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"Undetected Detective to Protect the Forest Trees Against Poaching Using WSN Technology"

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***Abstract* –** In recent years poaching or smuggling of environmentally and economically important species of trees in forested areas such as Sandalwood, Teak wood, The Pine and Rosewood has been increased extremely.There having several abilitiestake on by various stakeholders – particularly - by the Govt. Of India, to mitigate these problems. These include the recruitment, training and deployment of anti-poaching watchers and/or private/govt. security guards across forests. Strict punishments for convicted offenders, as well as giving special incentives for antipoachingactivities (Twelfth Five Year Plan 2012-2017) were aimed for eradicating the menace.

Keywords- WSN-3; 3-axis MEMS accelerometer; Zigbee.

INTRODUCTION

ZigBee is a mesh network protocol. It is designed to carry small data packets over short distances while maintaining low power consumption. Zigbee runs on a mesh topology network, it means that information travels from a single sensor node on a web of nodes (each of which act as a data source *and* a repeater) until the transmission gets to the gateway. It uses a version of the IEEE (Institute of Electronics Engineering) 802.15.4 standard; it is widely used in local area sensor data networks. ZigBee uses the 2.4 GHz ISM frequency band and since this is a global standard, the applications of ZigBee can be used virtually anywhere. The application of ZigBee includes home automation, security systems, HVAC systems, smart lighting, and more. Generally we can say that, the energy can be stored in a capacitor, super capacitor, or battery. When the application needs to provide the huge energy spikes at that time capacitors are used. When the device needs toe steady flow of energy at that time batteries re used because it leaks less energy. For independent sensor networks current interest of peoples in low power energy harvesting. An energy harvesting scheme puts power stored into a capacitor then boosted/regulated to a second storage capacitor or battery for the use in the microprocessor. The power is transmitted possibly through a wireless method and it is generally used in a sensor application and the data stored .In this system we are going to setup a combination of such software and hardware that by using the same or by implementing the system in the forest area will help to protect the trees in the forest without any human need for surveillance in the forest. However, the punitive measures have remained largely ineffective, but still poachers was continue to thrive. The most promising solution is– "the implementation of a real time, wireless sensor network and data logging system" which will be a sophisticated and a cheap modern technology to make monitoring more robust, effective and feasible. WSN is a most emerging technology, widely used in many industrial applications such as monitoring, maintenance, security and control application, specific in remote monitoring applications etc. In forest areas, WSN are widely used for fire detection in forest, to detect rearing/poaching of wild animals, for environmental monitoring, etc. Hence WSN has many advantageous applications in real world and so used in this system. The installation and maintenance of Wireless Sensor Network is easy; because they eliminate the use of expensive cables and because of that it saves cost. To design a portable wireless sensor node is the main idea presented in this system which is a part of wireless sensor Network. It will be mounted on trunk of each tree, which is capable of detecting theft as well as automatically initiate & send alarm signals if any to remote terminal through wireless media. A network interface used here i.e. Xbee RF module has IEEE 802.15.4 standard or ZigBee which is developed as an open global standard for wireless technology and

supports basic communication interface of low-cost, low power wireless sensor network.

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DESIGN

1. 15- 20 Sensor Nodes: Each Sensor Node will have sensor inputs as data of Accelerometer and Microphone.

2. Master Node: Receives the messages from all the sensor nodes and forward it to Base station. It has additional Intelligence i.e. it processes the messages from the Sensor Nodes and raises the alarms levels.

