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ScienceDirect

Procedia - Social and Behavioral Sciences 195 (2015) 1846 – 1850

Procedia
Social and Behavioral Sciences

World Conference on Technology, Innovation and Entrepreneurship

Fire Detection Systems in Wireless Sensor Networks

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Abstract

Natural disasters have increased due to man recently being senseless and with the effects of the damages they caused on the environment. These factors which negatively affect the ecosystem in the world have been noticed and the hitches are wanted to be prevented. As known, fires are the leading of these disasters. Most of the fires are triggered by the environmental causes even though a minority of them are self-triggered. To prevent fires many different safety systems have been developed. Among these systems, Wireless Sensor Networks stand out with their ease of use and low cost. In this study implementation of systems for keeping track of fires in a certain area with Wireless Sensor Networks has been discussed.

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Peer-review under responsibility of Istanbul University.

Keywords: Wireless Sensor Networks, Fire Systems, Forest Fires

1. Introduction

Wireless Sensor Networks are a technology that has recently been used popularly. It is a system where gateway nodes and a coordinating node get in contact and exchange data. And the fact that it is wireless, it is a cheap, fast and quality data transmitting technology without the cost and mess of the wires. Wireless Sensor Networks can be used in many fields. They can be used in smart homes, in tracking systems, in agricultural fields, in military fields, in environmental fields and many. One of the most significant of these is the environmental implementations (Tan, 2007). Because, many hitches encountered in the environment may cause long-term damages in human lives. Fires are the leading one of them. Fire danger may be possible to be encountered in forests, buildings, workplaces and

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many places (Zhang, 2008). While forest fires are an indispensable part of forest ecosystems of the Mediterranean basin, they play an important role in redressing of the ecological balance. At the same, the fact that many hectares of forests are burnt down every year causes economic, ecologic and cultural destructions. Even though the temporal progress of the forest fires illustrates a graph with ups and downs, it is seen that the amount and the number of forested lands burnt down in forest fires have increased. This situation can be linked to the fact that the number of factors causing fires increases with increase in the population. In as much as 91% of the forest fires in our country are caused by human activities. Most of these places are impossible to be monitored on-site. For instance it may be sometimes required to remotely monitor forests and take necessary measures to prevent fires. This is exactly where the Wireless Sensor Networks come into the play. In this technology which can provide communication everywhere regardless of time and location, with the monitoring of possible temperature increases, forest fires can be prevented. In this study the working ways of fire detection systems created in Wireless Sensor Networks on web-based as well as mobile platforms are explained. Contained in this study is a study about the using and managing of fire detection systems managed by Wireless Sensor Networks on web-based as well as mobile platforms. Zigbee technology is mentioned in the second part and in the third part the study is discussed in detail. In the last part however, the conclusions on the study are presented.

2. Wireless Sensor Networks

Wireless Sensor Networks networks are created by means of haphazardly spreading of many limited-capacity, short-ranged sensors with low-power and low cost into an environment which cannot be reached easily and which most of the time is not reliable (Chong, 2003). Each node has capabilities for calculating, sensing and communicating (Lin, 2004). These nodes which can be spread haphazardly in the environment to be searched can get to know each other and can perform calculation tasks in a wide region by making common efforts. Because of these features, they can be used in many fields from medical to military, securing of a building to pre-determination of forest fires (Wang, 2006). Wireless Sensor Networks allow for

- Data collection
- Information Processing
- Monitoring and tracking of various places for environmental applications

The sensors are set up easily, because there is no need for human intervention. They accomplish their tasks by sensing, calculating and acting in place. They can get organised (Organisation) and they can be adjusted to support different applications. Every sensor node is capable of wireless communication and signal processing as well as intelligence enough to broadcast data. The limited power, processing capacity and communication resources necessitate the use of many sensors in wide areas. This high number of sensor makes it possible for the sensor to detect the actual speed, direction, size and other features of the moving object more accurately compared to a single sensor.

3. Fire Detection Systems

We can analyse fire detection systems created with wireless sensor networks in two different ways. The first one is detecting of possible fires in indoor places, the second one is the detecting of forest fires.

- Fire Detection Systems in Indoor Places
- Forest Fires Detection Systems

3.1. Fire Detection Systems in Indoor Places

In this section, working ways of fire systems created with wireless sensor networks are discussed. Firstly, the sensor networks that are the gateway and coordinating nodes are placed in the zones where the system will be set up. Following completion of all the introduction and matching, on the web-based application of the fire systems, a new

user is defined and these nodes are introduced to the system. Then the user logs on to the system and is able to monitor the spontaneous information coming from the wireless sensor networks.

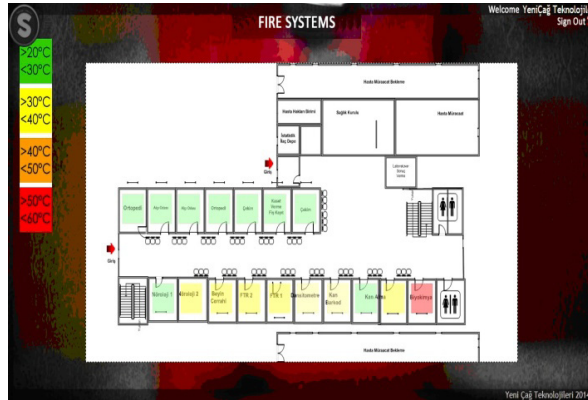


Fig.1. Web-based Application of Fire Systems

As seen in Figure-1, markings have been done as many as the number of nodes entered from the administration panel. These markings have been placed according to the coordinate’s information that will come from the nodes. Also there is information on temperature for each marking made. The scale bar on the left is taken as basis as per these information and colour changes are made on the marked zones. Thus temperature conditions of all the zones added can also be monitored.

