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DESIGN AND DEVELOPMENT OF WIRELESS SENSOR NODE FOR ANTI-POACHING

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Abstract: Smuggling/Theft of Valuable Trees for selfish needs has lead to an increase risk of Natural Resources getting extinguished thus causing a total unbalance in Nature. This paper proposes a microcontroller based anti-poaching system employing a WSN protocol, which is capable of detecting theft by monitoring Vibrations produced while cutting trees using a MEMS accelerometer. A low power msp430f5528 microcontroller is used along with 2.4Ghz CC2500 transreceiver to communicate to a central Base Station from a unknown location where activity is detected. WSN is widely used technology for monitoring application to reduce the limitation of transmitting capacity of a communication module and also to reduce battery consumtion of device to extend Battery life. The embedded system architecture and the hardware/ software designs are described in detail.

Keywords: WSN, msp430f5528, 3-axis MEMS accelerometer, CC2500, Vibration Measurement.

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INTRODUCTION

In recent years, Poaching of Valuable Tress has been tremendously increased due to man's selfish needs. Trees which are mostly affected include Sandalwood, Teakwood, Pine and Rosewood. There have been several initiatives undertaken by different Organizations, and in particular Govt. of India, to mitigate this problem. This include recruitment, training and deployment of anti-poaching watchers across forests. Strict punishments for convicted offenders, as well as giving special incentives for anti-poaching (Twelth Five Year Plan) were aimed at eradicating the menace.

However, many of the measures have remained largely Ineffective. The most promising solution is –"the implementation of wireless sensor network" which will be a robust, effective and feasible technology for monitoring. WSN is a most emerging technology, widely used in many application which involve monitoring and control. In forest areas, WSN is already deployed for fire detection, rearing/ poaching of wild animals[6].WSN facilitates easy installation and maintenance[3][7];they eliminate the use of expensive cables and save cost.

The main idea presented in this paper is to design a portable wireless sensor node which will be a part of a Wireless Sensor Network. It will be mounted on trunk of each Tree, capable of detecting theft as well as automatically initiate and send alarm signals if any to Central Base Station. The system developed will be a low power design, so it will to a larger period. The power source will be a set of rechargeable batteries which will be charged with solar panel[12].

In a network, a cluster of 15-20 nodes can be formed with a master node having additional

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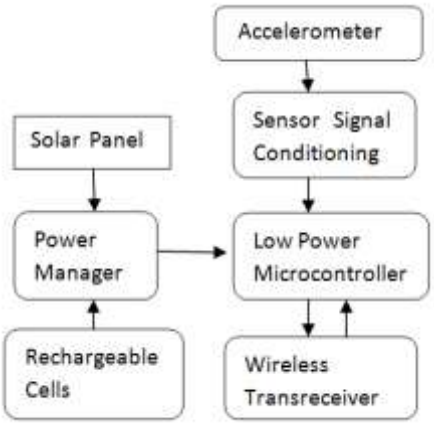
Resources and Intelligence to communicate with Base station. The base station will be located surrounding the boundary of forests. Number of Base station may vary according to the size of forest to be covered. Two differ rent protocols have been developed for the
system to communicate with the Base station.



The figure 1 shows an individual Wireless Sensor Node which will form a Wireless Sensor Network. Power Management is the major challenge of a Wireless Sensor Node. Battery life is limited which affects the performance of the Node . To overcome this, we can extend the Battery of a node by,

1. Reducing consumption by Controller.
2. Adopting Energy Harvesting System.

In this paper**,** proposed system and architecture will be discussed in section II, section III discusses the obtained Results . The Conclusion and future work are given in section IV. Section V gives References for the paper.

II.OVERVIEW OF PROPOSED DESIGN

Hardware Design Aspect:

Sensor Node consist of four basic components, a sensing unit (3 axis MEMS accelerometer), a processing unit (MSP430F5528 microcontroller), a trans receiver unit (CC2500) and a power unit.

All components and sensors were carefully selected to have a 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 ADXL362 is an ultralow power, 3-axis MEMS accelerometer that consumes less than 2 µA at a 100 Hz output data rate and 270 nA when in motion triggered wake-up mode. Unlike accelerometers that use power duty cycling to achieve low power

consumption, the ADXL362 does not alias input signals by under sampling; it samples the full bandwidth of the sensor at all data rates. [13]

2. Processing Unit: MSP430F5528 [10]- The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The digitally controlled oscillator (DCO) allows wake-up from low-power modes to active mode in 3.5µs (typical). [14]

3. RF Module: The CC2500 is a low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency band.[15]

Two Routing protocols were tested to communicate with the Base Node.

