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Wireless Sensor Network Based Monitoring System for Forest

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Abstract- Wildlife prevention has become an important practice due to negative effects of human activities such as cutting of trees on large scale and unregulated hunting which causes major threat to wildlife. So we are going to introduce the project on prevention of trees and wildlife in forest. This article presents the design of a system for detection of vibration for prevention of cutting of trees, detection of temperature for prevention of forest fires also detection of pulses of animal for prevention wildlife using wireless sensor networks to prevent a disaster (forest) that could lead to loss of a significant number of natural resources. In this project, The sensing device can sense the vibration, pulse, and temperature, and then sent them over zig-bee networks to forest office. To save the transmission cost, we also sent the GPS location information simultaneously. Here we use Wireless Sensor Networks (WSNs).In this network numerous sensors are usually deployed on remote places, the deployment and maintenance must be easy and scalable. Wireless sensor network is the network which consists of large number of small nodes. Sensor nodes are great for deployment in hostile environments or over large geographical areas.

Keywords—*Deforestation, wireless sensor network, temperature, force ,Zig-Bee ,GPS, GSM.*

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I. INTRODUCTION

Our topic is related to prevention of trees and wildlife. Today's life we have understood the value of trees.Our atmosphere is present because of trees. We get valuable oxygen because of trees so the protection of trees is very important in our life. So we are going to introduce the project on, "WSN Based prevention of trees extinction and wildlife" For that there will be two systems one is Master & other is Slave. Master is to transmit the present force of trees at present one force sensor we are using between our trees because in jungle all trees are very near even one tree get cut or any other force exerted on tree will effect on other side trees. In forest, rain is high so we are going to use slave circuit which will receive the force & location signals. It consists of transmitter and receiver unit.The main components of project are Force sensor, pulse sensor temperature sensor, ARM, Zig-bee module, GPS Module. We use ARM Microcontroller as main controlling unit. It is high performance, low power,32 bit microcontroller. Zig-bee MODULE used as transmitting and receiving unit. This is done with the help of antenna. Based on these requirements and the characteristics of wireless sensor networks, several research challenges of new protocols as well as hardware and software support are examined.This system does following work:

1. Interface ZIG BEE to create wireless sensor network.
2. Interface LCD to display the location where the trees are cut, fire has occurred, hunting of animal because of GPS Module.
3. Interface GSM module for sending message to forest office

II. RELATED WORK

There are number of researches and applications in various areas focusing on prevention of trees and animals depending upon research demands for a real world experiment and upcoming problems towards wildlife.

Each proposal can be classified into 3 groups: types of monitoring sensors, wireless transmission technologies, and monitoring devices. Consider the first group. In general, various sensors are used for monitoring purpose. For example in Chakchai [2] simple motion sensor or a camera-based sensor is used to track the animals. Here, image processing and motion tracking systems were collaborated to recognize and to detect in order to warn drivers

III. WIRELESS SENSOR NETWORK

A Wireless Sensor Network (WSN) is a useful architecture for the deployment of the sensors used for fire and trees cut detection. This deployment method is used in situations where it is very important for every event to be detected or when it is important to have multiple sensors cover an area.

A WSN consists of many small devices called sensors which measure physical parameters such as temperature, pressure, from the environment [4].

A sensor is a device which is able to transform physical readings collected from the environment into signals

that can be measured by a system. In our case we have developed a multi-sensor node that is able to sense several magnitudes in the same device. In a multi-sensor, the input variables could temperature, force etc.

However, barriers to the widespread for use of sensors in structures and machines remain. The use of bundles of lead wires and fiber optic "tails" are leads to breakage and are connector failures. As wire requires installation and maintenance cost, that limits number of sensors that may be developed, and therefore reducing the quality of the data reported. Wireless sensing networks eliminate costs, easy installation and eliminating connectors [1].

