International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.(02), March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

DESIGN OF A WSN NODE FOR FOREST TREES AGAINST POACHING

Mr.V.Narasimman Asst.Prof[1], Anand.M[2], Anandhakumar.C[3], Krishnan.T[4]

[1,2,3,4]*Department of ECE, Sri Sairam Institute of Technology, West tambaram, Chennai (India)*

ABSTRACT

Smuggling/theft of most important trees such as sandal wood in forests, poses a serious threat to forest resources, causes significant economic damage and ultimately has quite a devastating effect on the environment all over the world. These trees are very costly as well as less available in the world. These are used in medical sciences as well as cosmetics. Because of huge amount of money involved in selling of such treessmuggling occurs.This paper propose a microcontroller based anti-poaching system employing WSN technology, which is capable of detecting theft by monitoring the vibrations produced by the cutting of trees/branches using a 3 axis MEMS accelerometer. WSN is widely used technology in remote monitoring applications. Due to nature disaster some trees may fallen and create some sounds for that purpose we are using GPS module for continuous monitoring of trees location.The embedded system architecture and the hardware/software designs are described in detail. Vibration data collected by various tests on wood and simulated. It is also used along with the IOT modules to communicate to a central server from a remote place.

Keywords-Firesensor,MEMS accelerometer, Sound sensor, Smoke sensor, Vibration measurement,WSN

I.INTRODUCTION

Now a days poaching or smuggling of environmentally and economically important species of trees in forested areas - such as Teakwood, Sandalwood, Pine and Rosewood has been dramatically increased. There have been several initiatives undertaken by different stakeholders – and in particular - 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 anti-poaching activities (Twelfth Five Year Plan 2012-2017) were aimed for eradicating the menace. However, the punitive measures have remained largely ineffective, but still poachers was continue to thrive.The most effective solution is– "the implementation of a real time, wireless sensor network(WSN) and data logging system" which will be a advanced 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 animals[6],for environmental monitoring, etc. [3][7].Wireless Sensor Network facilitates easy installation and maintenance; they eliminate the use of expensivecables and save costs. With the help of WSN and some other sensors we can implement the system which used to reduce the poaching level in the forest areas.

II.EXISTING SYSTEM

Plundering of sandalwood trees is one of the key challenges faced by the department. Forest department has found an innovative way now to protect these – steel armours. "Before we put up this mesh, we lost some trees to the thieves. They are very quick, they cut down the trees and take them away in a few minutes. After we put up the steel cover, "Some thieves once tried to cut the trees even after the steel mesh had been installed. But they did not succeed and were arrested.But some cases many thieves are cutting the trees and escaped during night time. For monitoring large areas, there is a need for an automated system for longer lasting solution Tracking applications, GPS.

III. LITERTURE SURVEY

3.1.WIRELESS SENSOR NETWORK FOR TEMPERATURE MONITORING:

In this paper a portable wireless data logging system for temperature monitoring in real time process dynamics. 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.

The aim of this paper is to design a low cost wireless temperature data logging system with 8-bit embedded microcontroller and low-power ZigBee RF transceiver. The main functions of the proposed system are:

• Continuous temperature monitoring

• To transmit the data to remote personal computer

• To implement Peer-to-Peer network and multipoint network can be established by configuring each modules to operate as a sensing node

3.2. PREVENTION OF ILLEGAL LOGGING OF TREES USING IOT:

Smuggling of the trees such as sandal, Sagwan etc. is one of the major national issue. These trees are very expensive and less obtainable in the market. To avoid such type of smuggling and to save the forests around the globe some preventive systems need to be developed. In this paper we are proposing a system based on Internet

of things which can be used to detect the illegal cutting of tree and restrict the tree smuggling. This system can be used by government to protect the trees.

Indian government is attempting to set a farthest point the exportation of sandalwood. It has been as of now government controlled however not legitimately kept up, and evacuation is not permitted whether on individual or open grounds until the tree is 30 years of age. This has not prevented numerous poachers from chopping trees down when experts are not viewing.

