# Anti-Smuggling Unit for Forest Monitoring using WSN

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*Abstract*— From the past few years, the newspapers are often filled with news about smuggling of the trees like sandal. These trees are very costly and more useful in the medical sciences as well as cosmetics. To restrict such smuggling and to save the forests around the globe, some preventive measures need to be deployed. An antitheft alert system is developed to reduce deforestation. Wireless sensor networks (WSNs) have emerged as one of the most promising research areas in recent years and are widely recognized as powerful means to offer environment and habitat monitoring, healthcare applications, home or industrial automation and control, product quality monitoring, disaster areas monitoring and inventory tracking. This approach is aimed at detecting and verifying fires in rural and forest environments. The WSN based proposed model includes ZigBee, GPRS, Ethernet communication modules and solar energy harvesting modules. It also applies a node hopping scheme to reach the data server.

***Key words:*** WSN (Wireless Sensor Networks), Zigbee, Mems, Global Positioning System (GPS), Smuggling

## I. INTRODUCTION

Trees are of high value in market because of their application in furniture, medicine and decoration. The tree is already government controlled, and deforestation is banned until the tree is thirty years old. However, people resort to illegal smuggling of trees without thinking about the effect of their action. Anti-smuggling system is required to detect illegal logging and cutting of trees.

Forest fires are a recurrent phenomenon, natural or man-made, in many parts of the world. Global warming will contribute to increase the number and importance of these disasters. Forest fires are one of the natural disasters that frequently occur around the world, causing irreparable human, material and environmental losses [1, 2]. Every season, not only are thousands of forest hectares destroyed by wild land fires, but also, firefighter and civilians are at risk, with a terrible toll in human lives each year.

In WSNs, diagnosis is a challenging task due to the distributed nature and stringent resources. Most previous approaches are supervised, relying on a-priori knowledge of network faults. In addition to predefined faults, silent failures that are unknown beforehand, account for a large fraction of network performance degradation. Currently, there is no effective solution for silent failures because they are often diverse and highly system-related. X. Miao et.al [3] proposed an Agnostic Diagnosis (AD), an online lightweight failure detection approach, which is motivated by the fact that the system metrics of sensor nodes usually exhibit certain correlation patterns.

## II. LITERATURE SURVEY

In [4], a portable wireless data logging system for temperature monitoring in real time process dynamics is proposed. Process variables (like temperature, pressure, flow, level) vary with time in certain applications and these variations should be recorded so that a control action can take place at a defined set point. This paper proposes a 8-bit embedded platform for a temperature sensor node having a network interface using the 802.15.4 ZigBee protocol, that is a wireless technology developed as open global standard to address the low-cost, low-power wireless sensor networks. The wireless temperature sensor node senses and transmits the variations in the local temperature to the central computing unit placed within the range. The central base station receives the data and stores it in the file and plotting the variations simultaneously. Vibration analysis is presented in [5] to provide relevant information about abnormal working condition of machine parts. Vibration measurement is prerequisite for vibration analysis which is used for condition monitoring of machinery. Also, wireless vibration monitoring has many advantages over wired monitoring. An implementation of a reliable and low cost wireless vibration monitoring system is proposed in [6]. Vibration measurement has been done using 3-Axis digital output MEMS Accelerometer sensor. This sensor can sense vibrations in the range 0.0156g to 8g where, 1g is 9.81m/s2. Accelerometer Sensor is interfaced with Arduino-derived microcontroller board having Atmel's AT-mega328p microcontroller.

To confront a wild forest fire, it is essential to have an accurate description of the operations environment, which allows to take decisions in line with reality and collaboration among the different agencies involved in response operations. In [7], an architecture is described for implementing of a Command and Control Information System that enables to obtain an accurate situational awareness of the operations theater, communications with the deployed units inside and outside the disaster environment. The coordination and effective transmission of decisions making process is also presented when responding to the presence of a wild forest fire.

A novel centralized hardware fault detection approach is proposed in [8] for a structured WSN based on Naïve Bayes framework. To maximize the network's life, Centralized Naïve Bayes Detector (CNBD) analyzes the end-to-end transmission time collected at the sink. Thus all the computation will not be performed in individual sensor node that poses no additional power burden to the battery of each sensor node. Since the accuracy of data is important to determine the system performance of sensor network, detecting nodes with faulty readings is an essential issue in network management. As a complementary solution to detecting nodes with functional faults, this article, S. Guo et.al [9] proposed a novel method called "FIND" to detect nodes with data faults that neither assumes a particular sensing model nor requires costly event injections. After the nodes in a network detect a natural event, FIND ranks the nodes based on their sensing readings as well as their physical distances from the event. FIND works for systems where the measured signal attenuates with distance.