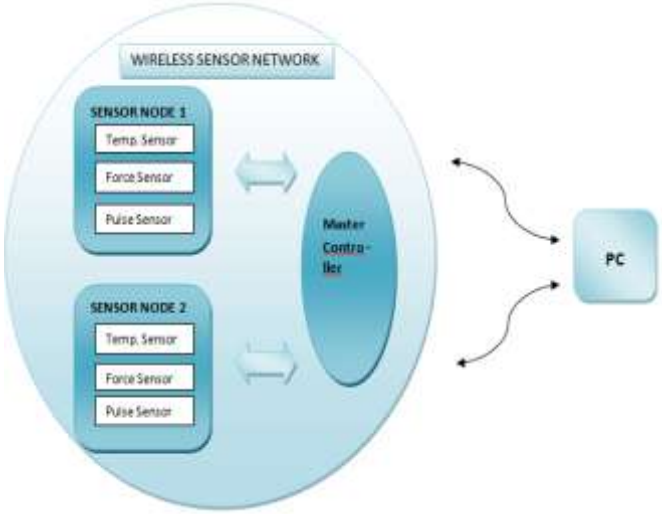

Figure.1 WIRELESS SENSOR NETWORK

Above figure is basic structure of Wireless Sensor Network. In this network large number of sensor nodes are distributed over large geographical area of the forest. There are multiple sensors like temperature, pressure and pulse sensor, that are integrated in a sensor node so it is a multi-sensor node. These distributed nodes are continuously monitoring the status of its various sensors, and if any event (fire or tree cut) occurs then one or all of these distributed multi-sensor nodes detect this and then wirelessly sends this to master. The master controller then gives indication of the event to receiver by wirelessly sending the status of sensors[9].

The ideal wireless sensor is networked and scalable, which consumes little power, that is smart and software programmable, also is capable of getting fast data and accurate. And costs for purchase and install is also low and requires no any real maintenance[5]. The Battery life, sensor update rates, and size are all major design considerations in WSN. Most recent advances have resulted in the ability to fabricated sensors, radio communications, and digital electronics into a single integrated circuit package. This capability is enabling networks of very low cost sensors that are able to communicate with each other using low power wireless data routing protocols[5].

Wireless Sensor Networks which can also offer unique benefits and versatility with respect to low-power and low cost rapid increase for many applications, which do not need human supervision for this [8].

IV. SYSTEM ARCHITECTURE

In general, there are two main sections : 1) sensing section that is slave 2)monitoring section that is master

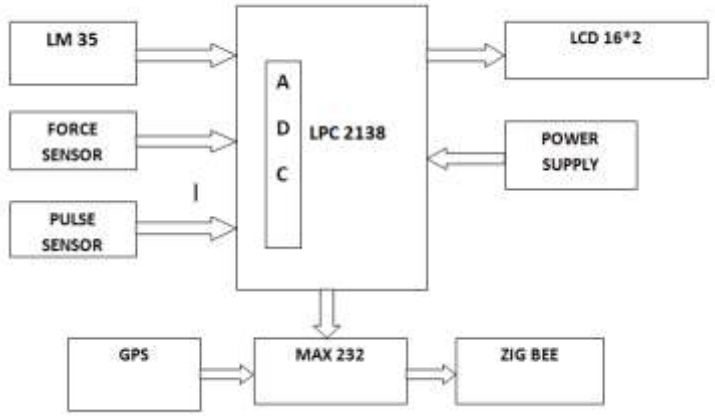

Figure.2 Block Diagram of Slave

Fig. 2 shows first section. Details of each as follows:

1) Sensing section: this component performs as the main function to collect change in environmental condition, and then send it over wireless networks to a tracking device. Note that we used LPC 2138 Arm controller.[1]

2) Tracking section: This is the interaction to the human for tracking, searching.[2] Here we have used GPS as a tracking device. [7]

Zig -Bee WSN is used to send the current location tracked by GPS to monitoring section [7]. It has three kinds of nodes: 1) the coordinator 2) the router 3) the end device. There is no difference between them on hardware design. The main difference is only software design.

As the gateway of the Zig-Bee WSN, coordinator automatically initiates the formation of the network. After that, it will wait on until all the nodes nearby finished joining in the net [3]. Then the coordinator will sent instructions or collect information such as the connection status, sensor data and location data, and then sent them to the control center to update value in the location software. All these processes are completed in a specified number of regularly timed execution cycles.

