Networked, Autonomous Field Deployable Fire Sensors

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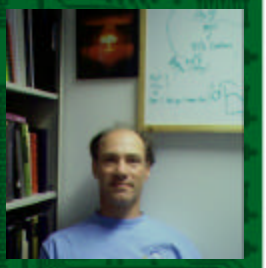

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Abstract

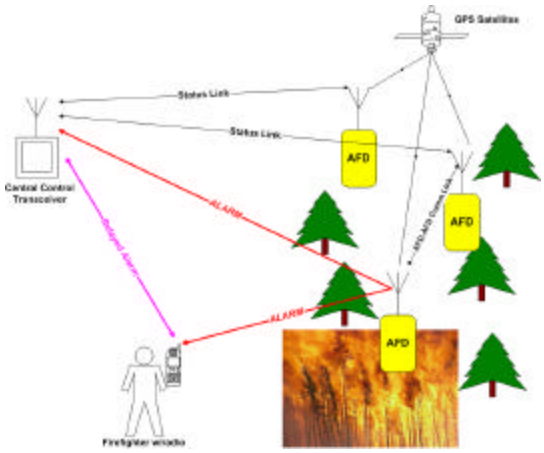
An autonomous fire detector (AFD) is an electronic system consisting of fire detection sensors, a power source, a communication radio and a global positioning system receiver (GPS). AFDs will be stationed as sentries in and around a fire site to monitor the location and movement of the fire. The package could be dropped by spotter planes at a fire site or positioned by firefighters already on the ground. Using current radio technology, an AFD could be made to operate for a many days with a simple dry battery pack, and could be made to have a transmitting range of several kilometers. AFDs could communicate unit-to-unit as well as unit-to-base, which would provide extended range and flexibility. A transceiver/display unit carried by a fire team could be made equally light, inexpensive and portable. These devices could markedly increase safety and efficacy of the fire fighting team. AFDs can now be made with commercial-off-the-shelf components. The widespread availability of powerful microprocessors, sensitive detectors for particulate smoke, carbon monoxide and other fire-evolved gases and GPS receiver modules mean that small, inexpensive, field-deployable packages can be produced inexpensively to remotely sense fire phenomena. We have developed system models and built a prototype AFD using inexpensive, readily available components.

Concept

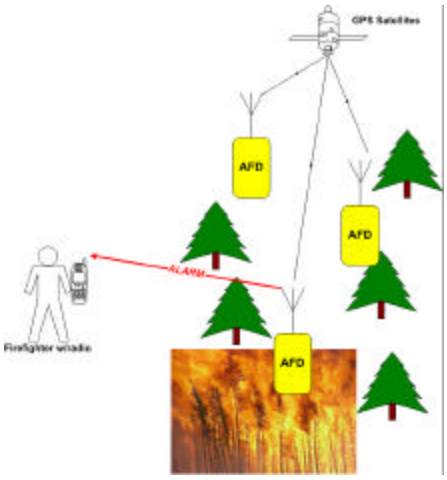
In use, the AFDs would be dropped from a spotter plane or placed manually by fire crews over an area where a fire had previously been detected. The mechanical package of the AFD can be designed to be canopy penetrating (to descend to the forest floor) or canopy snagging (hangs in the upper branches of the canopy). The devices would periodically report their position and fire status to each other, a central receiver, or to radio receiving equipment provided to firefighters.

After they are deposited in the fire area, AFDs will locate themselves (via their internal GPS receiver) and report their position and fire alarm status. Communication will be provided by a low power radio transceiver, which allows AFD-to-AFD as well as AFD-to-base unit communication. One option for communication is a digital link with a network protocol. A diagram of the communication links between the various units is shown in Figure 1. The AFDs will periodically report their status to each other and a central control transceiver unit. On detection of a fire, the reporting AFD or AFDs will transmit an alarm to other AFDs in the area and to the central transceiver. Crews in the area can be alerted either directly from the reporting AFD, or through alarm messages that are relayed from the control transceiver.

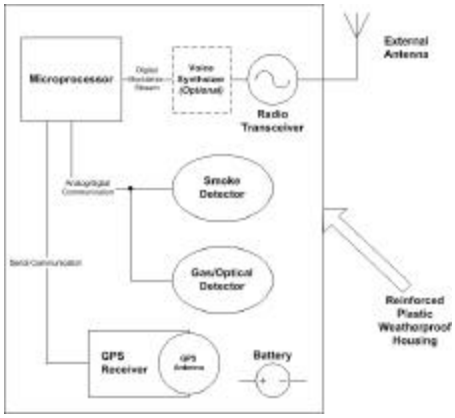
A prototype AFD with microprocessor and radio transmitter sub-units. A- Microprocessor; B- Analog processing; C- Input switches; D- Status LEDs; E- GPS communication port; F- RF communication deck



AFDs can communicate among themselves and to base units and firefighters on the ground. A fully networked system is shown. Each AFD can operate independently to detect fire within its effective detection radius. This level of networking and interoperability represents an advanced AFD concept. The detection radius depends on the severity of the fire, the sense gas/system employed on the AFD and prevailing weather conditions.



There are many other simple communication configurations for AFDs. In this configuration, AFDs are totally autonomous, and report their fire alarm condition via a synthesized voice to firefighters using their VHF/UHF FM portable radios ('handi-talkies') . AFDs report at different times in order to avoid data collisions, and can be kept synchronized because of the high accuracy of the GPS clock.



Block diagram of the AFD showing logical and signal interconnections between the fire sensors, global positioning system receiver (GPS), radio transceiver, and power system. In this particular version of the AFD, a smoke detector (ionization or light transmission) and gas detector (CO, methyl chloride, or CO_2) are used in combination to reduce the chance of false alarms and provide enhanced operational range.