ISSN XXXX XXXX © 2016 IJESC

Research Article Volume 6 Issue No. 12

Real Time Online Early Forest Fire Detection using WSN in the Western Himalayan Region of India

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Abstract:
In this paper, a Wireless Sensor Network (WSN) was setup for the study of real time online early forest fire detection in the state of Himachal Pradesh, which is located in the western Himalayan Region of India. The paper narrates live WSN setup and its demonstration. As a pilot project WSN has been set up for the campus of Himachal Pradesh University, Shimla, which provides real time, results online. WSN is able to give minute to minute update of different parameters such as Pressure, Humidity, temperature, dust, Oxygen, Carbon dioxide, Carbon Monoxide, etc. These parameters are important for early forest fire detection. WSN has got the capabilities of Wi-Fi, GPRS, GPS for communication purpose with location identification and which enable itto send an SMS, once the threshold value is crossed. This will be a major step to detect early forest fire as a sustainable solution and to prevent forest fire in the region.

Keywords: Wireless Sensor Network (WSN), Forest Fire, HIMSWAN

I. INTRODUCTION

In the era of advancement in Science and Technology, it is still a big challenge to get the early detection of wildfires. In the state of Himachal Pradesh, the Forest Department [1] has mentioned that 22 percent or 8,267 sq km of the total forest area in the state is fire-prone. A majority of the fires are reported from the pine forests during summers when the trees shed their needles, which are inflammable. The pine forests are found up to an altitude of 5,500 feet. Forest officials have observed that most fire incidents are deliberate acts. The local villagers also tend to set grasslands afire to get softer grass after the rains. In most cases, fire from grasslands spreads to nearby forests. In this study, WSN based pilot project was tested in a forest situated near Himachal Pradesh University, Shimla, India at an altitude of 5,500 feet to 8, 300 feet and is heavily prone to forest fire due to dense pine covering. At present, the system of forest fire detection is via Satellite only. But this method has not been very successful because of delay transmission of important information in detecting forest fire, resulting in their delayed detection. What makes a forest fire detection system efficient and effective is its constant surveillance which can be succeeded by an immediate response, in order to minimize the scale of the disaster. Medium and large-scale fire surveillance systems do not accomplish timely detection due to low resolution and long period of scan. Therefore, there is a need for a scalable improvisation that can provide real-time fire detection, with high reliability and accuracy. Wireless sensor networks can deployed as the tangible, low cost solution to this grave problem. This system can monitor environmental parameters which can give used to give an early warning for forest fire. These parameters are temperature, relative humidity, pressure and the presence of combustible gases. Recent advances in sensor networks, support and provide promising cloud based framework for building real time forest fire detection system which could be available to all the citizens. Hence, the data which is collected by the sensors, is sent immediately to the monitoring centre of the forest department.

II. OBJECTIVES

The following are the objectives:
(i) Environmental Monitoring using WSN.
(ii) To get early detection of forest Fire Using WSN
(iii) To get real time minute to minute updated status of S No 1 and 2.

III. WIRELESS SENSOR NETWORK

The details of the wireless sensor network are given below:

- A sensor network consists of multiple detection stations called sensor nodes, each of which is small, lightweight and portable. Every sensor node is equipped with a transducer, microcomputer, transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output and transmits the data to the coordinating/coordinating station.
- These nodes can monitor, sense and collect information of different environment locations and various monitoring objects [3]. This is a solution based on the low-cost and low-power with short range wireless network communication system. Using a wireless sensor networks, information such as temperature, humidity, pressure and presence of combustible gases (such as CO2, CO, CH4, O2, NH3, SH2, NO2, and many more) at any part of the forest, covered by the network can easily be collected, dealt with and analysed on real time basis.
- Sensor network communication framework for real time application: A wireless sensor network system includes sensor nodes, gateways, databases and a monitoring server. Sensor nodes are fitted with microcontroller of low processing capacity and are distributed randomly in the forest and nearby areas to collect the previously mentioned fire monitoring parameters. Then data collected from sensors from the field is transmitted to its cluster head, through which it is further transmitted to the

cloud /monitoring server, hence providing a decision-making basis for forest fire.

- Structure of the sensor node: The sensor node is a basic unit and platform of the wireless sensor network. A sensor node is commonly composed of four modules: sensing module, a processing module, a transceiver module and a power module.

IV. NETWORK CONNECTIVITY ARCHITECTURE

Integration of WSN with the existing Himachal State Wide Area Network (HIMSWAN), already proposed by the author [3] for the Environmental monitoring through ubiquitous wireless sensor network would be used at the large scale. This solution is expected to provide a complete answer with advantages for all the limitations and challenges involved in implementing WSN based features, as mentioned below:

Coverage: The sensor network is connected with HIMSWAN, which is having a very wide coverage in the state of Himachal Pradesh.

Connectivity and Performance: HIMSWAN is a wired solution based on fiber connectivity, therefore WSN application data will be error free where higher level of performance can be expected.

Automatic Processing: No manual collection of the environmental data is required. Data will be automatically transferred to the central processing station.

Automatic Analysis and Reporting: An automatic analysis system can analyze the available data and generate the results and reports in no time.

Awareness creation through GSM/CDMA/Wi-Fi based network: The WSN air pollution results can be sent to the end users with the help of GSM/CDMA/Wi-Fi based network. This will enhance the awareness level among the society and will definitely contribute in lowering the pollution level.

Security: This architecture is very securing both at the physical and dynamic level.

Man power Requirement: No need for extra manpower to maintain the network as HIMSWAN manpower will be able to manage this network without any extra burden.

Real Time Data availability: Environmental data will be available online to various concerned end users and research organizations.

Alarming System: Alarming system can be attached to this WSN network.