3. Base Station: Receives the messages from more than one master node and logs the messages to the server.

4. PC based Server Software with GUI: To give audiovisual alarms.

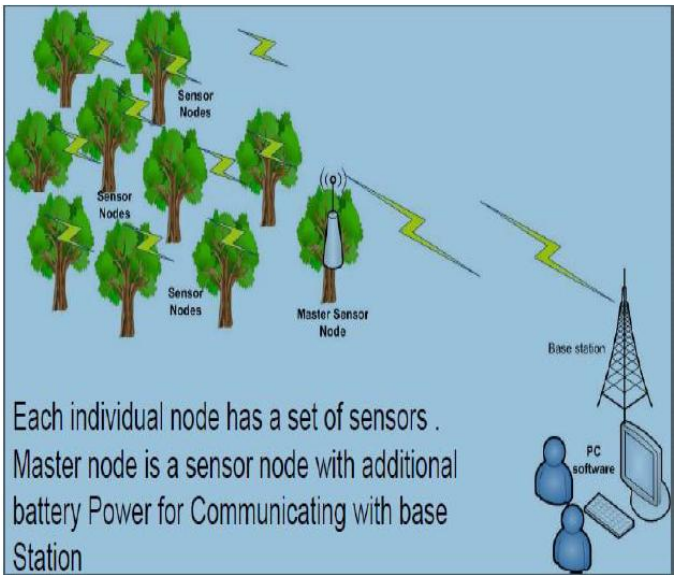

Fig.1: WSN Design

In above figure we can see the basic design of our wireless sensor network (WSN). The number of sensors will be directly proportional to the number of trees in the forest. We are going to mount the each sensor on every trunk of the tree it contains the accelerometer and microphone after that the master node will be mounted the master sensor node which is on to the single trees which will be connected to every sensor and every tree in cluster. Here the clustering means a group of 40 to 50 trees or it may be greater or smaller depending on to the range of wireless transmitter. Depending on to the size of forest there will be more than one cluster. Each and every cluster will contain the finite number of sensor nodes and a single master sensor node. Master sensor node is a type of sensor node which is having an additional battery power and intelligence. After the master sensor node there will be a base station which will collect all the data sent to him by all the sensor nodes. The base stations performs a very limited work that means it only collects the data which is sent by master nodes and without doing any further work sends the data or transfers it to the pc based administrator which is sitting in the control room. The Software called LABVIEW of National Instruments which consists of many and various tools can be used to view the result by which one can easily understand what is happening on to the forest.

HARDWARE DESIGN

The sensor node consists of four basic components these are, a sensing unit (3axis MEMS accelerometer & microphone), a processing unit (MSP430F5529 microcontroller), a transceiver unit (Xbee RF module) and a power unit. All components and sensors were selected carefully to have low power consumption profile and have common input supply voltage range of 1.8-3.3V.Basic components are listed below.

1. Sensing module - The ADXL345 is a 3-axis, low power, MEMS accelerometer. It has selectable measurement range of ±2g, ±4g, ±8g or ±16g (1g=9.8m/s2).There solution of 4 mg/LSB will enable to measure the inclination change of less than 1.0°This ADXL345 is interfaced to microcontroller through I2C/SPI . Has an ultra low power consumption of - 40 μA in active mode and 0.1 μA in standby mode at 2.5 (typical).

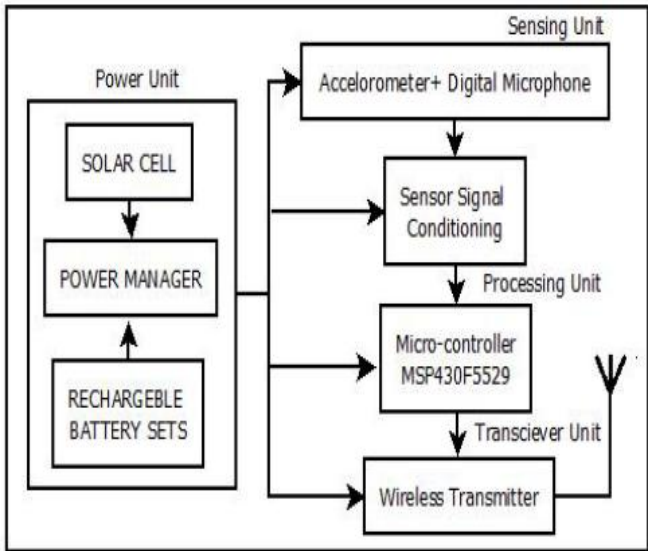

*Fig.:2*Embedded Sensor Node

2. Processing Unit - MSP430F5529- it is TIs MSP430™ family- ultralow-power microcontroller. The processing unit having different sets of peripherals for various applications. The architecture, design for extensive low power modes, so that to get extended battery life it is optimized for portable measurement applications. Power Consumption of MSP430F -

• In Active Mode – 290 μA/MHz at 8 MHz, Flash Program Execution & 150 μA/MHzat 8 MHz, RAM Program Execution (Typical).

• In Standby Mode (LPM3 mode) - 1.4 μA.

3. RF Module -. Communication module Xbee from Digi-Key is used, which is based on ZigBee/IEEE 802.15.4 standard. It operates at 2.4 GHz (freely available ISM band in India), providing a maximum range of 30m. Its RF data rate is 250 Kbps. With higher power consumption within range compared to 900 MHz, we gain in terms of much higher data rate and smaller compact antenna. Low power, low cost and ease of use.

4. Power unit - 6AH Li-poly battery will be used. These are light weighted and slim, based on the new Polymer Lithium Ion chemistry. Its output voltage is 3.7V with2.7V cut-off voltage. There are two different types of protocol with the base node.

