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Forest Monitoring using WSN

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Abstract: Forests are part of the important and indispensable resources for human survival and social development that protect the balance of the earth ecology. In recent years, the frequency of forest fires has increased considerably due to climate changes, human activities and other factors. Currently, Forest Fire prevention methods largely consist of Patrols, Observation from watch towers, Satellite Monitoring. To restrict smuggling of forest resources and to save the forests from fires around the globe some preventive measures need to be deployed. Although observation from watch towers is easy and feasible, it has several defects. In the first place, this method requires many financial and material resources and a trained labor force. Second, many problems with fire protection personnel abound, such as carelessness, absence from the post, inability for real-time monitoring and the limited area coverage.

We are developing such a system using WSN which can be used to restrict this smuggling and to help our natural vegetation form forest fires. animal detection have been an important field in order to have a better understanding on animal behavior and to restrict the damages done to humankind when they are outside the forest by reporting to authority immediately. In this project we propose a wireless sensor network paradigm for real-time forest fire and conservation detection. The wireless sensor network can detect and forecast forest fire, increase in carbon-dioxide, decrease in soil moisture and also falling of trees more promptly. This project mainly describes the data collecting and processing in wireless sensor networks for real-time forest fire and conservation detection. In this project to the neck of animal this light weight designed system is attached such that spark generating sensor will be very close to the body of that animal. Thus, if it goes over boundary line it is sensed and sends to micro controller properly. Uses ZIGBEE modem to send signals and from there it will be sent to Server Room.

Keywords: Wireless Sensor Networks (WSN), Forest Monitoring, ZIGBEE, Spark Generating Sensor, Forest Fires.

I. INTRODUCTION

Forests, integral to human survival and ecological balance, face escalating threats from factors like climate change and human activities, leading to a surge in forest fires globally. Current preventive methods such as patrols and satellite monitoring, while essential, suffer from limitations like resource intensiveness and inadequate real-time monitoring. To combat these challenges and safeguard our natural resources, we propose a comprehensive forest monitoring system leveraging Wireless Sensor Networks (WSN).

This innovative system aims to curtail smuggling activities and mitigate forest fires by providing real-time detection and conservation measures. By employing a network of wireless sensors, our project facilitates prompt detection and forecasting of forest fires, along with monitoring indicators like carbon dioxide levels, soil moisture, and tree falls. Additionally, the system integrates animal detection functionalities to enhance understanding of animal behavior and promptly report any incidents to relevant authorities. Through lightweight design and efficient communication protocols like ZIGBEE, our system ensures seamless data transmission for enhanced forest protection and conservation.

Our project introduces a transformative approach to forest monitoring using Wireless Sensor Networks (WSN). By leveraging lightweight sensors and advanced communication technologies like ZIGBEE, our system enables real-time detection of forest fires and animal activities. With a focus on proactive conservation efforts, our innovative solution aims to mitigate the increasing threats to forest ecosystems and safeguard our natural resources effectively.

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II. LITERATURE SURVEY

[1] Zadar proposed an unmanned aerial vehicle (UAV)-based forest fire monitoring and detection system utilizing image processing techniques to enhance early fire alarm systems. By incorporating color and motion features, their methodology aims to improve fire detection accuracy while minimizing false alarms, demonstrated through indoor experiments.

[2] Advanced Technologies for Communications (ATC) introduced a wireless communication-based smoke detection system for forest fire monitoring. Their design integrates sensor nodes with a router and coordinator, transmitting data to a GPRS module for display on a PC, providing a promising solution for forest environment monitoring needs.

[3] Beijing University of Posts and Telecommunications presented research on constructing a simulation model of user relationship networks in social networking services (SNS) using the Forest Fire model. By optimizing characteristic values and parameters, they achieved simulation results more akin to real user relationship networks, proving the model's effectiveness.

[4] Khaled A. Ghamry and Youmin Zhang developed a fault-tolerant cooperative control strategy for UAVs in forest monitoring, ensuring continuous fire detection even with UAV faults. Their approach utilizes distributed sliding mode formation control and reconfigurable controllers to maintain optimal coverage around fire spots, validated through simulation.

[5] Liping Chen et al. also explored user relationship networks in SNS using the Forest Fire model, enhancing it to better simulate real network behavior. Their improvements and optimizations resulted in a model more effective for simulating SNS user relationships, contributing to better understanding network dynamics.

[6] Soumalya Sarkar et al. proposed a wavelet-based method for target detection and classification in unattended ground sensor (UGS) systems. Their approach, validated on seismic and infrared sensor datasets, offers fast execution and low memory requirements, suitable for real-time implementation in UGS systems.

