Wireless Sensor Network for Forest Fire Sensing and Detection in Tamilnadu

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***Abstract*— Wireless sensor networks appearing in many wireless communication developments. WSN modules sensing a variety of phenomena including temperature, relative humidity and smoke [1]. Which are helpful in fire detection systems. A sensor network deployed in forest reports its data to a processing center for possible actions, such as alerting local residents and dispatching firefighting crews. Sensors are deployed uniformly at random in the forest .Forest fire are the disasters which, cause loss of life, property and destruction of thousands of hectares of forest land in tamilnadu during the summer every year. The technological breakthrough was developed as part of the research project with MSG-SEVIRI sensor based network for detecting fire regions. The project is to address applications for detecting large scale temperature field monitoring (Forest Fire Detection) and Landslides. This proposed technique is given for detection of fire regions**

Keywords- MSG-SEVIRI sensor networks, Sampling Distance, Forest fire, Remote sensing images;

I. INTRODUCTION

In this paper we propose a new real time forest fire detection method by using wireless sensor networks . Our goal is to detect and predict forest fire promptly and accurately in order to minimize the loss of forests, wild animals and people in the forest fire. In our proposed paradigm, a large number of sensor nodes are densely deployed in a forest. Sensor nodes collect measured data (temperature, relative humidity) and send to the respective cluster nodes. It has been shown in the literature that about 20% of CO2 emissions in the atmosphere are due to forest fires [5]. It is also known that the soil becomes more susceptible to erosion since it is left bare [1]. WSN has enabled a more convenient early warning system and secondly, WSN provides a system able to learn about the phenomena of natural disasters. The losses due to these disasters are increasing in an alarming rate. In order to minimize damage, early detection of forest fires is a crucial issue. Without a clear and correct understanding of the distribution and dynamics of forest fires, it is impossible to effectively manage them [3]. Thanks to the technology that enables the deployment of devices called motes [4], in large numbers directly into fire zones, wireless sensor networks (WSNs) can significantly improve the accuracy and density of parametric measurement of physical phenomena [1].It will be beneficial to detect the pre-cursors of these disasters, early warn the population, evacuate them, and save their life.

II. FOREST FIRE IN TAMILNADU

TamilNadu is located in the southernmost part of the country (India). It has a geographical area of 1,30,058 sq. km , which constitutes 3.96% of the area of the country .Forest fires, also known as wildfires, are very frequent along the coastal zones]. About 80 % of the fires occur in these zones, which represent more than 90 % of the annually burned area [7].

Forest fires occur throughout the year, but in summer seasons they are much more concentrated where temperatures are high and humidity is low [12]. The dates between the first of April and end of May constitute what we call the “Fire Season” since 80% of the forest fires occur during this period [10].

A. Table forRecorded forest area in Tamilnadu

Reserved Forest	19,388 km2
Protected Forest	2,183 km2
Unclassed Forest	1,306 km2
Total	22,877km2
State’s Geographic Area	17.59%
Country’s Forest Area	2.95%

These disasters are largely unpredictable and occur within very short spans of time. Therefore technology has to be developed to capture relevant signals with minimum monitoring delay. Wireless Sensors are one of the cutting edge technologies that can quickly respond to rapid changes of data and send the sensed data to a data analysis center in areas where cabling is inappropriate. Recorded forest areas of Tamilnadu are listed in Table A. Section III presents a brief review of technological requirements of projects and Wireless sensor networks (MSG-SEVIRI sensor) existing in the literature related to forest fire detection.

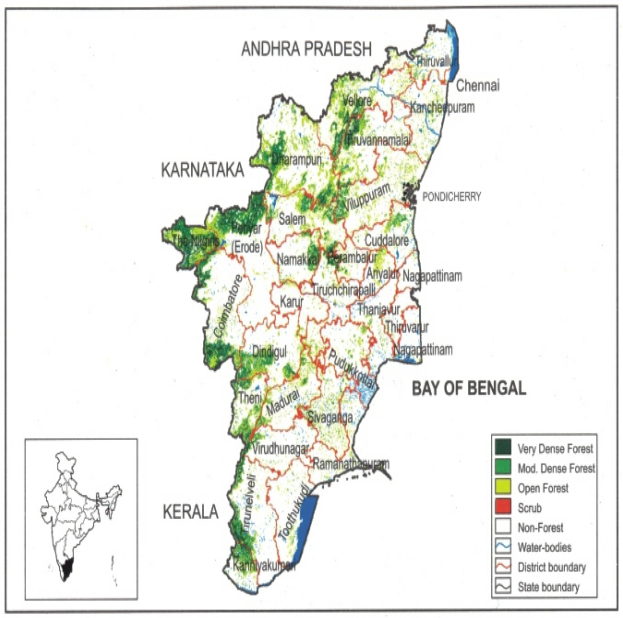

Figure 1. Forest cover map of Tamilnadu

A concise description of the applicability of MSG-SEVIRI sensor network in the forest fire detection system is given in Section IV. The results are summed up in Section V.

