Mobile Embedded Wireless Sensor Network to Prevent Deforestation

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***Abstract*—** Research in wireless sensor network is an on going at a large scale for application deployable word-wide like forest monitoring etc. Novel system is proposed to develop an embedded based forest monitoring robot to monitor temperature, earth vibrations, landslides, tree falling, etc., in the forest area based on event detection. The robot is fitted with necessary sensors and driven by battery powered motor to roam the forest area in fixed routes or through guided routes. Travelling the sensors will keep on monitoring the various parameters like temperature, vibration, etc. In the event of any abnormality a wake-up signal (an interrupt signal) is generated to initiate the processor to record and transmit the information to central station, through wireless system. The wake-up signal can be generated by comparing the generated signal with a predetermined set value using op-amp based comparators. An H-bridge motor driver is used for the forward and reverse movement of the robot.

Keywords- *Robot, Wake Up signal, Op-Amp, H Bridge Circuit, Wireless System, and Event Detection.*

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I. INTRODUCTION

Deforestation is the removal of a forest or stand of trees where the land is thereafter converted to a non forest use. Deforestation is a main environmental concern in the world. Numerous researches suggest that deforestation may be the first link in a chain of environment degradation that includes erosion, climatic changes, loss of biodiversity in the forest environment. Forests being an indispensable resource play an important role in maintaining the earth's ecological balance. Forest Trees also play a important role in absorbing the greenhouse gases that fuel global warming. The Fewer forests mean will cause larger amounts of greenhouse gases entering the atmosphere—and increased speed and severity of global warming.

The major reasons of deforestation are logging off of trees (legal or illegal), tree theft, forest fire etc. Large number of the deforestation has negative impact on the atmosphere resulting in global warming, landslides, flash floods etc. Due to these negative effects, forest management department in all over the countries have taken steps for monitoring the forest to prevent deforestation to. The quickest solution to deforestation would be to simply stop cutting down trees and the forest fire in the forest area. Several decades of forestry research have resulted in many advances in field of forest monitoring such as fire detection, honey theft, valuable tree theft and so on.

Fig. 1 shows the forest environment during occurrence of deforestation. Several surveillance techniques have been employed for monitoring and prevention; they are broadly classified as Ground-based sensing techniques and Remote sensing techniques. The ground based technique based on the humans so that weather condition cannot be predicted continuously so that this cannot be an accurate method for forest monitoring. In this paper remote based technique was proposed for the forest monitoring environment it is based on the wireless sensor network, in this information from sensors is transmitted to remote station through the Zigbee communication.

Figure. 1 Example for deforestation

II. EXISTING SYSTEM

Nowadays, remote sensing technologies are also used like, aerial photographs, automatic video surveillance, wireless surveillance systems and satellite imagery. Satellite system for monitor the forest environment was very costly to detect the illegal activity like tree theft. On other hand wireless sensor network is introduced to detect the forest environment. Due to the advancements in wireless communication, various low power, Low cost, small-sized sensors nodes are available for monitor the forest environment.

Wireless Sensor Networks (WSNs) technology is being used widely for monitoring and controlling applications. Recently three main wireless standards are available for monitor the forest environment they are Bluetooth, Zigbee and Wi-Fi. Zigbee based Wireless sensor network system for detection of wood logging was

achieved using real time analysis of sounds from surroundings. The WSN system periodically acquires sound samples from the environment, processes it and transmits it to the central server. Tools which are mainly used for deforestation are chainsaw. There is a characteristic sound associated with chainsaw during a logging activity. Whenever, the sound samples acquired from the sensors matches the sound samples of logging tools, a wood logging activity is detected and the responsible personnel is notified through an a SMS alert or e-mail is generated using wireless GSM or GPRS technology.

WSN based systems which monitor the humidity or temperature for early detection fires that happen in the forest environment. Weather conditions especially rainfall, temperature and humidity that determine the speed and degree by which fire spreads in the forest. The risk of fire at any given location can be predicted using the correlation between the various weather elements and flammability of the waste of branches and trees. The main drawback of the existing system is that it detect only the particular forest environment and also consumes the more power because it transmit the information to control station without any event occurrence.

