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DESIGN AND IMPLEMENTATION OF WIRELESS ANTI-POACHING ALARM SYSTEM

Kavitha.A.K*[1], Sneha.S[2], Savitha.T[3] & Nithya.V[4]

*[1]Assistant Professor (Senior Grade) / ECE, Sri Ramakrishna Institute of Technology, Coimbatore

[2,3,4]UG Scholars, Department of ECE, Sri Ramakrishna Institute of Technology, Coimbatore

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ABSTRACT

Smuggling or theft of most important trees such as sandalwood, teakwood and timbers in forests, poses a serious threat to forest resources, causing significant economic damage and ultimately has quite devastating effect on the environment all over the world. Inspite of growing technology, protection for trees in a large area like forest is difficult. It is also expensive to implement. A system that can prevent the smuggling of trees in forest is designed and implemented. The main objective of this system is to monitor such peculiar trees whose plundering has been tremendously increased by the use of Micro Electro Mechanical System (MEMS) Technology and vibration sensor for the forest department with the help of renewable energy sources of solar energy. This System proposes a microcontroller based anti- poaching system employing Wireless Sensor Network (WSN). It is capable of detecting theft by monitoring the vibrations produced by the cutting of trees/branches using a three axis MEMS accelerometer. Depending on the vibration and movement of the trees,it will send a message to the forest officer to indicate the tree cutting in deep forest area.

KEYWORDS: Vibration Sensors and MEMS Sensors, Arduino UNO, Zigbee protocol.

1. INTRODUCTION

From many days, it could be read in the newspapers and journals about the smuggling of precious and peculiar trees like sandalwood, teakwood, rosewood etc. These trees are very costly and precious. They are mostly useful in the medical sciences studies and cosmetic production. Because of the huge amount of money involved in the sale of such rare trees, there is illegal activity like smuggling. Several steps have been taken by various stakeholders in India. However, the punitive measures have remained largely ineffective. This problem isn't related to India only. China, Australia and African countries are also struggling with same issues. Considering the cost, Indian sandalwood costs 12000 to 13000 INR per kg whereas in international market Red Sandal costs a high price of INR 10 crore per ton. If the tree is already government controlled, then its removal is prohibited whether on private or temple grounds until the tree is thirty years old. In order to avoid the smuggling, a system which consists of Micro Controller, MEMS sensor, vibration sensor, and GSM modules will provide connectivity between the trees and the server. There will be one designated person on main server who will receive the messages and can take action to provide protection accordingly. Tree cutting will be detected by the sensors. Considering this problem, a system is designed which helps achieve the goal of stopping the cutting of trees.

2. PROPOSED METHODOLOGY

The proposed system includes two sections, a transmitter section and a receiver section. Transmitter section consists of Arduino UNO controller, Vibration Sensor, MEMS sensor and the Zigbee module. The transmitter is placed on trees which is to be monitored. So the number of transmitters in a specific geographical area will be higher. The Vibrations and micro- movements in the trees will be detected by using vibration sensor and MEMS sensor present in the transmitter. The zigbee module used will transmit the information to the Receiver. The

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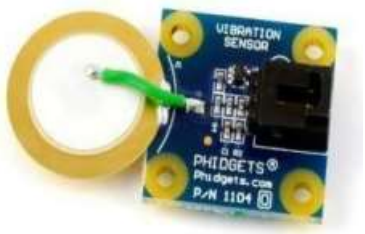
Receiver section consists of Arduino UNO controller, GSM module, Node MCU and the zigbee module. MCU is used to transmit the information to the web.

3. COMPONENTS USED

Vibration Sensor

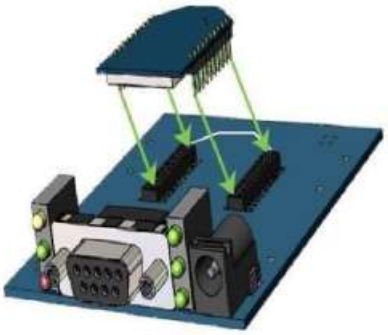
The vibration sensor used here, sense the vibrations produced in trees while smuggling. It is interfaced with the Arduino UNO. It is used to detect plant branch surface movements in the event of a debris storm and also while cutting. It is extremely important to determine, before installing a vibration sensor, which degree of vibration is sufficient to activate the sensor in the event of a debris flow and also the degree has to be defined when the cutting of tree branches for smuggling is done in the forest end. This is to differentiate the movement of tree branches when the tree moves in wind/strom or because of the cutting of trees. These sensors in general are used to remember the possibility of accidental activation caused by earthquakes, as well as areas where construction traffic and other vibrations are present and also in the industries for monitoring the functions of the machineries and the level of vivbration which may be harmful for the human using thoses machineries. This sensor is simple to install and operate. It is easy to integrate in test ring applications and existing control systems. It is advanced digital signal electronics for lowest noise combined with highest sensitivity. The frequency response is 0.5 Hz to 22 kHz. Velocity up to ± 500 mm/s(3 ranges).