1. Multi-level Hierarchical Protocol

2. Zone Routing Protocol

Fig.3 shows a Multi-Level Hierarchical Protocol. This Protocol contains a configured node as Master node and all other nodes as Slaves. To co-ordinate with all the nodes present in a cluster this is the task of the master node.The Masters deploy in such way that each Master will have access to other adjacent Master Nodes. The sensors send their sensed data periodically and will react to any sudden change in the value of the sensed attribute by reporting the corresponding values to their Masters. Algorithm of MEMS accelerometer for vibration detection. The accelerometer has an inbuilt logical feature that detects activity (acceleration above threshold) and inactivity(Acceleration below threshold).These events are indicated in the status register and configured to generate an interrupt.(Acceleration below threshold).

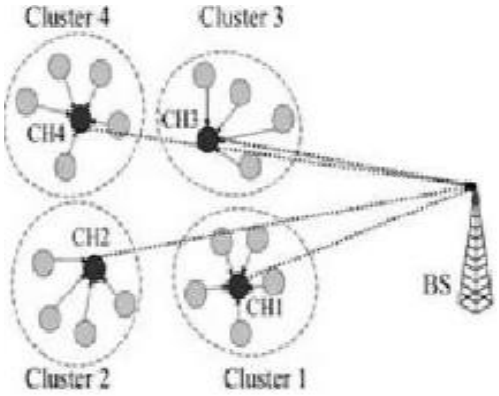

fig.3: A Multi-level Hierarchical Protocol

These events are indicated in the status register and configured to generate an interrupt. The activity status of the device, i.e. whether it is moving or stationary, is indicated by the respective bit which is mapped to INT1 interrupt. This algorithm is shown in fig 6

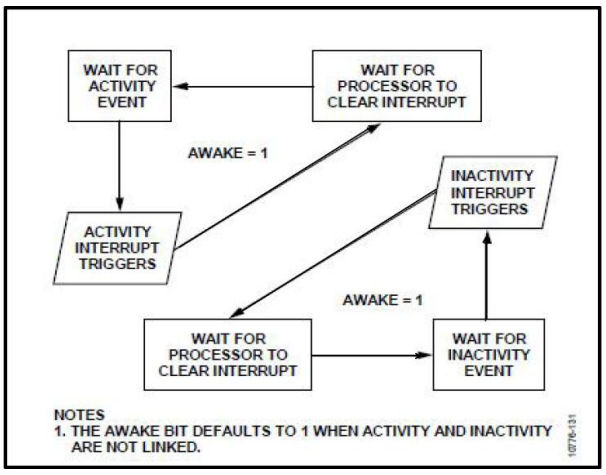

Fig.4: A Flowchart describes Activity and Inactivity Operation of ADXL

The embedded software developed in C program. IAR Embedded Workbench &CC Studio is used as the development environment for MSP430.IAR Embedded Workbench is one of the most popular IDEs in to days market. Understanding the development flow helps you understand how to use the different components of the CC studio CC Studio IDE. The CC Studio IDE extends the basic code generation tools with a setof de-bugging and real-time analysis capabilities you can't go wrong learning to use this popular tool.CC Studio Setup allows you to configure the CC Studio IDE software to work with different hardware or simulator targets. You can quickly begin working using the default configuration or one of the standard configuration files supplied with CC Studio IDE. For the C5000 system, the default configuration is the C55x simulator, and for the C6000 system, the C64xsimulator is the de-fault configuration. The open source X -CTU software is used for programming of Xbee modules'-CTUis free software, provided by Digit (the manufacturer of XBee), which we use to configure and manage XBees, and test XBee networks. We will require all the above tools for the development of microcontroller unit. The microcontroller we are using here is MSP430in X-CTU the Application Programming Interface mode is used for following purpose:

1. Configuring the Xbee Radios as PAN Co-coordinator,

2. Router or End Device

3. Deciding the desired baud rate

4. Analyzing the initial range test

5. Measuring the RSSI value

The figure which is shown below, we can see the flowchart of the system. We can see that the system will start first then initialization will takes place, after initialization the process of data acquisition will takes place i.e. the process of collection of data from ADXL which is our accelerometer sensor which senses vibrations along trees after collection of data that data will be sent to processor to process it in G form. If the data is not collected then the system will again ask the ADXL to collect data and will ask until it collects the data. After processing the data in G form it will be compared with the threshold value. If the value is greater than the threshold value then there will be an alarm generation and if it is less than threshold value than there will be no action occurs.