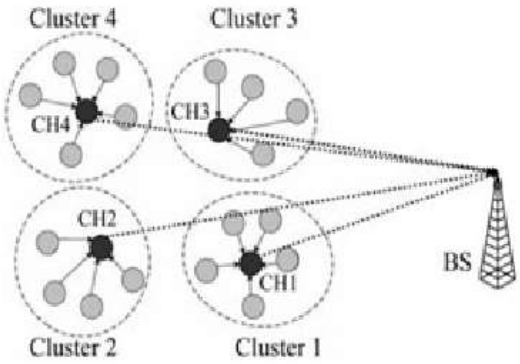


Fig.2 A Multi-level Hierarchical Protocol

Fig.2 shows a Multi-Level Hierarchical Protocol. This Protocol includes a node configured as Master and all other nodes as Slaves. The Master has the Task to co-ordinate all the nodes present in a cluster. The placement of Masters should be such that each Master will have access to other adjacent Master Nodes. The sensors send their sensed data periodically and react to any sudden change in the value of the sensed attribute by reporting the corresponding values to their Masters[].

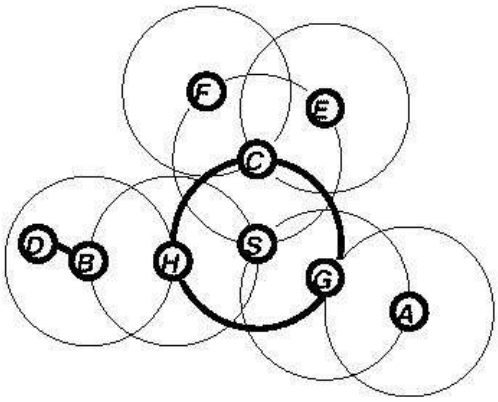


Fig.3 Zone Routing Protocol

Fig.3 shows a ZRP Protocol which is a hybrid protocol, reactive / proactive. Each node defines its own routing area, depending on the distance of the node. When you need to route something, it turns out where the destination is located, is within the zone sends directly, you are out, looking for the way through multicast to nodes of the edge (using the shortest path within the zone). If the path is known to host some of the edge, it responds with the path, if not, does the same in its own edge. The major advantage is its scalability, the protocol reduces the need for storage of large tables. But has the same problems as on-demand protocols, the waiting time for connections and the condition of finish of the route request.

Software Design Aspect

Data Rate of Adxl362 is kept at 100Hz, selecting range of ± 2g. The Vibration sensed by each axis is stored in form of 16 bit Register for each axis. The data output of each axis i.e X Axis, Y Axis and Z Axis is 11 bit, with 12 to 15 bits sign extended. Threshold of the Accelerometer is set to be 300 mg(programmed in codes) for 0.1 sec. This is done to avoid any false detections by the accelerometer. If the accelerometer senses more accelerartion than 300mg for more than 0.1 sec, then it starts recording acceleration details on all the three axes.

As soon as it detects activity, it sends data captured to a node according to a protocol it is programmed with. When acceleration is less than 80 mg for 2 seconds, then the node detects Inactivity and the Node goes in Sleep mode. Activity and Inactivity is kept in linked mode for proper functioning of Activity-Inactivity detection.

The working of ADXL362 can be briefly explained as,

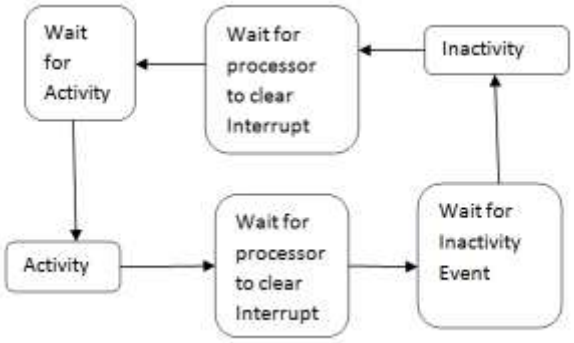


Fig.4 ADXL362 Working

III. RESULTS AND DISCUSSION.

In this section experimental results are observed and discussed,

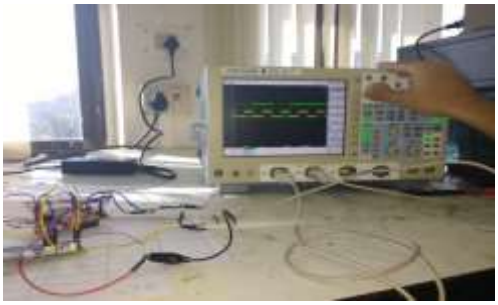


Fig.5 ADXL362 reading on CRO

Fig.6 Ammeter Reading while Receiving Data

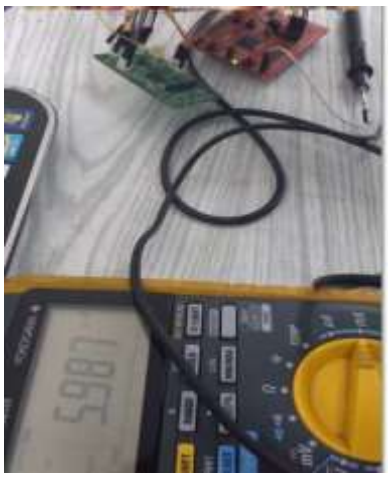


FIG.7 Ammeter Reading while Transmitting Data

Fig.8 Ammeter Reading in Sleep Mode

Calculation of Battery Life a Node:

Mode	Current Consumed in mAh
Sleep	2.1
Transmitting	6
Receiving	18.477

Calculating number of Hours the Battery will last,
We have three Conditions, First is case where node is receiving, Second is case where there is Event detection and third is case where node is in Sleep mode.