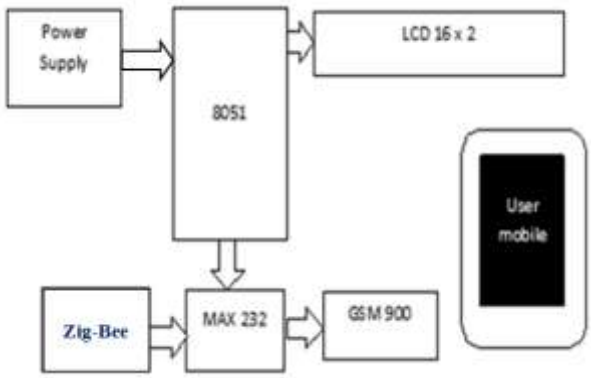

Figure.3 Block Diagram of Master

Figure. 3 shows monitoring and alerting section. Details of each component as follows:

1)GSM : - SMS-GSM Processing: with environmental and location data available, this module performs the actual data transmission using SMS services back to the tracking device in a character-based format. Note that all required information can be fitted in one SMS message (160 bytes). Here, we used SIM 900 GSM/GPRS module which delivers GPS/ GPRS850/900/1800/1900MHz performance for messaging, in a small factor and with low power consumption. This SIM socket for SMS transmission. In addition, this module can receive the command from the tracking device, again via SMS services, to let the sensing device perform a particular task, e.g. determining a specific threshold to activate GPS functionalities [2],[6].

V. WORKING

Prevention of trees extinction and wildlife system based on wireless sensor networks consists of the monitoring nodes, base stations, communications systems, and the structure of monitoring hardware as well as software system[1]. According to its functions, a large number of the different sensors can be placed in the field and constructed a self-organized network and monitor the value change including temperature, force, pulses. The data is collected and then send to wireless node[2]. The nodes are divided into two types that is the common node and cluster-head node. The common nodes will collect all the data from sensor which transmitted to the cluster-head node[1][2].

Sensor node is the basic part of wireless sensor networks. The sensor is consisting following parts, sensor node module, the processing module, wireless communication module and power module [3]. Sensor module is responsible for collecting temperature, force, pulses and other parameters and data conversion module. This is sent through the wireless network to a central server [4]. The processor module controls the operation of the sensor nodes then processes collected data. Wireless communication module communicates with other nodes, exchanges information and sends and receive data. Out of all the module the most important components of a sensor node are the power section.[5].

ARM (LPC 2138) performs number of functions as like data collection from the sensors and performing power management functions. This also sends the data to the base station by using GSM [6]. Zig-Bee modules provide effective wireless connectivity to devices and benefits are low cost and Range, obstruction avoidance [1][3]. It can transmit data over long distances by passing data through a star or mesh network. Every network may have one coordinator device. In the star networks, the coordinator are central node. The central node will sent instructions such as the connection status, sensor data and location data [3]. The information collect at the central node i.e. Master node. At the same time GPS enable a location processing logic to transmit the current position to the master[7]. It can collect the data of wirelessly and sent to the computer of forest office to update the location.[9] . We use GSM module for sending actual data transmission using SMS services from master to forest office[2][9].

VI. HARDWARE DESCRIPTION

1. Temperature sensor LM35:-

The LM35 series are precision integrated-circuit temperature sensors, its output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 has an advantage over linear temperature sensors calibrated in Kelvin[1][4]

2. Force sensor (Force sensing resistor):-

Force Sensing Resistors (FSR) are a polymer thick film (PTF) device which exhibits a decrease in resistance with an increase in the force applied to the active surface. And its force sensitivity is optimized for use in human touch control of electronic devices. FSRs are not load cell or strain gauge, even though they have similar properties. FSRs are also not suitable for precision measurements.

