Wireless Sensor Networks for Early Wildfire Detection

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POSETR ABSTRACT/SUMMARY

The increased destruction caused by wildfires necessitates detection strategies to increase emergency response in order to minimize potential damage. An important aspect of designing a wildfire detection system is being able to accurately monitor a large outdoor area for any signs of wildfire, and quickly respond to any detected emergency. This paper describes a wildfire detection implementation that utilizes a wireless sensor network that can cover a high-risk area to monitor for signs of wildfire. Once signs of wildfire are detected on the wireless sensor network, it alerts an autonomous rover that will quickly travel to and investigate the area and assess the situation. After a fire has been detected by the sensors and is verified by the rover, the proper authorities will be notified to provide a quick response to the wildfire. The wireless sensor network developed in this project is a useful application of Internet of Things technology.

The use of a wireless sensor network provides an easy implementation for wildfire detection over a large area. Wireless sensor networks can be easily configured and customized for large, irregular areas by adding more nodes. Through this, it is easy and fast to implement a wireless sensor network for a designed wildfire detection system with minimal extra configuration.

Each node of the wireless sensor network has a variety of sensors, such as temperature and smoke sensors, that can detect signs of wildfire. GPS modules equipped to each node will be able to send the coordinates of the node, so that the precise location of a wildfire will be known as soon as signs of wildfire are detected. The nodes can send information between each other, and the data can be monitored in real time through an app.

Once a wildfire is detected, an autonomous rover is dispatched to travel to the location and verify the wildfire. This allows for an accurate verification, to ensure that there are no false positives for the wildfire detection and makes sure that resources are wisely expended in responding to actual wildfires. The rover is equipped with each sensor that the nodes have, as well as a camera and infrared camera to have a greater accuracy in detecting and assessing wildfires.

The real-time data from the system can also be monitored by a user manually through the app. However, the automatic monitoring allows for a greater degree of accuracy with minimal human intervention. The only time when there is manual control required in the system is responding to the wildfire after the system detects it and sends an alert.

Arduino is used for the microcontrollers of the rover and nodes due to the ease of implementation, low cost, and high level of flexibility. Our implementation is using Arduino Nano for the nodes of the wireless sensor network, which makes the system low cost and easy to configure. The rover uses Arduino Mega 2560 as the microcontroller. For the wireless sensor network configuration, XBee boards are used for the nodes to communicate with each other. The modules on each node include a NEO-6m GPS module, MQ2 Gas sensor, and a DHT-22 Temperature and Humidity sensor. Building on our research, the wireless sensor network implementation can be easily modified for different applications as well, by adding more sensors to the nodes and changing the parameters in the app. One such example would be adding wireless sensor network nodes around a large factory to detect signs of carbon monoxide.

Large 6V 3.5W solar panels are used in order to help power the nodes, extending the unattended operational lifespan and making the wireless sensor networks efficient to implement outdoors in remote locations. The panels are waterproof, scratch resistant and UV resistant, making them ideal for outdoor use. Solar panels are additionally used on the rover, ensuring the system remains operational with minimal maintenance to change batteries.