Pirating of sandalwood has made financial and peace issues in regions circumscribing the condition of various states in India. To maintain a strategic distance from such kind of carrying and to spare the backwoods around the world some preventive frameworks should be created. We are framing a framework which can be utilized to confine this pirating. In this paper we are proposing a system based on Internet of things that can be used to avoid the smuggling of the trees which would in turn stop the de-forestation and uphold the Environmental stability, which would help to solve one of the issues with the Global Warming. Each tree is having with one electronic division, which consists of Micro Controller, Flex Sensor, accelerometer sensor, TEMP sensor, and GSM module. Tree cutting will be detected by accelerometer sensor.Communication between the trees and server will be done by GSM modules.

3.3.REAL TIME WIRELESS VIBRATION MONITORING SYSTEM:

Vibration analysis provides 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. This Paper presents, implementation of a reliable and low cost wireless vibration monitoring system. 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/s^2. Accelerometer Sensor is interfaced with Arduino-derived microcontroller board having Atmel's AT-mega328p microcontroller. The implemented system uses ZigBee communication protocol i.e. standard IEEE 802.15.4, for wireless communication between Sensor Unit and Vibration Monitoring Unit. The wireless communication has been done using XBee RF modules. National Instruments LabVIEW software has been used for development of graphical user interface, data-logging and alarm indication on the PC. Experimental results show continuous real-time monitoring of machine's vibrations on charts. These results, along with data-log file have been used for vibration analysis. This analysis is used to ensure safe working condition of machinery and used in predictive maintenance.

3.4. A SENSOR BASED ANTI-POACHING SYSTEM:

In recent years poaching incidents has been massively increased encompass slaughtering of endangered species in Tanzania and Africa in totality. Different initiatives have been taken world widely including establishment of International Anti-Poaching foundation (IAPF). Tanzania in particular has taken several initiatives on the matter at different time including sending her own military army across the borders of National parks as an attempt to eradicate poaching activities.However poachers are still continued to put a bullet on the heads of these species of monumental importance. The main idea presented in this paper involve employing a modern and a

sophisticated technology in which poachers will be left behind and being netted easily there by eliminating Poaching activities. The idea utilize animals themselves with sensors as mobile biological sensors (MBS) mounted with sensor fusion (having visual, infrared camera and GPS) that transmits the location of MBS, access points for wireless communication and a central computer system which classifies animal actions. The system propose three different actions of responses, firstly: access points continuously receive data about animals' location using GPS at certain time intervals and the gathered data is then classified and checked to see if there is a sudden movement (panic) of the animal groups: this action is called animal behavior classification (ABC). The second action can be called visualization where by different image processing techniques of the obtained images surrounding an animal group are performed and therefore provide an ample assistance in understanding what makes sudden movement of the anima group. The last action is to send messages to the game ranger's cellular phones about the panic of animals and the location through GSM network.

3.5.WIRELESS BODY SENSOR NETWORK WITH ADAPTIVE LOW POWER DESIGN FOR BIOMETRICS AND HEALTHCARE APPLICATIONS:

A four-levels hierarchical wireless body sensor network (WBSN) system is designed for biometrics and healthcare applications. It also separates pathways for communication and control. In order to improve performance, a communication cycle is constructed for synchronizing the WBSN system with the pipeline. A low-power adaptive process is a necessity for long-time healthcare monitoring. It includes a data encoder and an adaptive power conserving algorithm within each sensor node along with an accurate control switch system for adaptive power control. The thermal sensor node consists of a micro control unit (MCU), a thermal bipolar junction transistor sensor, an analog-to-digital converter (ADC), a calibrator, a data encoder, a 2.4-GHz radio frequency transceiver, and an antenna. When detecting ten body temperature or 240 electrocardiogram (ECG) signals per second, the power consumption is either 106.3 ¿W or 220.4 ¿W. By switching circuits, multi sharing wireless protocol, and reducing transmission data by data encoder, it achieves a reduction of 99.573% or 99.164% in power consumption compared to those without using adaptive and encoding modules. Compared with published research reports and industrial works, the proposed method is 69.6% or 98% lower than the power consumption in thermal sensor nodes which consist only of a sensor and ADC (without MCU, 2.4-GHz transceiver, modulator, demodulator, and data encoder) or wireless ECG sensor nodes which selected Bluetooth, 2.4-GHz transceiver, and Zigbee as wireless protocols.

