Chapter 39
Forest Fire Information System Using Wireless Sensor Network

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ABSTRACT

Forest fire is the most common hazard which is a great threat to the ecosystem. Remote Sensing and GIS are widely used for forest fire detection. Wireless Sensor Network (WSN) is an emerging technology which is used to monitor environmental parameters towards alerting forest department officers for prevention or control. In this research, the authors developed Forest Fire Information System (FFIS) that provides interface to monitor, assess and analyze the forest fire data emanating from WSN which is a part of Intelligent Forest Fire Detection System. The information system also maintains necessary details of forest fire incidents that can be used for analysis and report generation. It also has a Decision Support System (DSS) integrated into it that can be used by forest officials for strategic planning. This has been developed using PHP and MySQL. This paper is an extension of research work carried about Intelligent Forest Fire Detection System using WSN.

INTRODUCTION

Forest is one of the most valuable and indispensable natural resource which balances the ecosystem. Throughout the globe, all the countries provide importance to sustainable management of the forest in their region. Forests are prone to some natural as well as anthropogenic hazards. Forest fire is the most detrimental to flora and fauna of the region of its occurrence. It is observed and established fact that the forest fire is the most common hazard which destroys the forest and it is a great threat to the environment. Apart from the human induced extreme weather conditions, lightning, climate change and draughts are some of the causes of forest fire. Forest department monitors and controls the forest fire using different methods and technologies. Aerial monitoring, ground patrolling, watch tower, remote sensing, GIS etc.,

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are used for forest fire detection. Developed and developing nations use remote sensing and GIS for forest fire detection and management. The Moderate Resolution Imaging Spectroradiometer (MODIS), Active Fire Mapping Program provides active fire detection and monitoring for the continental United States, Alaska, Hawaii and Canada (USDA Forest Service, 2016).

The total forest cover in India is 701673 sq. km which is 21.34% of the geographical area of the country. The estimated forest fire prone area is 64.29% that is classified as heavy, moderate and occasional fire incidents with the percentage of 2.40, 7.49 and 54.40 respectively (Forest Survey of India, 2015).

Forest Survey of India (FSI) uses MODIS sensor data for near real time monitoring of forest fire since 2004 (Saxena & Srivastava, 2007). The FSI is monitoring forest fire incidences through Remote Sensing and GIS based technology from 2004 to 2011 developed by University of Maryland. From 2012 onwards, FSI in collaboration with National Remote Sensing Centre (NRSC) has initiated a Real Time Monitoring of Forest Fire wherein the forest fire alerts from active fire locations are being generated as Keyhole Markup Language (KML) file which is the Google compatible format.

In terms of deploying Wireless Sensor Network (WSN) for forest fire detection, numerous researches were carried out. In one of the research, Wireless sensors were simulated in ns-2 towards a different setting pattern of sensor nodes, the number of nodes and their movement pattern (Jie-fu, Lin & Yan-dong, 2009). Research has also been conducted (Keshtgary & Rikhtegar, 2013) towards simulating routing protocols of Ad-hoc networks like AODV, DSR, DSDV in wireless sensor for forest fire detection. These protocols were simulated again in ns-2, towards routing data in wireless sensor node in terms of end to end delay, packet delivery ratio and energy consumption. The results showed that AODV was worst in energy consumption.

A lot of research work has been conducted already towards implementing efficient routing protocol for data dissemination and gathering in the WSN due to resource constraint. There is a need to analyze the best suitable hierarchical routing protocol among Low Energy Adaptive Clustering Hierarchy (LEACH), Threshold Sensitive Energy Efficient Routing Protocol (TEEN) and Adaptive Periodic Threshold-sensitive Energy Efficient Sensor Network (APTEEN) (Jamal & Ahmed, 2004; Manjeshwar, 2001) with a clustering approach for the system where the physical intervention by the human is very less. Also, the node requirements based on the terrain size of the forest are important factors that need to be considered. (Devadevan and Suresh, 2016) simulated the Destination Sequence Distance Vector (DSDV), LEACH and APTEEN routing protocols for continuous monitoring, periodic monitoring, periodic monitoring with threshold and also periodic monitoring with threshold for different fire prone zones. The APTEEN protocol simulated towards Intelligent Forest Fire Detection System.

In terms of developing information system and DSS to support the decision-making process, lots of research works were carried out. In one of the research, different scenarios used by the information manager are stored in the database that can be used by the forest fire managers (Jia et al., 2011). San-Miguel-Ayanz, (2005) highlighted that the system alerts the commander to command the scene of emergency work on disaster relief work.

The authors have developed Forest Fire Information System (FFIS) that provides an interface to monitor, assess and analyze the forest fire data from WSN. The system provides an interface to query data from WSN that enables to retrieve data on-demand based on historical data recorded. In addition to developing a continuous monitoring system for data analysis and action, the authors developed an event driven system in sensors that would alert the forest officials for action or prevention once the environmental parameters reach to certain threshold. These data monitored under query and event driven would

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