Ideation Phase

Literature

Survey

Date	20 October 2022
Team ID	PNT2022TMID51523
Project Name	Emerging Methods for Early Detection of Forest Fires
Maximum Marks	2 Marks

Emerging Methods for Early Detection of Forest Fires

Literature survey

Georgi Hristov et.al. [1] Forest Fires are mainly caused by the actions of humans, but different nature and environmental phenomena, like lightning strikes or spontaneous combustion of dried leaves 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 number 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 Lora WAN sensor networks and we will analyse and present some of the hardware and software components for the realisation of such sensor networks.

Chi Yuan et.al. [2] Over the last decade, UAV-based forest fire fighting technology has shown increasing promise. This paper presents a systematic overview of current progress in this field. First, a brief review of the development and system architecture of UAV systems for forest fire monitoring, detection, and fighting is provided. Next, technologies related to UAV forest fire monitoring, detection, and fighting are briefly reviewed, including those associated with fire detection, diagnosis, and prognosis, image vibration elimination, and cooperative control of UAVs. The final section outlines existing challenges and potential solutions in the application of UAVs to forest firefighting.

Mohamed Hefeeda et.al. [3] Early detection of forest fires is the primary way of minimizing their damages. We first present the key aspects in modelling forest fires according to the Fire Weather Index (FWI) System which is one of the most comprehensive forest fire danger rating systems in North America. Then, we model the forest fire detection problem as a node k-coverage problem ($k \geq 1$). We propose approximation algorithms for the node k-coverage problem which is shown to be NP-hard. We present a constant-factor centralized algorithm, and a fully distributed version which does not require sensors know their locations.

Priyadarshini M Hanamaraddi et.al. [4] Forests can purify water, stabilize soil, cycle nutrients, moderate climate, and store carbon. They can create habitat for wildlife and nurture environments rich in biological diversity. They can also contribute billions of dollars to the country's economic wealth. However, hundreds of millions of hectares of forests are unfortunately devastated by forest fire each year. Forest fire has been constantly threatening to ecological systems, infrastructure, and public safety. In the image processing-based forest fire detection, method adopts rule-based colour model due to its less complexity and effectiveness. The method not only separates fire flame pixels but also separates high temperature fire centre pixels by taking in to account of statistical parameters of fire image like mean and standard deviation. This paper presents a literature study on Image processing for forest fire detection.

Panagiotis Barmpoutis et.al. [5] The environmental challenges the world faces nowadays have never been greater or more complex. Global areas covered by forests and urban woodlands are threatened by natural disasters that have increased dramatically during the last decades, in terms of both frequency and magnitude. Large-scale forest fires are one of the most harmful natural

hazards affecting climate change and life around the world. Thus, to minimize their impacts on people and nature, the adoption of well-planned and closely coordinated effective prevention, early warning, and response approaches are necessary. This paper presents an overview of the optical remote sensing technologies used in early fire warning systems and provides an extensive survey on both flame and smoke detection algorithms employed by each technology.

Three types of systems are identified, namely terrestrial, airborne, and spaceborne-based systems, while various models aiming to detect fire occurrences with high accuracy in challenging environments are studied.

Vinay Chowdary et.al. [6] Forest fire disasters have always been mankind's constant and inconvenient companion since time immemorial. In the recent past years, managing crisis for example a large-scale fire has become a very difficult and challenging task. Things that are common in most of the forest fire that occur at large scale are loss of life (human or animal), loss of vegetation, loss of flora and fauna, and communication failure (if any). Apart from causing a great loss to valuable natural resources of nature forest fire pose a greater risk not only to life of human being but also to the inhabitant's such as wild life living in the forest. As per National Fire Danger Rating System (NFDRS), if a fire is detected within 6 minutes of its occurrence, then it can be easily disposed-off before it turns into a large-scale fire. For this a network that can detect fire at a very early stage is required. There are numerous techniques to detect the occurrence of forest fire and this article is dedicated towards reviewing detection techniques present in the literature. This work will give a bird's eye view of the technologies used in automatic detection of forest fires and reviews almost all the detection techniques available in the literature. To the best of our knowledge this is the first time that almost all the techniques available in the literature are reviewed and considering almost all the parameters.

Majid Bahrepour et.al. [7] Automatic fire detection is important for early detection and promptly extinguishing fire. There are ample studies investigating the best sensor combinations and appropriate techniques for early fire detection. In the previous studies fire detection has either been considered as an application of a certain field or the main concern for which techniques have been specifically designed. These different approaches stem from different backgrounds of researchers dealing with fire, such as computer science, geography and earth observation, and fire safety.

Dr.L.Latha et.al. [8] Fire detection at an early stage is important for the safety of the people. Lack of information due to manual detection is the main cause of failure of fire detection. Fire can be detected by using smoke at an early stage as it is the fire indicator. Generally automatic forest fire detection using image processing techniques represents one of the significant aspects of forest fire avoidance earlier. Detection using image and video is effective than using sensors.

In image processing the inputs for the fire detection may be an image or a video but the input as a video is quite complex process but provides good result. The techniques such as Wavelet decomposition, spatial and temporal analysis, Gaussian Mixture Model, Multi-Feature fusion detect fire in an accurate manner.

P. Piccinini et.al. [9] The proposed method exploits two features: the variation of energy in wavelet model and a color model of the smoke. Smoke is detected based on the decrease of energy ratio in wavelet domain between background and current. The deviation of the current pixel color is measured by the color model. Bayesian classifier is used to combine these two features to detect smoke.

References:

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