3.6. DIGITAL OUTPUT MEMS ACCELEROMETER-ADXL345:

3.6.1 GENERAL DESCRIPTION:

The ADXL345 is a small, thin, ultralow power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16 g. Digital output data is formatted as 16-bit twos complement and is accessible through either a SPI (3- or 4-wire) or I2C digital interface. The ADXL345 is well suited for mobile device applications. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (3.9 mg/LSB) enables measurement of inclination changes less than 1.0°. Several special sensing functions are provided. Activity and inactivity sensing detect the presence or lack of

motion by comparing the acceleration on any axis with user-set thresholds. Tap sensing detects single and double taps in any direction. Freefall sensing detects if the device is falling. These functions canbe mapped individually to either of two interrupt output pins. An integrated memory management system with a 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor activity and lower overall system power consumption. Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at extremely low power dissipation. The ADXL345 is supplied in a small, thin, 3 mm × 5 mm × 1 mm, 14-lead, plastic package.

3.6.2 FEATURES:

- Ultralow power: as low as 23 μA in measurement mode and 0.1 μA in standby mode at VS = 2.5 V (typical)
- Power consumption scales automatically with bandwidth
- User-selectable resolution
- Fixed 10-bit resolution
- Full resolution, where resolution increases with g range,up to 13-bit resolution at ±16 g (maintaining 4 mg/LSB scale factor in all g ranges)
- Embedded memory management system with FIFO technology minimizes host processor load
- Single tap/double tap detection
- Activity/inactivity monitoring
- Free-fall detection
- Supply voltage range: 2.0 V to 3.6 V
- I/O voltage range: 1.7 V to VS
- SPI (3- and 4-wire) and I2C digital interfaces
- Flexible interrupt modes mappable to either interrupt pin
- Measurement ranges selectable via serial command
- Bandwidth selectable via serial command
- Wide temperature range (−40°C to +85°C)
- 10,000 g shock survival
- Pb free/RoHS compliant
- Small and thin: 3 mm × 5 mm × 1 mm LGA package

3.6.3 APPLICATIONS

- Handsets
- Medical instrumentation
- Gaming and pointing devices
- Industrial instrumentation

- Personal navigation devices
- Hard disk drive (HDD) protection

IV. PROPOSED SYSTEM

The proposed WSN has:

• 15- 20 Sensor Nodes: Each Sensor Node will have sensor inputs as data of Accelerometer and sound sensor.
• 1 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.
• 1 Base Station: Receives the messages from more than one master node and logs the messages to the server.
• 1 PC based Server Software with GUI: To give audio visual alarms

