Emerging Methods for Early Detection of Forest Fires

Literature Survey

S.No	Title	Author and Publication year	Proposed work	Advantages	Limitations
1.	Early Detection of Forest Fire Using Mixed Learning Techniques and UAV [1]	Varanasi LVSKB Kasyap, et al (2022)	The proposed work deployed on an onboard UAV uses a mixed deep learning technique composed of YOLOv4 tiny and LiDAR techniques. It has achieved 1.24 seconds of classification time with an accuracy of 91% and an F1 score of 0.91.	The proposed model outperforms the traditional methods such as Bayesian classifiers, random forest, and support vector machines.	This model is sensitive to the forest with dense fogs and clouds. This is because smoke appears the same as fog, and the model may misclassify the fog as smoke.
2.	Predictive modeling of wildfires: A new dataset and machine learning approach [2]	Younes OuladSayad, et al (2019)	This paper proposed a methodology to analyze the created dataset in order to predict the occurrence of wildfires in a specific region. Artificial Neural Networks and Support Vector Machines were implemented in “Databricks”. The model gave good results for both algorithms (SVM 97.48%, NN 98.32%);	The accuracy was assessed using classification metrics, cross-validation, and regularization. Thus, they confirm the efficiency of the model in predicting the occurrence of wildfires.	Weather data must be included as it plays a major role in the occurrence, growth, spread and the Extinction of wildfires. It can impact on the strength and movement of fire, and thus burn more land, which makes its extinction even more difficult.
3.	Fire detection using infrared images for UAV-based forest fire surveillance [3]	Chi Yuan, et al (2017)	The paper proposed an image processing method for the application to UAV for the automatic detection of forest fires in infrared (IR) images. The algorithm makes use of brightness and motion clues along with image processing techniques based on	This approach uses both brightness and motion features of fire to improve the accuracy and reliability. Histogram based segmentation and optical flow analysis,differenti	Using only IR images may lead to false alarms. The combination of IR images with visible range images together to reduce the false alarm rates of fire detection.arm

			histogram-based segmentation and optical flow approach for fire pixels detection.	ates fires from background as well as non-fire hot moving objects.	results.
4.	An intelligent system for false alarm reduction in infrared forest-fire detection [4]	B.C. Arrue, et al (2000)	The FAR system consists of applying new infrared-image processing techniques and artificial neural networks (ANNs), using additional information from meteorological sensors and from a geographical information database, taking advantage of the information redundancy from visual and infrared cameras through a matching process, and designing a fuzzy expert rule base to develop a decision function.	The study presented indicates a dramatic decrease in the false alarm rate maintaining the detection capabilities.	Incorporation of low-cost infrared detectors to increase the functional surveillance area and avoid hidden zones in areas with abrupt topographic irregularities
5.	Forest Fire Detection System Using IoT and Artificial Neural Network [5]	Vinay Dubey, et al (2018)	This paper makes use of Internet of things technology.The early fire detection model has been proposed with the help of the Raspberry Pi microcontroller and required sensors. Centralized server is used for storing the data and analyzing that data. Feed-forward fully connected neural network is used for prediction purposes. Then, an alert message is sent to the admin and to the people within the proximity.	Compared to other forest fire technologies, wireless sensor network with IoT is better to detect fire. Detection and the communication to the authorities can be done with minimum delay.	Wireless sensor networks are vulnerable to malicious security attacks, as they often lack any robust security system.
6.	Big data and artificial intelligence based early risk	Yong Chang Zang, et al (2020)	In this paper, a Deep Belief Network (DBN) with Recurrent LSTM Neural Network	The combination of proposed DBN-R-LSTM-NN	DBN requires huge data to perform better techniques and is expensive to

	warning system of fire hazard for smart cities [6]		(RLSTM-NN) is proposed for prediction of big data that are collected from smart cities based on IoT. Moreover, the proposed model mainly concentrates in predicting the fire hazard values that gathered from smart cities using IoT devices.	with IoT sensors gives betterment in performance of detection of fire outbreak. The large collection of data through IoT devices is processed through Arduino MCU which the acts as a brain for gathering data.	train because it has complex data models.
7.	A Deep Learning Based Forest Fire Detection Approach Using UAV and YOLOv3 [7]	Zentian Zho, et al (2019)	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	YOLOv3 has unparalleled advantages in the speed and accuracy of object detection, mainly due to its superior Algorithm. 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.	The detection algorithm is sensitive to large-area forest fires, and the performance needs further improvements in small-scale (such as the small fire spots in the forest).
8.	A YOLO based Technique for Early Forest Fire Detection [8]	Sidhant Goyal, et al (2020)	This paper makes use of a deep learning algorithm which has a minimum number of false positives and gives a good accuracy in real time data and at the lowest cost possible to our drone to monitor forest fire as early as possible and report it to the concerned authority. The technology used to locate a forest or a bush fire is based on the concept of deep learning and YOLO algorithm. This deep learning model	It saves human labour effort and intelligence from doing repeated and endless tasks. Can monitor areas where human survival is next to impossible.It can decrease the response time of various forest fire departments.	YOLO struggles to detect close objects and small objects because each grid can propose only 2 bounding boxes.

			is deployed on a Raspberry-Pi with neural stick on a UAV which help in detection of fire		
9.	Early Forest Fire Detection Using Drones and Artificial Intelligence [9]	Diyana Kinaneva, et al (2019)	This work 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 analyzed.	The system could enhance the available platforms for fire detection which significantly reduce the damages caused by untimely or late fire detection.	UAVs can be hijacked or manipulated. They can also trespass into authorized areas such as airports and military zones.
10.	SIADEX: An interactive knowledge-based planner for decision support in forest fire fighting [10]	Marc de la Asunción, et al (2005)	This paper has outlined the architecture of SIADEX, an integrated system in development under a research contract with the Andalusian Regional Ministry of Environment. It is based on several AI techniques and it is intended to serve as an intelligent decision support system for the design of forest fire fighting plans. It is based on four main components, a web server, that	SAIDEX is an easy to use tool for the technical staff of forest fire fighting, who are not experts in AI techniques, but that may access the system painlessly through a web service.	The main drawback of SIADEX, is that it requires end users to have a deep knowledge of planning techniques either to interact or to provide knowledge for the system

			centralizes all the flow of information between the system and the user, the ontology server, that is the cornerstone of the architecture as the basis for knowledge sharing and exchange between all the components, and the planning and monitoring servers that are offered as intelligent services through the web server.		

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Links:

1. https://www.hindawi.com/journals/cin/2022/3170244/
2. https://sci-hub.se/10.1016/j.firesaf.2019.01.006
3. https://ieeexplore.ieee.org/abstract/document/7991306
4. https://www.researchgate.net/publication/3420522_Arrue_BC_An_intelligent_system_for_false_alarm_reduction_in_infrared_forest-fire_detection_IEEE_Intelligent_Systems_and_their_Applications_153_64-73
5. https://sci-hub.se/10.1007/978-981-13-2324-9_33
6. https://sci-hub.se/https://doi.org/10.1016/j.seta.2020.100986
7. https://ieeexplore.ieee.org/abstract/document/8850815
8. https://www.researchgate.net/publication/342151249_A_YOLO_based_Technique_for_Early_Forest_Fire_Detection
9. https://ieeexplore.ieee.org/document/8756696
10. https://www.researchgate.net/publication/220308820_SIADEX_An_interactive_knowledge-based_planner_for_decision_support_in_forest_fire_fighting