III. PROPOSED METHODOLOGY

Proposed system is an embedded based forest monitoring robot used to monitor temperature, soil moisture, landslides, tree falling, etc, in the forest area. The robot can be move from one sector to another sector to monitor the forest environment. One of the major applications of wireless network is the event detection. Here, a sensor network is monitoring certain phenomenon and the respective port get triggered on occurrence of a certain event during the event occurrence the controller transmit the information to the remote station via communication module. Main component of the project are sensors, Comparator, robot and the communication module.

Sensor was monitor the information from environment and those signals are processed by signal conditioning unit. In built ADC in the ARM controller, which can process the information from the SCU those information are converted in to digital signal for the ARM processor. The wake up signal is provided from op Amp circuitry by comparing reference value to sensor output. Monitored information from the sensor network transmits to the remote place using Zigbee module. Fig 2 shows the monitoring station for the forest environment that includes sensor and signal conditioning unit to process the input signals.

Fig 3 shows the control station for the forest environment which is located within the 100 meters the information are transmitted from monitoring station through wireless communication network. This system can be based on the wake up signal so the power consumption is less compared to traditional system.

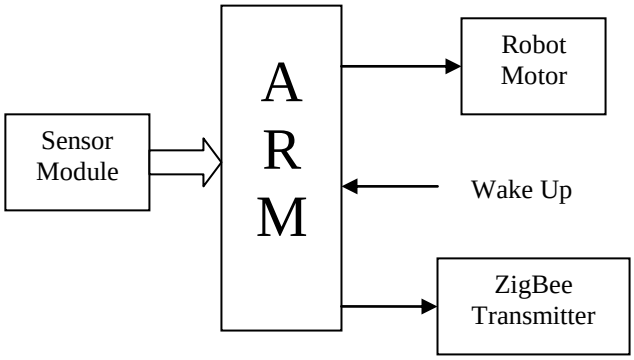

Figure. 2 Monitoring Station

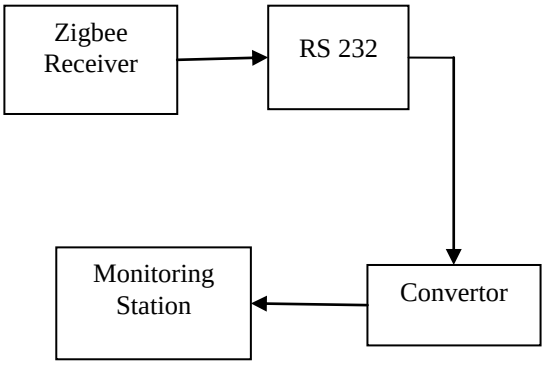

Figure. 3 Control Station

A. *ARM Controller*

ARM LPC 2148 is the heart of the monitoring system. The ARM7TDMI is a general purpose 32-bit microprocessor, member of the Advanced RISC Machines (ARM) family, which offer very low power consumption and provide high performance and low in price. The ARM architecture is based on simple instruction set and the related decode mechanism are much simpler. The Advanced Risc machine is a Reduced Instruction Set Computer (RISC) principles, has reduced instruction cycle. This LPC 2148 results in a high instruction throughput, high performance and impressive real-time interrupt response from a small and cost-effective chip.

The LPC2141/42/44/46/48 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support for debugging speciality, that combine the microcontroller with embedded high-speed flash memory ranging from 32 kB to 512 kB and also Advance Risc Machine. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate.

B. *Sensor Section*

A sensor (also a detector) is a convertor that measures a physical quantity and converts it in to a signal which can be read by a observer or by an instrument. The following sensors are used in the monitoring station temperature sensor, PIR sensor, Soil Sensor, Ultrasonic sensor, Vibration sensor.