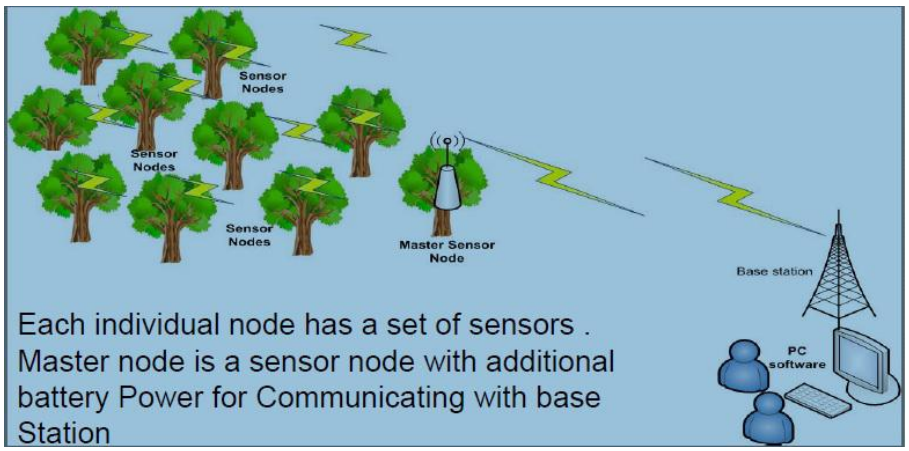


Fig.1.1 Proposed WSN System Architecture

We are developing such a system which can be used to restrict this smuggling. Every tree will be equipped with one small electronics unit which consists of Micro Controller, MEMS sensor, GPS and IOT module. In big forest, each tree will be having sensor unit which is fitted on stem of tree will Communicate with their server unit .The communication between tree unit and server unit take place by using IOT module. Tree cutting will be detected by sound sensor and MEMS. By using sound sensor we can predict the cutting tree .once the tree will fallen the nearest tree will sense the sound of fallen trees and send the signal to server.Sensor values having some fixed threshold value, once the threshold value will match to the current value, it will send the alert signal to server due to that signal the forest ranger may get more alert on that particular area. Due to nature disaster some trees may fallen, for that purpose we are using GPS module for continuous monitoring of trees location

4.1 BLOCK DIAGRAM :

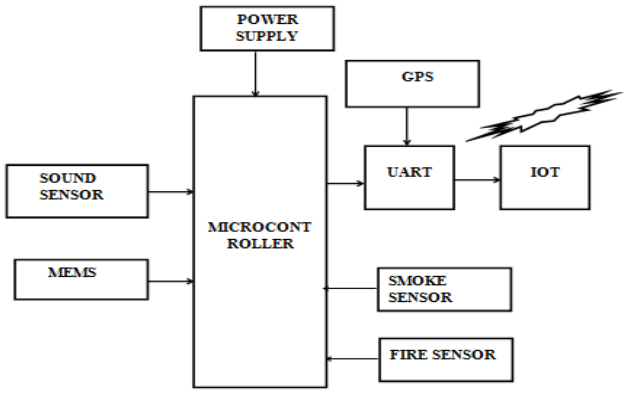


Fig.1.2. Transmitter block diagram

Fig 1.3 Receiver block diagram.

V.HARDWARE DESIGN DETAILS

5.1. POWER SUPPLY: Transformer 230V AC.

5.2. MICROCONTROLLER PIC16F877A:

The term PIC, or Peripheral Interface Controller, is the name given by Microchip Technologies to its single – chip microcontrollers. PIC micros have grown to become the most widely used microcontrollers in the 8- bit microcontroller segment.The PIC16F877A CMOS FLASH-based 8-bit microcontroller is upward compatible with the PIC16C5x, PIC12Cxxx and PIC16C7x devices. It features 200 ns instruction execution, 256 bytes of EEPROM data memory, self

Flash Memory: 14.3 Kbytes (8192 words)

Data SRAM: 368 bytes

Data EEPROM: 256 bytes

Self-reprogrammable under software control

In-Circuit Serial Programming via two pins (5V)

Watchdog Timer with on-chip RC oscillator

5.3 MEMS:

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).The resolution 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 [2]. Has an ultralow power consumption of - 40 μA in active mode and 0.1 μA in standby mode at 2.5 V (typical).

5.4 SOUND SENSOR:

The Sound sensor is a small board that combines a microphone and some processing circuitry. It provides not only an audio output, but also a binary indication of the presence of sound, and an analog representation of its amplitude. It detects sound from silence and outputs digital trigger signal. The digital signal can have an adjustable trigger level. LEDs indicate power and output signal. The sound sensor is able to measure noise levels in decibels (dB) at frequencies around 3-6 kHz where the human ear is most sensitive. It is a sensor whose mode of detection utilizes sound waves.

Fig.1.4. Sound sensor

5.5 FIRE SENSOR:

The fire sensor circuit is too sensitive and can detect a rise in temperature of 10 degree or more in its vicinity. Ordinary signal diodes like IN 34 and OA 71 exhibits this property and the internal resistance of these devices will decrease when temperature rises. In the reverse biased mode, this effect will be more significant.

5.6 SMOKE SENSOR: Detects lubricant gases in surrounding environment.

5.7 GPS:

The **Global Positioning System** (**GPS**)is made up of three parts: between 24 and 32 satellites orbiting the Earth, four control and monitoring stations on Earth, and the GPS receivers owned by users. GPS satellites broadcast signals from space that are used by GPS receivers to provide three-dimensional location (latitude, longitude, and altitude) plus the time.

