Literature survey

EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRES

Introduction

Forests are the protectors of earth's ecological balance. Unfortunately, the forest fire is usually only observed when it has already spread over a large area, making its control and stoppage arduous and even impossible at times. The result is devastating loss and irreparable damage to the environment and atmosphere (30% of carbon dioxide (CO_2) in the atmosphere comes from forest fires) in addition to irreparable damage to the ecology (huge amounts of smoke and carbon dioxide (CO_2) in the atmosphere). Among other terrible consequences of forest fires are long-term disastrous effects such as impacts on local weather patterns, global warming, and extinction of rare species of the flora and fauna.

The problem with forest fires is that the forests are usually remote, abandoned/unmanaged areas filled with trees, dry and parching wood, leaves, and so forth that act as a fuel source. These elements form a highly combustible material and represent the perfect context for initial-fire ignition and act as fuel for later stages of the fire. The fire ignition may be caused through human actions like smoking or barbeque parties or by natural reasons such as high temperature in a hot summer day or a broken glass working as a collective lens focusing the sun light on a small spot for a length of time thus leading to fire-ignition. Once ignition starts, combustible material may easily fuel to feed the fires central spot which then becomes bigger and wider. The initial stage of ignition is normally referred to as “surface fire” stage. This may then lead to feeding on adjoining trees and the fire flame becomes higher and higher, thus becoming “crown fire.” Mostly, at this stage, the fire becomes uncontrollable and damage to the landscape may become excessive and could last for a very long time depending on prevailing weather conditions and the terrain.

1 A Review on Forest Fire Detection Techniques

- Author name : AAhmad A.A.Alkhatib
- Published : March 4, 2014

Context . Apart from causing tragic loss of lives and valuable natural and individual properties including thousands of hectares of forest and hundreds of houses, forest fires are a great menace to ecologically healthy grown forests and protection of the environment. Every year, thousands of forest fires across the globe cause disasters beyond measure and description. This issue has been the research interest for many years; there are a huge amount of very well studied solutions available out there for testing or even ready for use to resolve this problem.*Aim* . This work will summarise all the technologies that have been used for forest fire detection with exhaustive surveys of their techniques/methods used in this application.*Methods* . A lot of methods and systems are available in the market and for research. The paper reviews all the methods and discusses examples of research experiment results and some market product methods for better understanding.*Result* . Each technique has its own advantages and disadvantages. A full discussions provided after each type.*Conclusion* . A full table is provided at the end to summarise a comparison between the four methods.

2 Forest Fire Detection and Identification Using Image Processing and SVM

- Author name : Mahmoud, Mubarak Adam Ishag
- Published : Feb 28, 2019

Accurate forest fires detection algorithms remain a challenging issue, because, some of the objects have the same features with fire, which may result in high false alarms rate. This paper presents a new video-based, image processing forest fires detection method, which consists of four stages. First, a background-subtraction algorithm is applied to detect moving regions. Secondly, candidate fire regions are determined using CIE L*a*b*L*a*b* color space. Thirdly, special wavelet analysis is used to differentiate between actual fire and fire-like objects, because candidate regions may contain moving fire-like objects. Finally, support vector machine is used to classify the region of interest to either real fire or non-fire. The final experimental results verify that the proposed method effectively identifies the forest fires.

3. A Review on Early Forest Fire Detection Systems Using Optical Remote Sensing

- Author name : Dr. Panagiotis Barmpoutis , PeriklisPapaioannou, Dr. Kosmas Dimitropoulos , Dr. Nikos GRAMMALIDIS
- Published : November 11, 2020

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. Finally, the strengths and weaknesses of fire detection systems based on optical remote sensing are discussed aiming to contribute to future research projects for the development of early warning fire systems.

4. Efficient Forest Fire Detection Index for Application in Unmanned Aerial Systems (UASs)

- Author name : Dr. Martina Eckert , Henry Cruz , Dr. Juan Meneses , Prof. Dr. Jose-Fernan Martinez
- Published : June 16, 2016

This article proposes a novel method for detecting forest fires, through the use of a new color index, called the Forest Fire Detection Index (FFDI), developed by the authors. The index is based on methods for vegetation classification and has been adapted to detect the tonalities of flames and smoke; the latter could be included adaptively into the Regions of Interest (RoIs) with the help of a variable factor. Multiple tests have been performed upon database imagery and present promising results: a detection precision of 96.82% has been achieved for image sizes of 960 × 540 pixels at a processing time of 0.0447 seconds. This achievement would lead to a performance of 22 f/s, for smaller images, while up to 54 f/s could be reached by maintaining a similar detection precision. Additional tests have been performed on fires in their early stages, achieving a precision rate of p = 96.62%. The method could be used in real-time in Unmanned Aerial Systems (UASs), with the aim of monitoring a wider area than through fixed surveillance systems. Thus, it would result in more cost-effective outcomes than conventional systems implemented in helicopters or satellites. UASs could also reach inaccessible locations without jeopardizing people's safety. On-going work includes implementation into a commercially available drone.