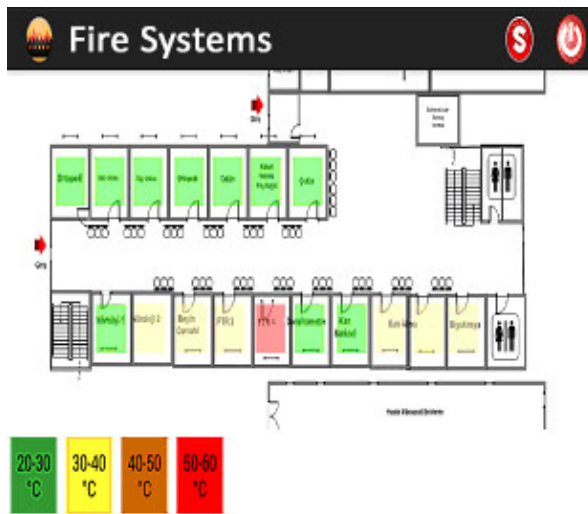


Fig.2. Fires systems Mobile Application

In the screen shot shown in Figure-2 however, mobile application of the fire systems is shown. In the mobile fire systems application too, which works in the same logic as the web-based application, data is saved on the database thanks to the nodes placed in certain zones. The information that comes is the information on temperature and the zones in which the nodes are placed are shown in different colours as per the colour chart shown on the bottom of the display. As seen in the figure 2, this is a sample screen shot. In this image; Green: temperature values in this

green zone range normally. Yellow: the temperature in Yellow zone is slightly over the normal. Orange: the temperature values in these zones may pose a danger. Red: these zones show the zones that do pose a danger.

3.2. Detecting of Forest Fires

Another type of fire systems is the applications for detecting of forest fires. These applications, too, work in a similar logic as the fire systems. Firstly, the forest to be monitored is determined. Necessary gateway nodes and a coordinator node are placed in the forest. Following making the necessary configurations, the nodes are defined on the web-based application of the fire system. A new user is defined and matched with these nodes. Then what temperatures are seen in which zones are detected by means of the temperature and coordinate information coming from the nodes.

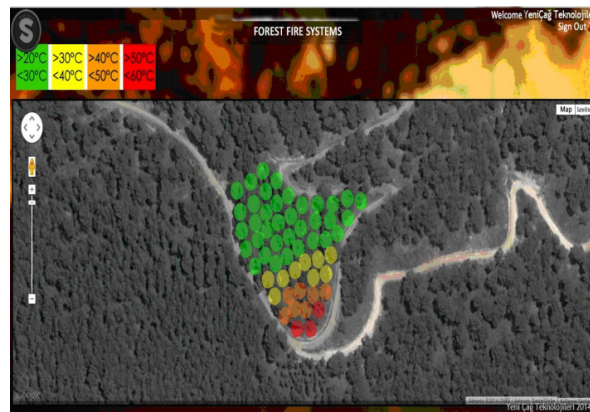


Fig.3. Forest Fires Detection System – Web-based Application

As seen in Figure-3, markings have been done as many as the number of nodes entered from the administration panel. These markings have been placed according to the coordinate's information that will come from the nodes. Also there is information on temperature for each marking made. The scale bar on the left is taken as basis as per these information and colour changes are made on the marked zones. Thus temperature conditions of all the zones added can also be monitored.

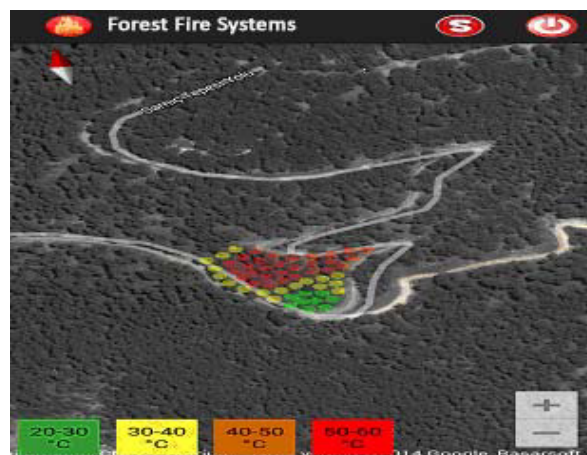


Fig.4. Forest Fires Detection System – Mobile Application

As seen in Figure-4, in the mobile application, too, which works in a similar logic as the web-based application, the user is able to display the temperatures available in the forest zones by looking at the colours seen on the map. Thus, fire predictions can be made as per the temperature information displayed in the desired forest and measures can be taken thus.

4. Conclusion

In this study, working principles of the fire detection systems created using wireless sensor networks have been analysed. Thanks to these systems created using Wireless Sensor Networks whether any danger is posed or not can be determined remotely without being present in these locations with a fire danger. In the study, it has been explained that the fire systems can be easily used on web-based as well as mobile platforms. As the nodes send temperature and coordinate's information, the related zones on the application are coloured as per the information that arrive and the process of finding out about the temperature information is accomplished. It is anticipated that the study would be useful in subjects of Wireless Sensor Networks and Management of Smart Environments.

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