pixel-based features that complicate smoke detection. In this paper, we propose a detection method called multioriented detection based on a value conversion-attention mechanism module and Mixed-NMS (MVMNet). First, a multioriented detection method is proposed. In contrast to traditional detection techniques, this method includes an angle parameter in the data loading process and calculates the target's rotation angle using the classification prediction method, which has reference significance for determining the direction of the fire source. Then, to address the issue of inconsistent image input size while preserving more feature information, Softpool-spatial pyramid pooling (Soft-SPP) is proposed. Next, we construct a value conversion-attention mechanism module (VAM) based on the joint weighting strategy in the horizontal and vertical directions, which can specifically extract the colour and texture of the smoke. Ultimately, the DIoU-NMS and Skew-NMS hybrid nonmaximum suppression methods are employed to address the issues of smoke false detection and missed detection. Experiments are conducted using the homemade forest fire multioriented detection dataset, and the results demonstrate that compared to the traditional detection method, our model's mAP reaches 78.92%, mAP 50 reaches 88.05%, and FPS reaches 122.

PAPER 3: Fire Detection Using Deep Learning

Published Year : 2020

Author : Suhas.G and Abhishek B

Journal Name : International Journal of Progressive Research in Science and Engineering

Summary : From sprawling urbans to dense jungles, fire accidents pose a major threat to the world. These could be prevented by deploying fire detection systems, but the prohibitive cost, false alarms, need for dedicated infrastructure, and the overall lack of robustness of the present hardware and software-based detection systems have served as roadblocks in this direction. In this work, we endeavor to make a stride towards detection of fire in videos using Deep learning. Deep learning is an emerging concept based on artificial neural networks and has achieved exceptional resultsin various fields including computer vision. We plan to overcome the shortcomings of the present systems and provide an accurate and precise system to detect fires as early as possible and capable of working in various environments thereby saving innumerable lives and resources. Fire accidents pose a serious threat to industries, crowded events, social gatherings, and densely populated areas that are observed across India. These kinds of incidents may cause damage to property, environment, and pose a threat to human and animal life. According to the recent National Risk Survey Report [1], Fire stood at the third position overtaking corruption, terrorism, and insurgency thus posing a significant risk to our country's economy and citizens. The recent forest-fires in Australia reminded the world, the destructive capability of fire and the impending ecological disaster, by claiming millions of lives resulting in billions of dollars in damage. Early detection of fire-accidents can save innumerable lives along with saving properties from permanent infrastructure damage and the consequent financial losses. In order to achieve high accuracy and robustness in dense urban areas, detection through local surveillance is necessary and also effective. Traditional opto-electronic fire detection systems have major disadvantages: Requirement of separate and often redundant systems, fault-prone hardware systems, regular maintenance, false alarms and so on. Usage of sensors in hot, dusty industrial conditions is also not possible. Thus, detecting fires through surveillance video stream is one of the most feasible, cost-effective solution suitable for replacement of existing systems without the need for large infrastructure installation or investment. The existing video-based machine learning models rely heavily on domain knowledge and feature engineering to achieve detection therefore, have to be updated to meet new threats.

PAPER 4: Emerging Methods for Early Detection of Forest Fires Using Unmanned Aerial Vehicles and Lorawan Sensor Networks

Published Year : 2018

Author **:** Georgi Hristov, Jordan Raychev, Diyana Kinaneva, Plamen Zahariev

Journal Name **:** EAEEIE Annual Conference (EAEEIE)

Summary : Forest fires are occurring throughout the year with an increasing intensity in the summer and autumn periods. These events are mainly caused by the actions of humans, but different nature and environmental phenomena, like lightning strikes or spontaneous combustion of dried leafs or sawdust, can also be credited for their occurrence. Regardless of the reasons for the ignition of the forest fires, they usually cause devastating damage to both nature and humans. Forest fires are also considered as a main contributor to the air pollution, due to the fact that during every fire huge amounts of gases and particle mater are released in the atmosphere. To fight forest fires, different solutions were employed throughout the years. They ware primary aimed at the early detection of the fires. The simplest of these solutions is the establishment of a network of observation posts - both cheap and easy to accomplish, but also time-consuming for the involved people. The constant evolution of the information and communication technologies has led to the introduction of a new generation of solutions for early detection and even prevention of forest fires. ICT-based networks of cameras and sensors and even satellite-based solutions were developed and used in the last decades. These solutions have greatly decreased the direct involvement of humans in the forest fire detection process, but have also proven to be expensive and hard to maintain. In this paper we will discuss and present two different emerging solutions for early detection of forest fires. The first of these solutions involves the use of unmanned aerial vehicles (UAVs) with specialized cameras. Several different scenarios for the possible use of the drones for forest fire detection will be presented and analysed, including a solution with the use of a combination between a fixed-wind and a rotary-wing UAVs. In the next chapter of the paper, we will present and discuss the possibilities for development of systems for early forest fire detection using LoRaWAN sensor networks and we will analyse and present some of the hardware and software components for the realisation of such sensor networks. The paper will also provide another point-of-view, which will present the involvement of students in the development and in the use of both systems and we will analyse the advantages and the benefits, which the students will gain from their work on and with these solutions.