Vibration Sensor

Zigbee Module

The Xbee module used as a communication device in this proposed system. GSM module is also used here, which will send message to the concerned Authority who has the access to the receiver section. The XBee RF Modules are basically designed to operate within the ZigBee protocol and are of low-cost wireless sensor networks utilizing low power.The modules require minimal power and provide reliable data.



Zigbee

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MEMS Sensor

MEMS sensor is used to detect any tilt or micro- movements produced while cutting the valuable trees. MEMS inclinometers and accelerometers are inertial sensors of low cost, high precision which serve a wide range of industrial applications. Accelerometers are used to sense both static (e.g. gravity) and dynamic (e.g. sudden starts/stops) acceleration. Tilt-sensing is among the more commonly used applications of accelerometers. Because they're influenced by gravity acceleration, an accelerometer will tell you how it's positioned toward the surface of the Earth. An accelerometer may also be used for sensing when a device is in a free fall state. This function is incorporated in several hard drives. The hard disk is turned off quickly to protect against data loss if a drop is sensed.

MEMS Sensor

Arduino UNO

In this system, Arduino UNO is used to control the sensor output and it sends the information to zigbee when the threshold exceeds. A microcontroller is a small computer on a single integrated circuit that includes a central processor, memory and programmable peripherals for input / output. The important part of it is that a micro-controller, which includes the processor (which all computers have) and memory, and some pins you can control input / output. It is often referred to as GPIO-General Purpose Input Pins. The Arduino Uno board is used in this working corporates a micro-controller and all the accessories to make designing and debugging simpler for specified application. The Uno is a board focused on the ATmega328P Microcontroller. It has 14 digital input / output pins (including 6 as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB link, a power jack. It contains everything needed to help the microcontroller. It can be simply connected with a USB cable to a computer or power it with an AC-to-DC adapter or battery to get it started. "Uno" means one in Italian, and has been chosen to mark Arduino Software (IDE) release 1.0.The Uno board and Arduino Software (IDE) version 1.0 were Arduino's reference versions, now evolving to newer releases. The Uno board is the first in a series of USB Arduino boards, and the Arduino framework reference model.

Arduino UNO

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GSM(Global system for mobile communication):
The Global Mobile Communications System (GSM) in is used to send the message received from the transmitter section to the user or Authority. It is a standard recognized internationally for wireless cellular communication.

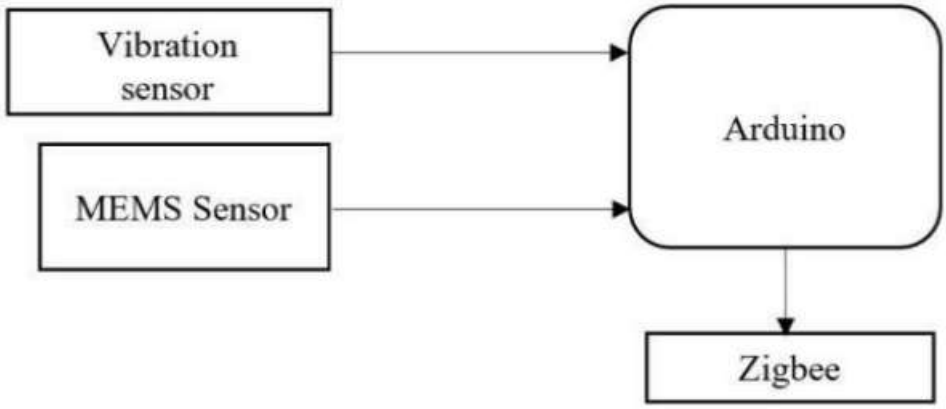
GSM is the name of a standardization group set up in 1982 to create a common European mobile telephone standard with requirements for pan- European mobile radio. information to the receiver zigbee. The alert message will be sent to authority using GSM in the receiver section. The Arduino UNO kit in receiver section has the control of data to be sent to GSM and Node MCU. Here, Node MCU loads the Alert message onto the web page using IOT. The alert message includes the location where the vibration or tilt is detected and it will be recorded continuously in the webpage which can be monitored from anywhere from anytime.