5.8 UART

The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a computer. UART is also a common integrated feature in microcontrollers. The UART takes bytes of data and transmits the individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits.

Communication can be "full duplex" (both send and receive at the same time) or "half duplex".

5.9 IOT MODULE

Internet of Things (IoT) is an environment in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or computer interaction. The IoT allows objects to be sensed and/orcontrolled remotely across existing network infrastructure, creating opportunities for directintegration of the physical world into computer-based systems, and resulting in improvedefficiency, accuracy and economic benefit. IoT board featured with SIM900 GPRS modem toactivate internet connection equipped with controller to process input

.

VI.SOFTWARE DESIGN

Data rate of ADXL345 is kept at 100Hz, selecting ±16g range, so that output is in 12bit.Data acquired from adxl over SPI is of clock 2MHz. Amplitude of vibration i.e. g (9.8m/s2) values along x, y & z directions are compared to threshold value. Vibrations in case of cutting with electrical machine are more than wind or any tropical natural resources. NTC Thermistor (10K) used to calculate the environmental temperature.

Parameter to be used by sensor node: -

- Accelerometer data in digital form
- Analog data from Thermistor
- Node address assign through switch.
- External RTC for Date & Time.
- Serial Data transmitted through Uart IoT module

The microcontroller processes accelerometer data in termsof g unit and compares it with threshold and transmits alarms serially through the IoT module.

The acceleration resolution is shown below 4 mg/LSB

$$\text{Acceleration Resolution (g)} = \frac{\pm 16g}{2^{12} = 4095} \quad \ldots\ldots\ldots\ldots (1)$$

$= 0.0039072$ g (1g= 9.8m/s^2)

$$\text{Acceleration Resolution (m/s}^2\text{)} = \frac{\pm 2g}{2^{12} = 4096} \times 9.8\text{m/s2}$$

$= 0.038290$ m/s^2

The acceleration can then be calculated using the followingequation.

Acceleration(g)= RAW DATA× 0.0039072 g…….... (2)

OR

Acceleration(m/s^2) =RAW DATA× 0.038290 m/s

6.1 Algorithm of MEMS accelerometer for vibration detection.

The accelerometer has an in-built 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. 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 [2].

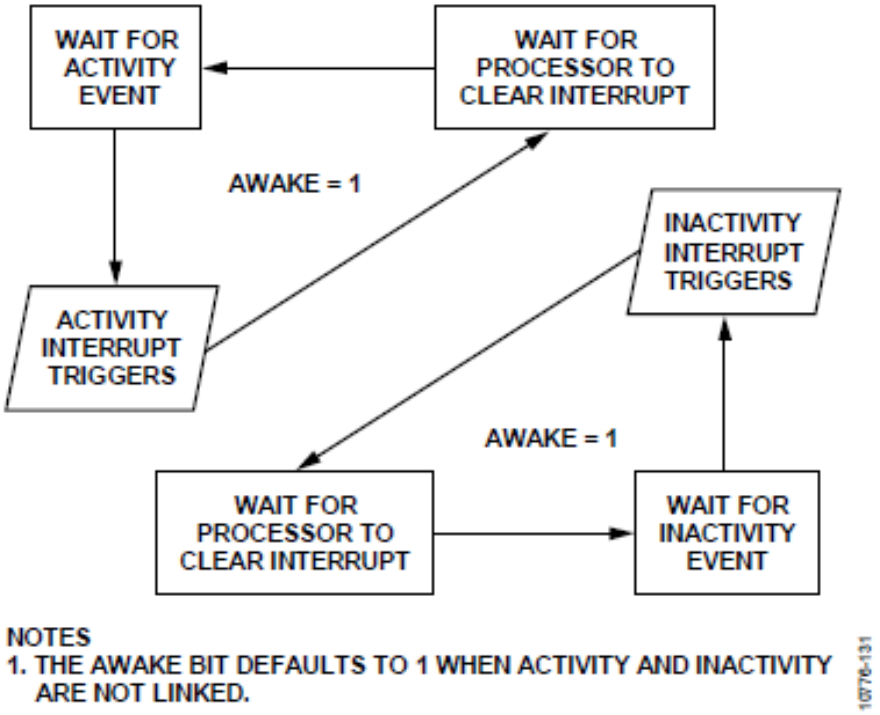
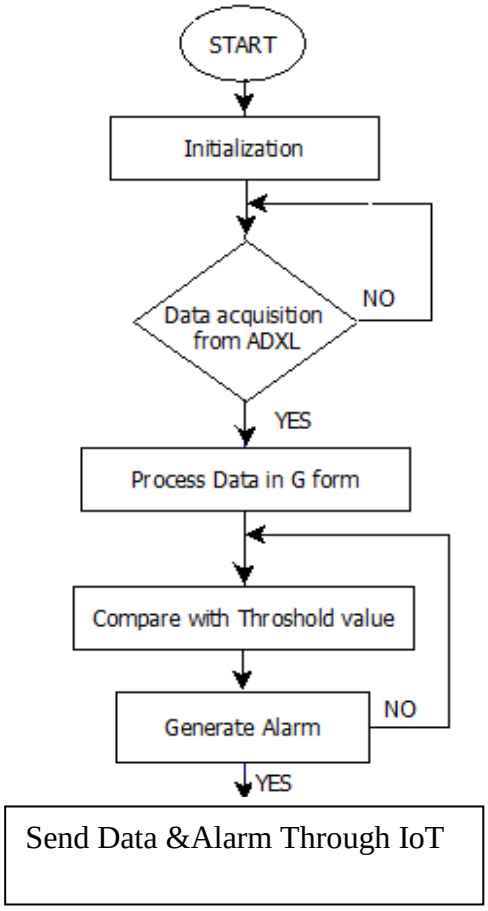