III. TECHNOLOGY REQUIREMENTS OF PROJECT AND MSG-SEVIRI SENSOR

The proposed research has been motivated by several earlier researches in the literature related to forest fire detection using wireless sensor networks technique. A concise description of some of the recent researches is given based on the MSG-SEVIRI sensor detection and placement of sensor. We have designed a sensor placement strategy that can be adapted for any forest fire area and potentially for placing sensors to detect other natural disasters, in other disaster prone areas. A sensor network is a computer network Composed of a large number of sensor nodes. [4] The sensor nodes are densely deployed inside phenomenon, they deploy random and have cooperative capabilities. Usually these devices are small and inexpensive, so that they can be produced and deployed in large numbers, and so their resources in terms of energy, memory, computational speed and bandwidth are severely constrained. There are different Sensors such as pressure, accelerometer, camera, thermal, microphone, etc. They monitor conditions at different locations, such as temperature, humidity, vehicular movement, lightning condition, pressure, soil makeup, noise levels, the presence or absence of certain kinds of objects, mechanical stress levels on attached objects, the current characteristics such as speed, direction and size of an object. Normally these Sensor nodes consist there components: sensing, processing and communicating. [8].

WSN technology has the capability of quick capturing, processing, and transmission of critical data in real-time with high resolution. MSG (Meteosat Second Generation) is the follow-up system to the old meteosat series. There will be four MSG satellites covering the 2002-2018 periods. MSG satellite carries the SEVIRI (Spinning Enhanced Visible and Infrared Imager) radiometer which is greatly improved compared to first generation meteosat. Those improvements include better spatial resolution, 3 km sampling distance and 1 km for the High Resolution Visible (HRV) channel, shorter repeat cycle of 15 minutes, better radiometric performances and improved data encoding facilities and 12 channels from the visible to thermal infrared. Characteristics of SEVIRI sensors allow many other application fields, including aerosols and clouds observation in the frame of climate studies. Along with the SEVIRI MSG satellites carries GERB ((Geostationary Earth Radiation Budget) instrument which provides data on the reflected solar radiation and thermal radiation emitted by the Earth and its atmosphere.

The calibration of the infrared bands is carried on board in SEVIRI and accuracy is 1k for thermal IR channels. MSG has geostationary orbit at altitude of 35,600km over the Earth. They are also assumed to know their location information by equipments such as GPS. Every sensor node sends measurement data, as well as the location information, to the corresponding analysis center. The cluster header calculates the weather index using a network method, and then it further sends the weather index to the manager node via the sink. The sink is connected to a manager node via a wired network. A few wind sensor nodes are manually deployed over the forest and connected to the sink via wired networks to detect wind speed.

IV. FOREST FIRE APPLICABILITY OF MSG-SEVIRI SENSOR NETWORK FOR TAMILNADU

In Tamilnadu there are some systems used for detection of forest fires including fire lookout towers, fire watch airplanes, and satellite imagery. Fire lookout towers are located at high points and a person is responsible for observation of fires. Fire Watchers work up to 12 hours per day and under difficult circumstances such as; extreme temperatures, poor hygienic conditions, isolation, and with only short breaks permitted off concentration. In addition to working difficulties, unreliability of human observations is the other disadvantage. Fire watch airplanes are used in countries with large forest areas [9].

Satellite-based systems can be used to monitor large areas. Weather conditions such as clouds affect the satellite imagery negatively. Satellite may not pass when the fire is taking place. Long scan period and low resolution of satellites will reduce the accuracy of the satellite-based forest fire detection systems and these systems could not predict the wildfire before it becomes uncontrollable [14]. Satellite based data cannot provide timely detection and used only to keep the fire under control [9]. The drawbacks of the currently used methods introduce the requirement of new system which can provide more scalable, more accurate and real-time solution for detection. In our forest fire detection method, sensor nodes collect measurement data such as relative humidity, temperature, smoke, and windy speed - all these factors are

required for determining the forest fire danger rate. MSG-SEVIRI sensor networks present improvements over traditional sensors where wired communication could be restrictive or interfere with measurement [7].

Fire detection is one of the feasible and beneficial wireless sensor network applications in the context of developing countries [14]. Sensor nodes can be deployed over a forest from an aircraft. They collectively determine the origin or spread direction of the fire before it becomes uncontrollable. This gives invaluable data to fire fighting teams. The application of wireless sensor networks for forest fire detection will help spotting the fire area and allocating personnel and machinery to that area [14]. Sensor nodes direct the nearest emergency response teams to the affected sites or find safe evacuation paths [13].