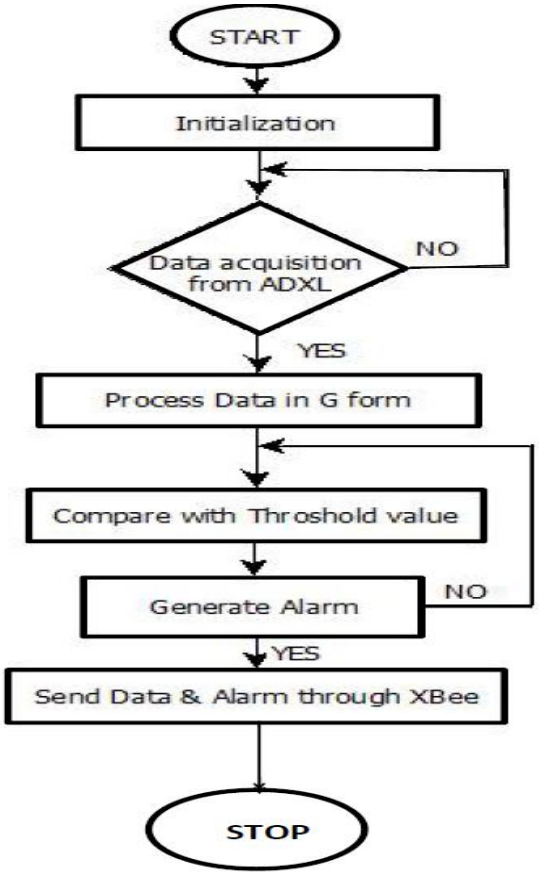

Figure 5: Data Flow Diagram

2 APPLICATIONS

1. Area monitoring

Area monitoring is the application of WSNs. In monitoring area, the WSN node is deployed in to an area where some phenomenon is to be controlled and monitored. Sensors and al l are used in military applications detects enemy intrusion; a civilian example is the geo-fencing of gas or oil pipelines.

2. Health care monitoring

The sensors can be used for medical applications which can be of several kinds: implanted, wearable, and environment-embedded. The implantable medical devices are those that are inserted inside human body. Wearable devices are used on the body surface of a human or just at close proximity of the user. Environment-embedded systems employ sensors contained in the environment. Possible applications

include body position measurement, location of persons, overall monitoring of ill patients in hospitals and at homes. Devices embedded in the environment track the physical state of a person for continuous health diagnosis, using as input the data from a network of depth cameras, a sensing floor, or other similar devices. Body-area networks can collect information about an individual's health, fitness, and energy expenditure. In health care applications the privacy and authenticity of user data has prime importance. Especially due to the integration of sensor networks, with IoT, the authentication of user become more challenging; however, a solution is presented inrecent work.

3. Environmental/Earth sensing

There are many applications in monitoring environmental parameters;examples of them are given below. They can face the extra challenges of harsh environments means such environment where power is highit can cause damage to the body. So for that it is used to reduce the power supply.

4. Air pollution monitoring

Wireless sensor networks have been deployed in several cities and to monitor the concentration of dangerous gases for citizens. These can take advantage of the a dhoc wireless links rather than wired installations, which also make them more mobile for testing readings in different areas.

5. Forest fire detection

The Sensor Nodes can be installed in a forest to detect ,At that time a fire has started. The nodes can be equipped with sensors to measure temperature, humidity and gases which are produced by fire in the trees or vegetation. The early detection is crucial for a successful action of the firefighters; thanks to Wireless Sensor Networks ,the fire brigade will be able to know when a fire is started and how it is spreading.

6. Landslide detection

A landslide detection system also use the wireless sensor network to detect slight movements of soil and changes in various parameters that may occur be fore or during a landslide. Through the data gathered it may be possible to know the impending occurrence of landslides long before it actually happens.

7. Water quality monitoring

Water quality monitoring it is analyzing water properties in dams, rivers, lakes and oceans, as well as underground water reserves. The use of two or more wireless distributed sensors enables the creation of a more accurate map of the water status,and the deployment of monitoring stations in locations of difficult access, without nead in data retrieval.

8. Natural disaster prevention

Wireless sensor networks can prevent the consequences of natural disasters, like floods. Wireless sensors nodes have been deployed in rivers where changes of the water levels have to be monitored in real time.

9. Machine health monitoring

Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionality. Wireless sensors can be placed in locations difficult or impossible to reach with a wired system, such as rotating machinery and undeterred vehicles.

CONCLUSION

This paper presented a low cost and low power Zigbee base on WSN.We all know that the importance of trees in our lifeand our city; it gives us from health to wealth so we need to stop the poaching activity is to completely destroying the diversity of multipal trees which are most important. The system suggests valuable trees from smuggling using WSN, ZigBee and various sensors. Smuggling can be easily prevented by continuous monitoring of the valuable trees in the forest automatically. The main goal of the system is to enhance forest management efficiency and decrease trees illegal logging cases. Continuity sensor and vibration sensor gives robust monitoring of the tree being cutting down. And immediate alert is given to forest guard patrol. So that they can take immediate actions. Thus from implementation of the system smuggling can be prevented and ecosystem is maintained balanced by preventing deforestation.

The future scope of work is implementation of Multi-node network and incorporation of microphone, motion detec to r sensor & temperature sensor to make systems

more effective to acquire data such human or animal interference, fire detection.

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