Fig 1.5. Algorithm of MEMS accelerometer.



Send data&Alarm through IOT

Fig.1.6.Flowchart for Design

VII.RESULTS AND DISCUSSION

In this section experimental result and simulated results areexplained.

Various tests were carried out to obtain vibrations ofcutting tree/branches. Sensors were mounted on big enoughwood STEM which was to be cut in sawmill and in carpenter'sshop, where electrical cutter & saw-tooth machine were usedfor cutting.

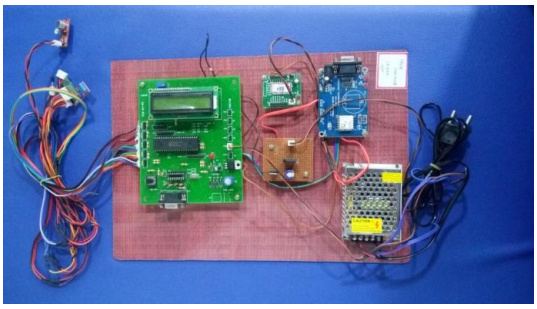


Fig.1.7. Anti-poaching system module

Accelerometer sensor is attached on test bench strongly; datais obtained by Microcontroller & transmitted via IoT to PC.

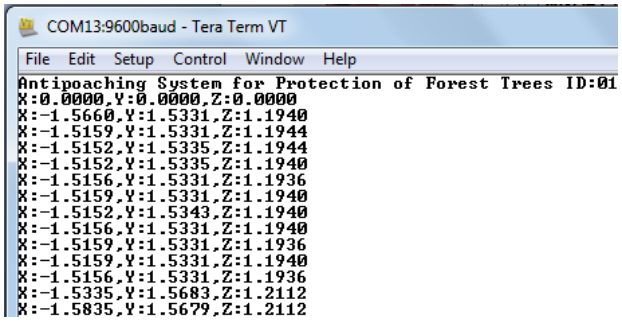


Fig.1.8. Data collected through serial port on PC

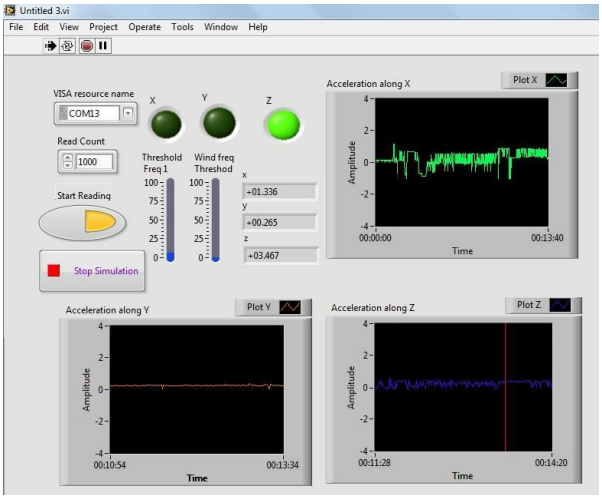


Fig.1.9.ADXL data shown on LabView graphically.

VIII.CONCLUSION AND FUTURE WORK

This paper presents a Microcontroller, sound sensor and IOT based WSN node to detect theft/smuggling contributing to the protection of important & costly species of tree. Simulations and experimental results have been compared to validate the proposed design. The peer to peer communication between the node and the computer is implemented here.

The future scope of work is implementation of Multi-nodenetwork and incorporation of microphone, motion detectorsensor & temperature sensor to make systems more effective toacquire data such human or animal interference, fire detectionetc.

IX. ACKNOWLEDGMENT

Here we would like to thanks Mr.V Narasimman, Department of ECE from Sri Sairam Institute of technology, Chennai for always being available when needed for support. Discussion with these researchers has been always helpful for project proceedings.

REFERENCES

[1] Anil Kulkarni, Ajay Khandare, Mandar Malve, "Wireless Sensor Network (WSN) for protection high cost trees in remote jungles from fire and poaching' 'International Seminar on Sandalwood: Current Trends and Future Prospects , Feb 2014,pp.68-73.