In the literature some related studies for forest fires by using MSG-SEVIRI sensor networks have been proposed [13, 14]. In this paper we emphasize the importance of forest fire sensing and detection using MSG-SEVIRI sensor network for Tamilnadu. Sensor nodes, also known as motes, consist of four basic units as sensing, processing, transceiver, power and some components can also be added if the application requires [7]. They can measure the parameters related to the sensor criteria. A number of serious forest fires were detected by the system in the earliest, which reduced their effect and therefore contributes to the reduction of the speed of global warming. The obtained values for the oldest system of forest fire detection is based on a fully automated method from satellite based images. These methods are not always good tools to capture the fire areas based on the signal, particularly if it is highly non-smooth; too much of processing algorithm is needed to reconstruct the signal locally. In these cases the MSG-SEVIRI sensor based analysis is often very effective because it provides a simple approach for dealing with the aspects of a fire region.

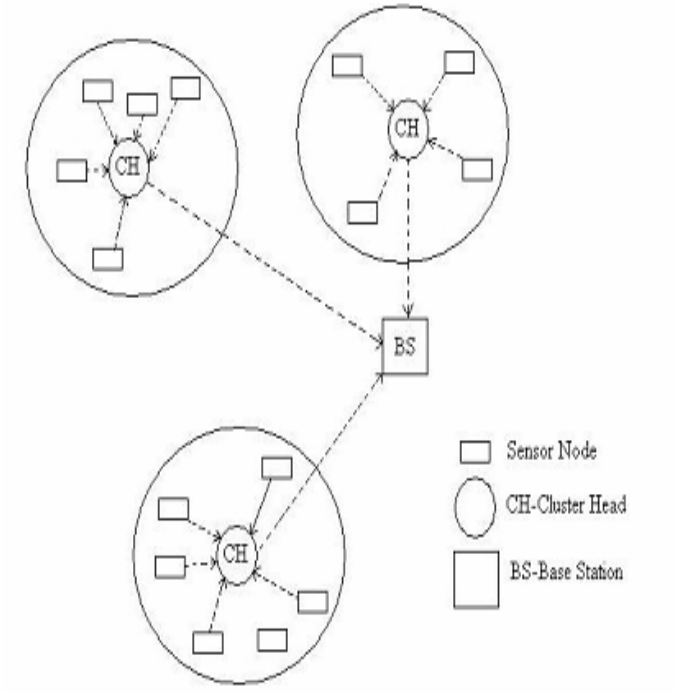

Figure 2. MSG-SEVIRI sensor networks

V. EXPERIMENTAL RESULTS AND DISCUSSION

The Proposed way of MSG-SEVIRI sensor mechanism is implemented by placing sensor between 3km distance in forest area. The sensor repeats cycle of sensing data for 15 minutes once. The mechanism is implemented for both summer and winter seasons with temperature criteria of 36oC and 28oC respectively. The Fig 3 has been chosen since it shows the

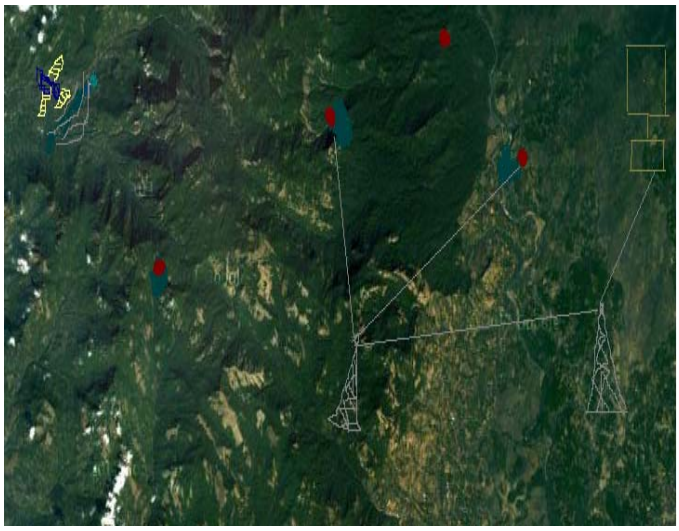

Figure 3. Sensor placement in Nilgiri forest

placement of sensor in Nilgiris forest area. When the temperature exceeds the threshold level because of the environmental factor then sensor collect data for fire regions. Based on the data from sensor detection fire alarm will be given. This kind of sensor based detection for forest fire is very useful for producing alarm for fire region.

The MSG sensor's capacity as an earth observer sensor that provides relevant information in the search of Nilgiris forest. The application of SEVIRI sensor networks for forest fire detection will help spotting the fire area and allocating personnel and machinery to that area. Sensor nodes direct the nearest emergency response teams to the affected sites or find safe evacuation paths.

VI. CONCLUSION

In this area so many researches done by found dry forest region. In this paper we emphasize the importance of forest fire sensing and detection using MSG SEVIRI sensor networks for Tamilnadu. The proposed system produce very scalable detection for fire and SEVIRI sensor improves the accuracy of satellite images compare to other traditional sensor based system. With the above result we can take necessary steps to prevent forest fire in Tamilnadu and various impact of forest fire such as global warming, loss of biodiversity, pollution etc.,. The motivation behind this research is to obtain beneficial information from satellite images and give information to the Forest Management Systems (FMS), Fire Management System.

In future, the work will be expanding by comparison of the forest fire regions with the different network performance.

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