[7] Tilo Burghardt et al. presented a real-time method for detecting and tracking animal locomotion in wildlife videos, integrating a face detection algorithm with a feature tracker for accurate tracking. Their approach, based on Viola-Jones detector concepts, offers reliable detection and tracking capabilities for annotating animal behaviors.

[8] Amit Sharma et al. conducted a review of forest fire detection systems based on wireless sensor networks (WSN), highlighting the advantages of WSNs for forest monitoring applications. Their review emphasizes the simplicity and wide coverage potential of WSNs in detecting and monitoring forest fires.

[9] Sakib Abdullah et al. introduced a low-power wireless ground sensor network (LPWGSN) equipped with various environmental sensors for forest monitoring. Their system employs intelligent ZigBee mesh networking for scalability and efficient data transmission across large forest terrains.

[10] S. Tanwar et al. proposed the GATA system for tracking and alarming to protect wildlife animals, combining wireless sensor network (WSN) and GPS technologies. By automatically tracking animal movements and sounding alerts when animals stray from designated zones, their system aims to deter anti-social activities and protect wildlife.

[11] Smita Gaikwad et al. developed a microcontroller-based anti-poaching system utilizing WSN technology to detect tree theft in forests. Their system, employing MEMS accelerometers and Xbee RF modules, offers remote monitoring capabilities to combat smuggling and theft of valuable forest resources.

III. SCOPE AND METHODOLOGY

Aim of the project

In existing system, the manual power had been used for fighting with the fire. So to avoid the human damage and to reduce the manual power we are going for the system. Existing research into wireless networks for wildlife tracking has resulted in homogeneous solutions. This is the ‘one size fits all’ approach, where a single type of tracking device has been designed. This has segmented the solution space into animals which can be tracked using wireless networks and those that cannot, due to weight restrictions placed on the tracking collar. Our topic is related to trees. Several million acres of forest are getting destroyed because of illegal cutting trees.

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In forest due to heavy rain trees getting affected and collapse. Also forest includes the very valuable trees like sandalwood, medicinal trees. For the prevention of trees and prevent illegal smuggling of trees, we use WSN (Wireless Sensor Network). It includes sensors which sense vibration and temperature in specific areas.

Existing System

Forests are vital resources crucial for human survival and societal progress, playing a pivotal role in maintaining the balance of the Earth's ecology. However, frequent occurrences of forest fires pose significant threats to both forest resources and the human environment, largely attributed to unchecked anthropogenic activities and abnormal natural conditions. In recent years, the incidence of forest fires has surged due to various factors including climate change and human actions, prompting global concerns among forest fire prevention organizations. Current forest fire prevention methods primarily include patrols, watch tower observations, satellite monitoring, and more recently, the utilization of wireless sensor networks. Despite the ease and feasibility of watch tower observations, this approach is fraught with limitations. It demands substantial financial and material resources along with a trained labor force. Moreover, challenges such as human errors, absenteeism, lack of real-time monitoring, and limited coverage area persist within fire protection personnel. Additionally, there is a growing concern over the smuggling of high-value trees like sandalwood and "Sagwan," which are rare and expensive commodities vital for medical and cosmetic industries. The lucrative nature of this trade has led to rampant incidents of illegal tree cutting and smuggling, necessitating preventive measures to safeguard global forests. Efforts are underway to develop a comprehensive system aimed at curbing such activities and preserving our forests for future generations.

Proposed System

In existing system, the manual power had been used for fighting with the fire. So, to avoid the human damage and to reduce the manual power we are going for the system. Existing research into wireless networks for wildlife tracking has resulted in homogeneous solutions. This is the ‘one size fits all’ approach, where a single type of tracking device has been designed. This has segmented the solution space into animals which can be tracked using wireless networks and those that cannot, due to weight restrictions placed on the tracking collar. Our topic is related to trees. Several million acres of forest are getting destroyed because of illegal cutting trees. In forest due to heavy rain trees getting affected and collapse. Also, forest includes the very valuable trees like sandalwood, medicinal trees. For the prevention of trees and prevent illegal smuggling of trees, we use WSN (Wireless Sensor Network). It includes sensors which sense vibration and temperature in specific areas.

The proposed work combines the embedded technology with the Zigbee wireless communication technology, this project deals with the tracking system for animals. This device tracks the animal’s space and also measures the animal’s physiological signal by using Zigbee transceiver and GPS. In this project, we propose a wireless sensor network paradigm for real-time forest fire and conservation detection. The wireless sensor network can detect and forecast forest fire, increase in carbon-dioxide, decrease in soil moisture and also falling of trees more promptly.

This project mainly describes the data collecting and processing in wireless sensor networks for real-time forest fire and conservation detection. In this paper to the neck of animal this light weight designed system is attached such that when it crosses the boundary it will sense and sends to nearest place where the data is sent to server room using wireless communication.