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## III. SYSTEM ARCHITECTURE

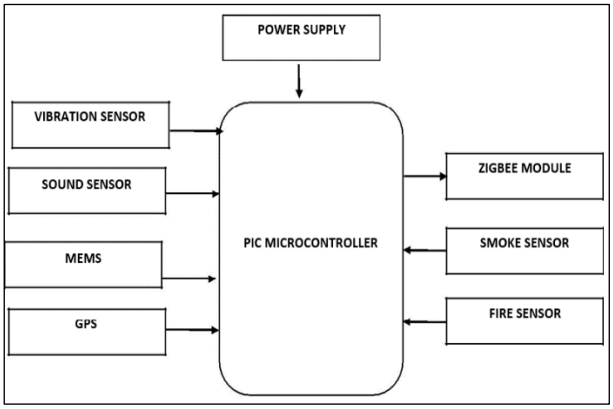


Fig. 1: Transmitter section

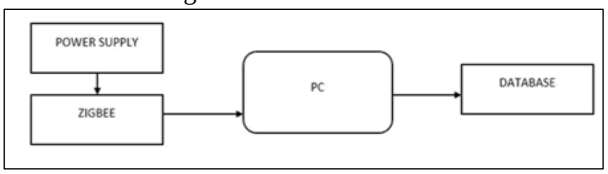


Fig. 2: Receiver section

Every tree will be equipped with one small electronics unit which consists of Micro-controller, sensors and Zigbee module. In fig.1, 5 sensor modules are connected with the microcontroller the PIC controller checks the status of the every sensors according to a priority order. The main sensor used to detect the cutting of trees is 3 axis MEMS. This sensor will detect the vibration in all the 3 axes and thus will send alert in case of a neighboring tree being cut. The vibration sensor first detect the vibration and on reaching its threshold value it prompts the MEMS to measure more accurately. Finally sound sensor detects the sound of falling tree and prompts the zigbee to send the coordinates of the location. In the receiving end, there is a zigbee receiver as shown in fig.2, which is connected to monitor or computer to obtain the location data for user friendly access. Thus, the forest officer can easily monitor the location and abnormal activities ie., smuggling inside the forest environment.

Fig. 3: Working model

## IV. RESULTS

The working model of the proposed system is shown in fig.3. The output efficiency is improved with the use of MEMS sensor. The threshold values can be modified and the zigbee range is adaptable. In addition, it gives a user friendly access to the end user since it is receiving end is configured with the computer system. On receiving the inputs from the sensors, the abnormal values are displayed as shown in fig.4 whenever it goes beyond the initial value or threshold value.


Fig. 4: Abnormal value on LCD

After receiving the prompt from the PIC, the GPS displays the position of the tree as shown in fig.5. The position will be in terms of exact latitude and longitude values.


Fig. 5: Latitude and Longitude value

The receiver section which consist of PC is continuously monitored for the alert. The alert message will be displayed along with the exact location of the tree as given in fig.6.

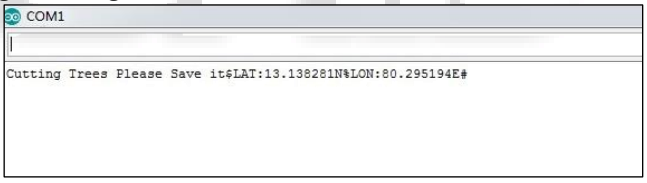


Fig. 6: GPS Value in PC

## V. CONCLUSION

The flex sensor based system is modified by using MEMS technology to restrict the smuggling of trees and illegal cutting in forest. It includes an alert system in addition to monitoring compared to the existing system. This cost effective system can be proposed to the Forest Department for real time application with improved accessibility and working accuracy. It helps in efficient monitoring of the forest cover and will be helpful in analyzing the fire prone area and take necessary precaution. The developed system is a dedicated model specially designs for preventing the smuggling and illegal logging in forest. The complete picture of forest can be observed from the main server unit and exact location of tree cutting can be attained easily.

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