PAPER 5: Early Forest Fire Detection Using Drones and Artificial Intelligence

Published Year : 2019

Author **:** Diyana Kinaneva, Georgi Hristov, Jordan Raychev

Journal Name **:** International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO)

Summary: 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.

PAPER 6: Forest Fire Detection Through Various Machine Learning Techniques using Mobile Agent in Wireless Sensor Network

Published Year : 2016

Author **:** Anupam Mittal, Geetika Sharma, Ruchi Aggarwal

Journal Name **:** International Research Journal of Engineering and Technology

Summary : Wireless sensor networks monitor dynamic environments that change suddenly over time. Machine learning also inspires many practical solutions that less energy consumption and to increase network lifetime. This paper provides review of machine learning techniques for detection of forest fire in wireless sensor network. Forests play an important role for supporting the human environment and Forest fires are among the largest dangers for forest preservation. Wireless Sensor Networks are used to forest fire detection.

PAPER 7: Forest Fire Detection Solution Based on UAV Aerial Data

Published Year : 2015

Author **:** Lan Zhang, Bing Wang, Weilong Peng

Journal Name **:** International Journal of Smart Home

Summary : This software provides functions on processing UAV (unmanned aerial vehicle) aerial image data according to the requirements of forestry area application on UAV platform.It gives a real-time and remote watch on fire in Greater Xing' an Mountains, simultaneously the UAV is flying and getting the aerial data, helping users quickly master the number and location of fire points. Monitoring software covers functions including fire source detection module, fire location module, fire range estimation module, and report generation module. Mutual cooperation among the various modules improves operational efficiency and detection reliability of the system. What's more, user-friendly visual interface is provided to give a convenience in user operation and interaction.

PAPER 8: Artificial Intelligence for Forest Fire Prediction

Published Year : 2010

Author **:** George E. Sakr, Imad H. Elhajj, George Mitri

Journal Name **:** IEEE/ASME International Conference on Advanced Intelligent Mechatronics- IEEE XPLORE

Summary : Forest fire prediction constitutes a significant component of forest fire management. It plays a major role in resource allocation, mitigation and recovery efforts. This paper presents a description and analysis of forest fire prediction methods based on artificial intelligence. A novel forest fire risk prediction algorithm, based on support vector machines, is presented. The algorithm depends on previous weather conditions in order to predict the fire hazard level of a day. The implementation of the algorithm using data from Lebanon demonstrated its ability to accurately predict the hazard of fire occurrence.

PAPER 9: An Intelligent System For Effective Forest Fire Detection Using Spatial Data

Published Year : 2010

Author **:** Dr.N.Radhakrishnan, K.Angayarkkani

Journal Name **:** International Journal of Computer Science and Information Security (IJCSIS)

Summary : The explosive growth of spatial data and extensive utilization of spatial databases emphasize the necessity for the automated discovery of spatial knowledge. In modern times, spatial data mining has emerged as an area of voluminous research. Forest fires are a chief environmental concern, causing economical and ecological damage while endangering humanlives across the world. The fast or early detection of forest fires isa vital element for controlling such phenomenon. The application of remote sensing is at present a significant method for forest fires monitoring, particularly in vast and remote areas. Different methods have been presented by researchers for forest fire detection. The motivation behind this research is to obtain beneficial information from images in the forest spatial data and use the same in the determination of regions at the risk of fires by utilizing Image Processing and Artificial Intelligence techniques.

PAPER 10: Real-Time Forest Fire detection with Wireless Sensor Networks

Published Year : 2005

Author **:** Liyang Yu, Neng Wang

Journal Name **:** International Conference on Wireless Communications, Networking & Mobile Computing-IEEE XPLORE

Summary: 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.