1. Forests should be conserved due to it soaks up CO2 from atmosphere and give a usefu byproduct O2 which is required for human survival.

2. Forests play an important role in preventing damage to the soil which decreases soil erosion.

3. Forests are home to almost half of the world’s species, with some of the richest biodiversity found in tropical forests.

4. Every animal, every plant serves a purpose on this planet.

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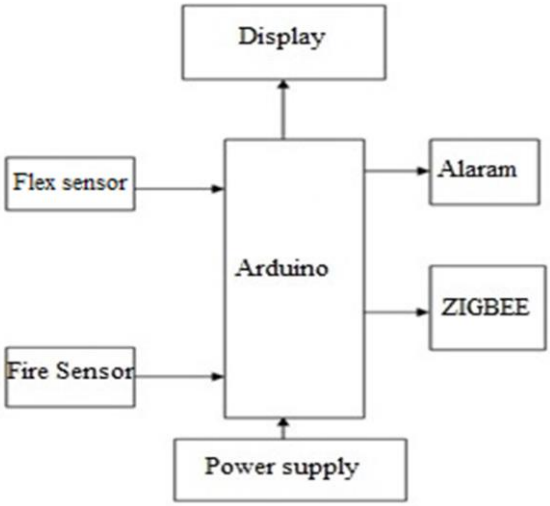

Fig1. Proposed system

System architecture

System architecture is the conceptual design that defines the structure and behavior of a system. An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the system components or building blocks and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system.

The below figure 2 depicts how the data flow occurs between different components of the system. It shows the data being collected from the sensors to the Arduino micro controller and from there data is forwarded in personalized area network, there after data is send to forest officer or person in charge via GSM/WIFI module. A WSN based forest monitoring system would typically consist of sensor nodes deployed throughout the forest. These nodes would collect data on environmental conditions, such as temperature, humidity, and soil moisture. The data would then be transmitted wirelessly to a base station, where it would be aggregated and processed. Forest officers or rangers could then access this data to monitor the health of the forest and identify any potential problems.

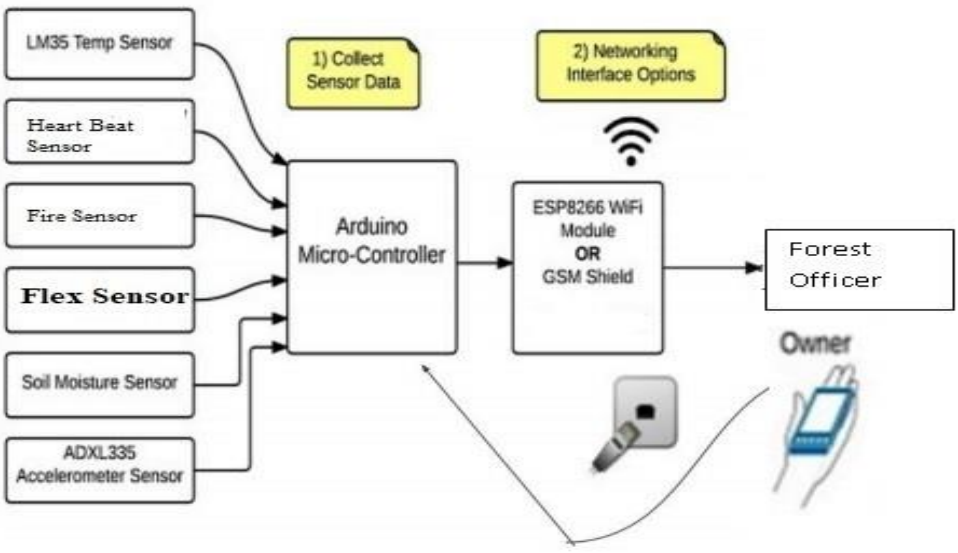

Fig 2. System architecture

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IV. CONCLUSION

In conclusion, the implementation of a Wireless Sensor Network (WSN) for forest monitoring and protection presents a significant advancement in combating forest fires and illegal logging activities. With the increasing frequency of forest fires due to various factors including climate change and human activities, traditional methods such as patrols and observation from watch towers have proven to be inadequate and resource-intensive. The proposed system integrates real-time detection of forest fires, monitoring of environmental parameters affecting tree health, and animal tracking functionalities. By utilizing sensors to detect abnormal activities such as vibrations and changes in temperature, humidity, and soil moisture, the system can promptly alert authorities to potential threats, allowing for swift response and mitigation measures. Moreover, the incorporation of geofencing features for animal tracking and early detection of forest fires enhances the system's effectiveness in safeguarding biodiversity and natural resources. Although challenges such as sensor maintenance and power management persist, the proposed system offers a promising solution to protect our forests and preserve our natural environment for future generations.

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