Formula for Calculating Battery life is,

Estimated Hours = Battery Capacity (mAh) / Device Consumption

Considering first case,

1.Node is receiving

We have,
Estimated Hours = Battery Capacity (mAh) / Device Consumption
Considering a 3.6V/3000mAh Rechargeable battery Source. = 3000 mAh / 18.477mAh

= 162.36 Hours
If we consider some factors affecting battery life,
= 162.36 * 0.7 (where 0.7 is external factor affecting Battery life)
= 113.65 Hours
2. Event detection
We have,
Estimated Hours = Battery Capacity (mAh) / Device Consumption
= 3000 mAh / 6mAh
= 500 Hours
If we consider some factors affecting battery life,
= 50 * 0.7 (where 0.7 is external factor affecting Battery life)
= 350 Hours
3. Sleep Mode
We have,
Estimated Hours = Battery Capacity (mAh) / Device Consumption
= 3000 mAh / 2.1mAh
= 1428.5 Hours
If we consider some factors affecting battery life,
= 1428.5 * 0.7 (where 0.7 is external factor affecting Battery life)
= 1000 Hours

IV. Conclusion and Future Work

This paper presented a low-cost and low power WSN node to detect theft/smuggling, contributing to the protection of valuable trees. This is laboratory prototype consisting of few nodes, so Protocol testing with larger number of nodes will be included in the future. The future work also includes making of single PCB for complete Wireless Node. Now, the cc500 transreceiver is mounted externally.

V. REFERENCES:

1. Jennifer Yick, Biswanath Mukherjee, Dipak Ghosal, Wireless Sensor Network Survey [J].
2. M. Tubaishat, S. Madria, Sensor Network An Overview [J]. IEEE Potentials, May 07, 2003
3. Anil Kulkarni, Ajay Khandare, Mandar Malve, SAMEER, IIT Powai Campus, Mumbai, Wireless Sensor Network (WSN) for protection high cost trees in remote.
4. V. Raghunathan, C. Schurgers, Sung Park, M.B. Srivastava, Energy-aware Wireless Microsensor Networks [J], IEEE Signal Processing Magazine, August 07, 2002
5. I.F. Akyildiz, Weilian Su, Y. Sankarasubramaniam, E. Cayirci, A Survey on Sensor Networks [J], IEEE Communication Magazine, November 07, 2002
6. R.C. Shah, J.M. Rabaey, Energy-aware Routing for Low Energy Ad Hoc Sensor Networks [J], IEEE Wireless Communications and Networking Conference, v 1, p 350-355, August 07, 2002.
7. Lu De Yang Bachelor of Science in Electrical Engineering implementation of a wireless sensor network with ez430-rf2500 development tools and msp430fg4618/f2013 experimenter boards from texas instruments, Jilin University, China, 2009 August 2011.
8. Awang, A., & Suhaimi, M. H. (2007). RIMBAMONc A Forest Monitoring System Using Wireless Sensor Networks. Proceedings of IEEE International Conference on Intelligent and Advanced Systems (ICIAS), ISBN 978-1-4244-1355-3, pp. 1101-1106, Kuala Lumpur, November 2007.
9. Lozano, C., & Rodriguez, O. (2010). Design of Forest Fire Early Detection System Using Wireless Sensor Networks. The Online Journal on Electronics and Electrical Engineering (OJEEE), Vol. 3, No. 2, Reference Number W10-0097.
10. F.G. Nakamura, F.P. Quintao, G.C. Menezes, and G.R. Mateus. An Optimal Node Scheduling for flat Wireless Sensor Networks. In Proceedings of the IEEE International Conference on Networking (ICN05), volume 3420, pages 475-483, 2005.
11. Kovacs, Z. G., Marosy, G. E., & Horvath, G. (2010). Case Study of a Simple, Low Power WSN Implementation for Forest Monitoring. Proceedings of 12th Biennial Baltic Electronics Conference (BEC), ISBN 978-1-4244-7356-4, pp. 161-164, Tallinn, October 2010.
12. Sonal Panel Circuit Design from www.evilmadscientist.com/2008/simple-solar-circuits/
13. ADXL-362 Datasheet available on www.ti.com
14. MSP430F5528 Datasheet available on www.ti.com
15. CC2500 Datasheet available on www.ti.com