

# The Use of Wireless Sensor Networks for Forest Fire Monitoring – A Survey

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## ABSTRACT

Wireless sensor network consists of small sensor nodes, deployed to capture various events of interest. For example, temperature, oxygen, humidity sensor nodes are deployed in remote, hostile and geographical areas where the presence of human being is infeasible. These nodes are powered by small battery, to communicate with each other for monitoring various environments. These networks have found their applications in various domains such as forest fire monitoring, industrial monitoring, military surveillance, inventory tracking, agriculture monitoring and health care monitoring. Forest fire is the disaster having many negative effects in social, economic and ecological matters. Forest fire cost million dollars in damage and claim many human lives every year.

**Keywords:** Wireless Sensor Networks, Health Care Monitoring, AVHRR, MODIS, WSN

## I. INTRODUCTION

Wireless sensor networks are spatially distributed systems that primarily work to collect data from physical environments. The most important fundamental element of these networks are sensor nodes [1-4]. These sensors nodes are small autonomous hardware devices that are capable of carrying out some processing, collecting sensory information, communicating with other connected nodes in the network and produce a measurable response to change in a physical condition [5-7] such as sound [8-11], temperature [12], humidity or pressure [13-15].

Wireless sensor network introduces a wide range of possible application such as agriculture monitoring, forest fire monitoring and medical monitoring. Forest fire are the unrestricted fires happening in the wide areas [16-22] in causing significant damage to natural and human resources.

The goal of literature and recent studies is to detect and predict forest fire immediately and actually, in order to minimize the loss of forests, people and wild in the forest fire. The network of a sensor nodes are deployed densely in a forest sensor nodes sense the

forest periodically and collect measure data (temperature, relative humidity) and sends to the respective cluster nodes [23]. It has been shown in the literature that about 20% of CO<sub>2</sub> emission in the atmosphere is due to forest fires. There are many causes of forest fire including lightning, human carelessness and exposure of fuel to extreme heat and aridity.

In this paper, we study the existing literature about wireless sensor network that are used for forest fire monitoring. We explain the advantages and disadvantages of recent studies and we present our own conclusion.

## II. METHODS AND MATERIAL

### A. Background of Detection System

Some of the early methods for the forest fire detection were based on manned observation towers such as

- Camera Surveillance System
- Satellite Images

Satellite images have proved more efficient than camera surveillance by two satellite the advanced very high resolution radio meter (AVHRR) [23-26],

launched in a 1998 and the moderate resolution imaging spectroradiometer (MODIS) launched in 1999 have been used. Unfortunately, these satellites can provide images of the regions of the earth every two days and that is a long time for fire scanning; besides the quality of satellite images can be affected by weather conditions.

The resolution of the wireless sensor network technology in current years has made it possible to use this technology for early forest fire detection. These sensors need to be self-organized and follow an efficient algorithm, interfaced with other technologies or networks [30-34]. A number of present literature considered using wireless sensor network in forest fire systems [27-29]. These techniques have their own limitations and disadvantages that are discussed in the next section.

### **B. Disadvantages of Satellite and Camera Surveillance Systems**

The accuracy and reliability of satellite-based system are largely impacted by the weather conditions.

In satellite system the detection accuracy is not that much accurate. In such systems, a fire can be detected only after it has spread largely [35] So it shows that early systems cannot provide timely detection. Camera surveillance systems cannot be applied to large forest areas easily and is cost effective [36, 37]. The most critical issue in a forest fire detection system is to provide highly rapid response in order to minimize the scale of disaster. Camera surveillance system and satellite images do not provide timely detection due to long period of scan. Therefore, we need real-time fire detection with high accuracy and reliability.

We studied that wireless sensor networks can potentially provide such solutions.

### **C. Advantages of WSN over Satellite Systems:**

A pair of AA batteries is used in Wireless sensor networks that can operate for a long period to provide a constant monitoring during the fire sensor.

Wireless sensor networks can be easily deployed and are low cost. These networks can detect events quickly and accurately. Sensor nodes can be deployed anywhere even when there is no human access

possible [38-40]. There is no need to build towers or set up complicated communication links such as microwave and satellite.

Based on the recent studies the key issues of this network for forest fire monitoring are:

- Localization: all the previous work used a GPS or fixed the nodes in a known place.
- Coverage: the nodes deployed randomly a full coverage almost impossible.
- Network life span: For sensor nodes working on batteries, it is impossible to go back to each node in the forest and recharge it again.
- Fire detection method: this is the heart of the application; it should be precise and reliable.

### **D. Architecture of Proposed Scheme**

Forest fire detection system based on wireless sensor network consists of small sensor nodes, base station, communication system, internet access and structure of monitoring hardware and software system. A large number of nodes are randomly deployed in a forest area and construct a self-organized network to monitor the forest fire [41]. The nodes collect the data send it to the sink.

### **E. Related Work**

Wireless sensor network used for forest fire detection consist of small sensor nodes that are used to monitor the forest environment. Sensor nodes periodically sense the forest when some emergency situation take place it detects that critical data (temperature, humidity, CO<sub>2</sub>) from the region and covert it to digital form and forward it to base station. Base station or sink is a device having high power energy.

## **III. CONCLUSION**

This is a survey paper in which some various studies about wireless sensor networks in the field of forest fire monitoring is discussed. First, this study provides that WSN technology is a very promising green technology for the future in detecting efficiently the forest fires. In this paper we present the deployment and implementation of a wireless sensor network system for detecting forest fires. Motes in the system periodically sense the environment and capture the sensed data, send it to the base station. To capture temperature and humidity in the forest in a more

timely and precise way, we pointed out some advantages of wireless sensor network.

The forest fire prevention is just one example of its applications, this technology can also be used in major areas such as intelligent transportation, environmental detection, alarm floods, monitoring animal habitat, monitoring health status of bridges, monitoring the security situation under hole. Its development and application have a profound impact on various fields of living and produced.

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