1) Temperature Sensor: The AD590 is a Temperature transducer it produce an output current proposed to absolute temperature. It can be used for measuring temperature in range of –55 to 150 Degree C. it doesn't require linearization, circutary, precision voltage amplifiers, cold-juction companion and impedance matching circuitary. In this application , regulated power source, a resistance and a volt meter can be used to measure temperature.

2) PIR Sensor: It allows you to sense motion, almost always used to detect whether a human has moved in out of range or within the range. They are often referred as PIR sensors is a passive Infrared Sensor which controls the switching on/off of the lighting load when it detecting a moving target. This operates based on motion of human body by change in surrounding ambient temperature when a human body passes across or any object. They are low Power, low cost, less range and easy to interface. This can be used to detect the intruder or obstacle detection within the forest.

3) Ultrasonic Sensor: Ultrasonic Sensors generate an ultrasonic wave by means of a piezo element in the front part of the housing. The wave spreads in the atmosphere in accordance with the laws of physics. The same piezo element can detect and measure the sound reflected by an object. Therefore it functions alternately as sender and receiver (transceiver). The measurement principle of ultrasonic sensors is based on the time taken for ultrasonic to travel through the medium air. Ultrasonic sensors UM30 are used as non-contact proximity switches which process reflected signals.

4) Soil Sensor: The soil sensor measure the soil water content, water level in the soil and also the moisture content in soil to find the dryness of the coil it will cause the problem of forest fire. Time domain transmissivity sensors are less expensive and require the samples of small area.

C. Comparator

In electronics, a comparator is a device that compares two voltages or currents and switches its output to indicate which is larger. They are commonly used in devices such as analog-to-digital converters (ADCs).An operational amplifier (op-amp) has a well balanced difference input and a very high gain. This parallels the characteristics of comparators and can be substituted in applications with low-performance requirements.

The operational amplifier one terminal is connected to the reference voltage and another input terminal is connected to sensor output these signals are compared with one another and the wake up signal is generated. As shown in fig.4 the wakeup signal depends on the sensor output s1, s2, s3, s4, s5.

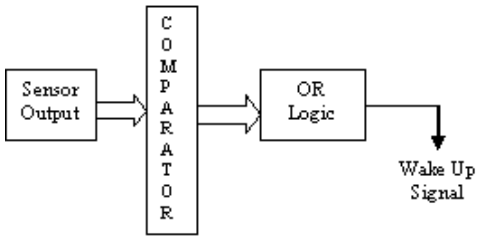

Figure. 4 Wake up signal generation

D. H-Bridge Driver

The H-bridge inverter is built with four MOSFET switches which is used to convert the dc voltage to ac.H-Bridge inverter, is used to convert dc power into ac power, there are many pulse width modulation (PWM) techniques used to control the inverter switches. If all switches operate at fundamental grid frequency, the output of the inverter will contain low order harmonics so that large output filter is required to remove them. PWM techniques were introduced to provide high output quality with low filter size; this is done by operating the inverter at high switching frequency. It is worth noting that these approaches suffer from high switching losses which reduce the efficiency of the inverter.

H-Bridge Inverter is a bucking-mode converter that requires an input voltage of greater than the designed output voltage. Two stages inverters consist of two cascaded stages. The first stage is a boost dc-dc converter and the second one is an H-bridge inverter. Single stage inverters should do both functions of boosting the input voltage and converting it into ac voltage bridge driver based on the on/off control of MOSFET switches that are connected in parallel for motor forward and reverse movement.

IV. Result And Discussion

The hardware section includes ARM controller, sensor network, and signal conditioning unit, H bridge driver and robot motor. Fig. 5 consists of five sensors, power supply unit, battery charger, Two H Bridge driver and stepper motor. First step the monitoring system run in two modes; Charging mode and run mode. Run mode used to monitor the forest environment in various conditions.