Low Cost: This solution will be with a low cost technology, as we are able to use the existing ICT infrastructure of the state and WSN off the self component itself are very much cost effective.

V. METHODOLOGY

The methodology of this experiment/pilot project is given below:

- Selection of the Site: The site for the WSN experimental has been set up in the forest near Himachal Pradesh University (H.P.U) Shimla, India which is prone to forest fires (Figure 1). WSN, with the capability of measuring pressure, temperature, humidity were tested initially, since these parameters are essential for the forest fire and environmental monitoring.

Figure. 1. Site location- Shimla, India.

- **Experimental Setup:** The Audrino platform was used for setup with energy efficient WSN. Firstly, the board was attached with the system using USB cable, then firmware was laid and it was then run and uploaded successfully.

- **Connectivity with Wi-Fi**- Once the WSN is ready, then parameters such as SSID and password are setup for the seamless communication purpose. This configuration is essential in order to send the data over the cloud for real time monitoring [2]. Presently for experimental purpose, site mentioned in [2] has been used.

- The real and working experimental setup as shown in the figure was able to send the real time parameters to the cloud.

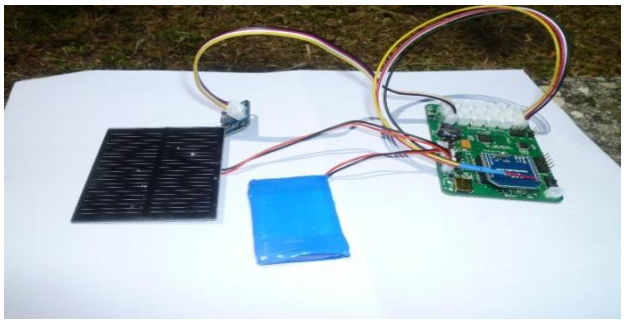

Figure. 2. Real experimental Setup duly configured with Wi-Fi.

VI. RESULTS AND CONCLUSIONS

Experimental Setup was successfully tested with real time data available via cloud [2]. The online real time experimental setup is shown below with location, date and time:

Temperature: Online real time temperature graph provided by WSN through cloud, has been depicted in figure 3.

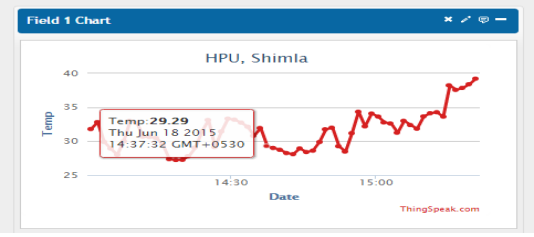

Figure.3.Real time temperature through successful experimental setup.

- **Pressure:** Online real time status of the pressure at the location of the WSN has been depicted in the figure 4.

Pressure is one of the important parameter for the forest fire occurrence.

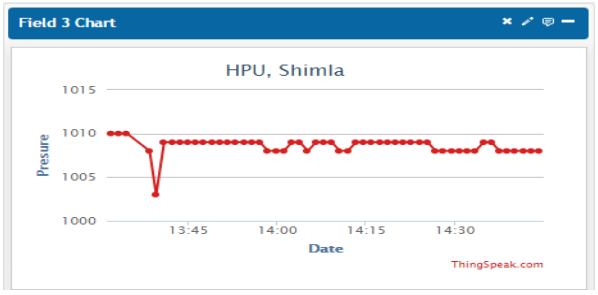

Figure. 4: Real time Pressure through successful experimental setup.

- **Humidity:** Online real time status of the humidity factor of the location has been clearly indicated in the figure 5. Low humidity indicates more probability of the forest fire.

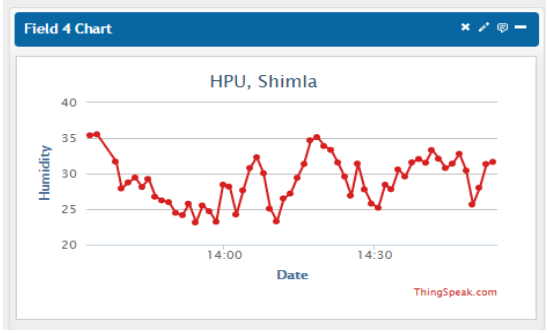

Figure .5: Real time Humidity through successful experimental setup

- Battery status: WSN is totally dependent on the battery therefore to get the status of the battery is very important. This status could be seen online remotely which is depicted in figure 6.

Figure 6: Real time Battery Status of the experimental setup

VII. CONCLUSION

Using Wireless Sensor Network, it is possible to do the forest fire early detection by monitoring different parameters on real time basis. It also becomes easy to visualise and analyse the data available online and remotely. Once the information is available online, then forest fires can be prevented without any delay. This is a low cost solution for effective environmental monitoring using WSN.

VIII. REFERENCES:

[1]. Himachal Monitors forest visa satellites: details Online https://sg.news.yahoo.com/himachal-monitors-forest-fires-via-satellites-074210672.html accessed on 18th June 2015. (Accessed on 25 November 2016)

1. [2]. https://thingspeak.com/channels/42969 accessed on 28th November 2016.
2.
3. [3]. D.Sharma, V. kumar, M. Zennaro Ubiquitous Wireless Sensor Networks for Environmental Monitoring in the Western Himalayan Region of India, International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 3, March 2014
4.

IX. ACKNOWLEDGEMENTS

This work was conducted with the technical support of ICT4D lab, ICTP, Italy. Special thanks to Prof. Sandro M. Radicella, Dr. Marco Zennaro, **Prof.Ermano** Pietrosemoli, Mr. Rodrigo Carbajales for their full support during technical discussions of this pilot project. Special thanks to the authorities of Himachal Pradesh University, Shimla, India for their encouragement and motivation.