[2] Digital Output MEMS Accelerometer-ADXL345, Analog Devices, 2009, datasheet available at www.analog.com.

[3] Sridevi Veerasingam, Saurabh Karodi, Sapna Shukla,"Design of Wireless Sensor Network node on Zigbee for Temperature Monitoring",2009 International Conference on Advances in Computing, Control and Telecommunication Technologies, IEEE Journals 978-0- 7695-3915-7/09,2009.

[4] Manish Y. Upadhye, P. B. Borole, Ashok K. Sharma, "Real-Time Wireless Vibration Monitoring System Using LabVIEW", 2015 International Conference on Industrial Instrumentation and Control Pune, India. May 28-30, 2015, pp. 925-928.

[5] Pedro Cheong, Student Member, IEEE, Ka-Fai Chang, Member, IEEE, Ying-Hoi Lai, Sut-KamHo,Iam-Keong Sou, and Kam-Weng Tam, Senior Member, IEEE,"A ZigBee-Based Wireless Sensor Network Node for Ultraviolet Detection of Flame",IEEE TRANSACTIONS ON
INDUSTRIAL ELECTRONICS, VOL. 58, NO. 11, NOVEMBER 2011..

[6] Jamali Firmat Banzi,"A Sensor Based Anti-Poaching System in Tanzania National Parks", International Journal of Scientific and Research Publications, Volume 4, Issue 4, April 2014.

[7] Ravi Bagree,Vishwas Raj Jain, Aman Kumar and Prabhat Ranjan,"TigerSENSE :Wireless Image Sensor Network to Monitor Tiger", P.J.Marron et al : Realwsn 2010,LNCS 6511,pp 13-24,Springer – Verlag Berlin Heidelberg 2010.

[8]"XBee/XBee-PRO RF Module", Digi International,Inc., Sept 2009.

[9] "X-CTU Configuration and Test Utility Software User Guide", Digi International, Inc., August 2008.

[10] Information about MSP430F5529, User_s Guide for MSP430 series.pdf available on www.ti.com.

[11] Shih-Lun Chen, Ho-Yin Lee, Chiung-An Chen, Hong-Yi Huang, Member, IEEE, and Ching-Hsing Luo, Member, IEEE ,"Wireless Body Sensor Network With Adaptive Low-Power Design for Biometrics and Healthcare Applications",IEEE SYSTEMS JOURNAL, VOL. 3, NO. 4,DECEMBER 2009.