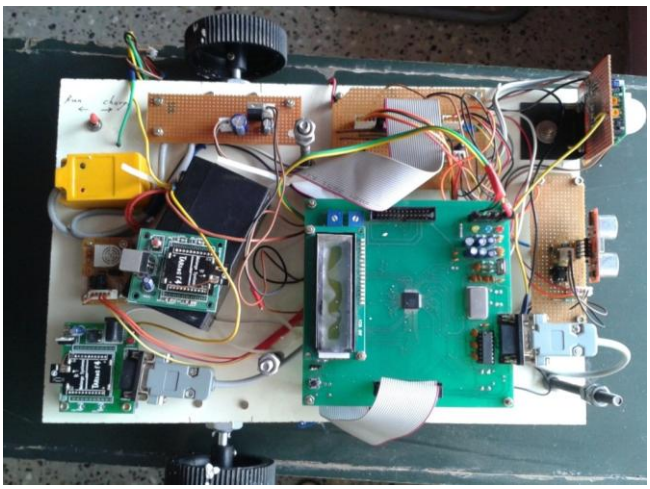

Figure.5 Hardware Implementation

The monitoring station will transmits the information to control station during event occurrence via communication module. The fig. 6 given below shows the monitoring station PC information which display the forest environment with various parameter such that, Temperature, Humidity, Tree

falling ,Vibration and number of humans in and out in sleep mode.

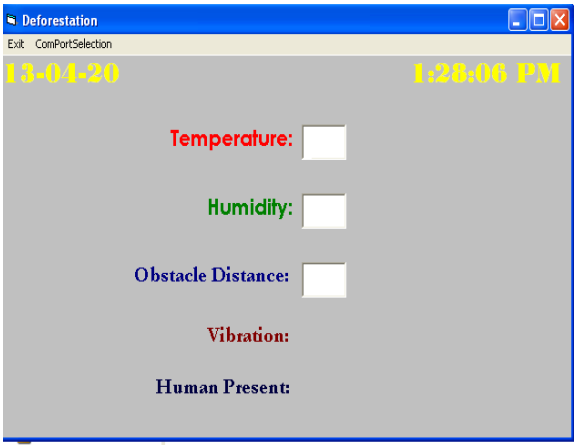

Figure. 5 Control Station Window in Sleep Mode

ARM controller generates a wake up signal based on the sensor output, which is given as input to the processor to transmit the information to the control station. Based on the wake up signal input Processor transmits the all parameter information to the monitoring station PC. Fig. 6 shows transmitted information of ARM controller the values displayed in monitoring station PC. The various parameter values Temperature in centigrade, humidity in percentage the normal range is given in monitoring station.

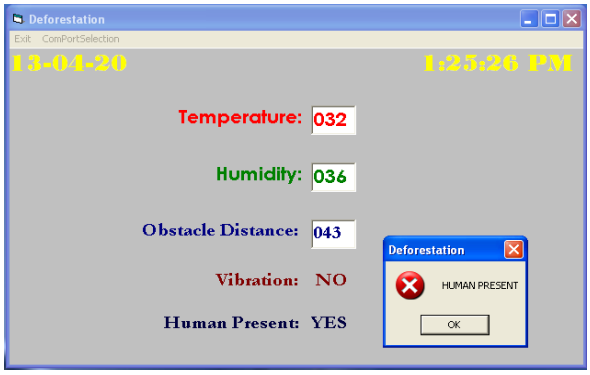

Figure. 6 Parameter Display in Control Station

V. CONCLUSION

A forest monitoring system was implemented by ARM controller and the sensor network based on the event detection. The Parameter changes notified by sensor network compared with reference voltage to trigger the wake up signal to drive the controller for transmit the information to control station via the UART communication port. The simulation result was implemented. This is initial step in building efficient embedded system for monitoring forest environment. This paper will minimize the deforestation problem to the environment.

Future work will be an environment monitoring using ROBOT system, in this system sensors are fitted in robot which can move one particular sector to another sector. This information is compared with reference signal, if the signal is above the reference signal then the wake up signal drive the controller to transmit the information to the remote place. For communication medium Zigbee are used. This monitoring system can find out forest tree theft and forest fire in effective manner.

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