GSM Module

4. HARDWARE IMPLEMENTATION

In the hardware implementation, a transmitter section and receiver section are designed and implemented. Based on the number of trees to be monitored in a specific geographical zone multiple transmitters placed are required to be fixed on each trees and all the transmitters information are received and monitored by a single receiver in the Forest departments main office.

Transmitter Section
The transmitter section makes use of the Vibration Sensors, MEMS sensors, an Arduino and a Zigbee module.



Transmitter Section

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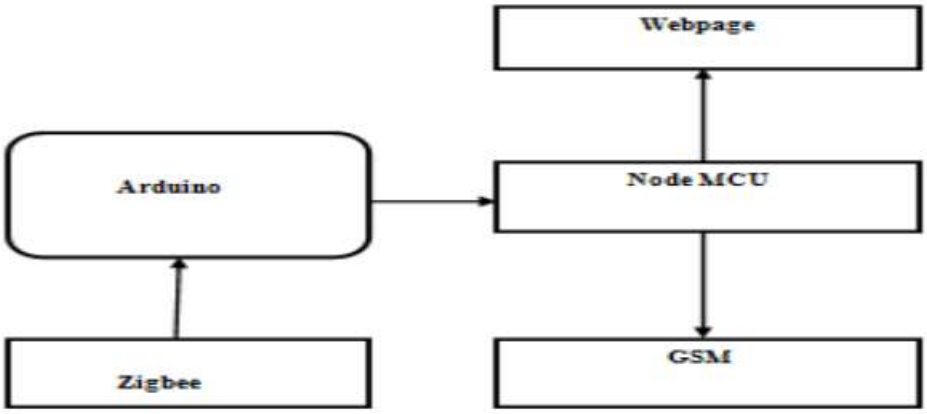
Receiver Section

The receiver section has includes an Arduino, Zigbee module, a Node MCU and a GSM module. The system output is also updated lively in a web page by interfacing using IOT as shown in figure.



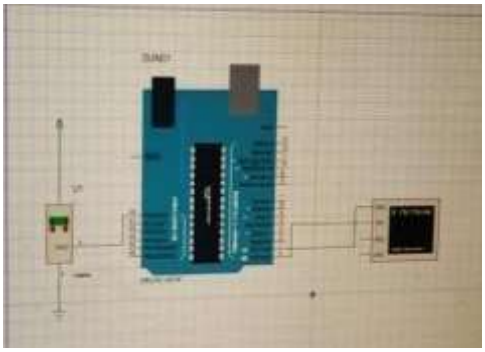
Receiver Section

5. WORKING

In the transmitter section, the vibration sensor and MEMS sensor are used which senses the vibrations and any tilt or micro movements which exceed the threshold level in the trees in which the transmitter is placed. The information sensed by the sensors will be coded using Embedded C into the Arduino UNO to which the zigbee module is attached. The zigbee module in the transmitter section will pass the information to the receiver zigbee. The alert message will be sent to authority using GSM in the receiver section. The Arduino UNO kit in receiver section has the control of data to be sent to GSM and Node MCU. Here, Node MCU loads the Alert message onto the web page using IOT.The alert message includes the location where the vibration or tilt is detected and it will be recorded continuously in the webpage which can be monitored from anywhere from anytime.

6. SIMULATION

The simulation of vibration sensor module in transmitter section has been done using the Proteus tool.



Simulation Result

7. CONCLUSION

This paper presents a low-cost and low power WSN node to detect theft/smuggling, contributing to the protection of valuable trees. This System contains a microcontroller based anti- poaching system employing Wireless Sensor Network (WSN).The main objective of this project is to prevent the cutting of trees in forests and to alert the officials in case of danger. This system will sense the vibrations and any tilt or micro movements which exceed

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the threshold level in the tress where transmitter is placed and the same information is coded and transmitted to the receiver. The alert message will be sent to authority for necessary actions and also a web page is created and linked with the transmitter part which will help us in tracking the various motions associated with regularly from the database updated in the webpage whenever necessary even though there is no emergency detected like cutting of valuable trees.

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