Name(s)	Project Number
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Project Title

Stop the Flame in Its Infancy! Multivariable Early-Warning System for Low-Cost Prevention of Wildfire Proliferation

Abstract

Objectives/Goals
In 2017, Devastating fires burned throughout the Napa Valley and Southern California, resulting in immense destruction, financial loss, and even casualties. In most present cases, firefighters are unable to identify wildfires until the flames grow into uncontrollable blazes. Thus, the main goal of the project was to create a low-cost, multivariable, distributed system for confident detection of wildfires that can be widely implemented for effective prevention of wildfire proliferation.

Methods/Materials
The present system consists of dispersed data acquisition devices that all wirelessly communicate with each other and a central workstation to provide comprehensive real-time monitoring of fire in the area. To confidently detect dangerous flames and evade false positives, multiple stages of verification are employed in order to use a variety of fire characteristics during detection (near infrared wide-band measurement, long-wave infrared thermal imaging, near infrared narrow-band imaging, smoke signature, and others).

Results
By using a variety of fire characteristics and environmental variables, the system was able to reliably detect small 1x1 meter fires from a large distance (70-90 meters). More realistic larger flames can be detected at much larger distances. The most probable false positives (e.g. direct sunlight, street lights, sky luminescence, car lights, etc) were proved to not set off fire warnings due to the system's multivariable verification algorithm. Various wildfire emission characteristics were studied to identify unique spectral features used in the detection method. Environmental factors such as wind patterns, temperature and humidity variation, are compensated by an algorithm that compares real-time readings to a calibrated baseline.

Conclusions/Discussion
The novel, affordable method of early-stage wildfire detection provided by this unique system will allow firefighters to contain fires before they transform into an uncontrollable inferno. Thus, the distributed system can save billions of dollars in fire damage and prevent future wildfire-related fatalities.

Summary Statement

I developed a novel, low-cost system that uses multiple fire characteristics and environmental variables to detect wildfires at their earliest stage, allowing firefighters to combat flames before they grow into deadly infernos.

Help Received

My high school science teacher (Mrs. Roxanna Jackman) provided advice on fire properties. My father helped me to borrow a spectrometer that was used to research spectral properties of various emission sources.