3. Microcontroller UNIT:-

Microcontroller like ARM (LPC 2138) performs tasks, such as processes data and control the function of sensor node. This also sends the data to the transceivers module for the transmission of data to the forest office. The processor has a number of functions including:

collection of data from the sensors and Performing power management functions[1][3]

Interfacing the sensor data to the physical radio layer Managing the radio network protocol. The LPC2141/2/4/6/8 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable

32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/2/4/6/8 are ideal for applications. it consist of multiple UARTS, SPI, SSP to I2Cs and on-chip SRAM of 8 kB up to 40 kB, Various 32-bit timers, single or dual 10- bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external interrupt pins make these microcontrollers particularly suitable for industrial control and medical systems.

4. Zig-Bee:-

Zig-Bee is a Technological Standard Created for Control and Sensor Network which is based on the IEEE 802.15.4 specification for (WLAN) wireless personal are network .It is a new wireless technology that has application in various fields. Zig-Bee benefits are low cost and Range and obstruction issues avoidance. The main features of this standard are network flexibility, low cost, low power consumption and low data rate in an ad-hoc self-organizing network among inexpensive fixed, portable and moving devices. Zig-Bee WSN has three kinds of nodes: that are the coordinator, the router and the end device. The coordinator will sent instructions or collect information such as the connection status, sensor data, location data, and then sent to the control center to update value in the location software. All these processes are completed within a specified number of regularly timed execution cycles.

5. GPS Module:-

GPS Location Processing: similar to the previous module; however, this is mainly used to enable a location processing logic to transmit the positioning data to the SMS-GSM module.GPS (Global Positioning System) is a worldwide radio-navigation system formed by a constellation of 24 satellites and their ground stations. With four satellites, a GPS receiver can provide very accurate clock (time, date) and position information. The Module must be used outdoors. It uses patch antenna. It provides current time, current date, latitude and longitude, also altitude, speed, and even travel direction.

VII. EXPERIMENTAL SETUP & RESULTS

We evaluated our proposal based on two sceneries to test performance as follows .After completing our system design and implementation first we show whether the system working properly .The prototype of our system has shown in following figure 4.

Sensing devices can sense the environmental conditions like force, temperature, pulses and then send them over GSM network to forest office and also send the GPS location.

Initially at the normal condition that is when temp. & force values are below threshold, the display shows waiting for signal as shown in figure 5.

For second condition, when fire occurs in forest temperature goes above threshold, then display shows fire detected condition as shown in figure.6

For third condition , when someone cutting a tree then pressure on a tree is exceed above threshold, then display shows trees cut detection condition as shown in figure.7

A). SET UP

Figure.4 Tx. And Rx. Set up

Figure.5 At normal condition

Figure.6 Fire detected

Figure.7 Trees cutting detected

B). RESULT

CONDITIONS	READINGS	DISPLAY AT MASTER
1.Normal	Temp and force ‹ Threshold	Figure.5
2.Fire Detected	Temp › Threshold	Figure.6
3.Trees cut Detected	Force › Threshold	Figure.7

VIII.ADVANTAGES

- The network must be Large-scale High-density Structure
- WSN has a distributed multi-dimensional and multi-angle information processing
- It can improve the signal noise ratio, reduce the possible exploration in the region, and eliminate shadows and blind spots.
- Automatic Location find and Automatic alert message
- Reduces man power.
- It will be More accurate

VIII. PROSPECT AND CHALLENGE

In the Forest fire monitoring system, all nodes always work under the adverse environmental condition, so they are different from the design of the traditional sensor network. Due to a larger monitoring area of forest , the sensor network has a large number of nodes while it ensures the cost of the network[1]. The nodes will be scattered in various regions to achieve a comprehensive monitoring on forest field. Because the sensor node energy is limited, the possibility of node failure is very large. The monitoring system must solve the reliability problem. The lifetime of WSN depends on the failure of the sensor node.

IX.CONCLUSION

This article has described the design and implementation of a Wireless Sensor Network for preventing trees and wildlife. Forest fires have multidimensional negative effects in social, economic and ecological matters. It can be difficult to say that fire fighting can be successful without enough data about fire such as spread direction and speed etc. The more data about forest fire means the more effective fire management.

So we concluded that wireless sensor network is very powerful and suitable tool to be applied in this application. Our project will be complete addition of electronic circuit hardware designing and software are knowledge.

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