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Advanced Techniques to Protect the Trees in Forest Using LoRa

Mr. M. Shanmugham[1], Mrs. G.Vijayakumari[2], Mr. U .Rajasekaran[3], T.Logesh[4], M. Rajeswari[5]

[1,2,3]Assistant Professor,[4,5]Student

Dept. of Electronics and Communication Engg., Builders Engg. College Tirupur, India.

E-mail: shanmuecengg@gmail.com

ABSTRACT

Smuggling the fog most important tresses has sandal wood in forests, poses a serious threat to forest resources, causes significant economic damage andultimately has quite a devastating effect on the environment all over the world. Themain aim of this project is to monitor the peculiar trees like sandalwood trees byusing MEMS Technology and vibration sensor for the forest department usingrenewable energy source of solar energy. This paper propose a microcontroller based anti-poaching system employing WSN technology, which iscapableofdetectingtheftbymonitoringthevibrationsproducedbythecuttingoftrees/branches using a 3 axis MEMS accelerometer. Depending on the directionvariation of the trees, it will buzzers loudly to indicate the tree snatching in deepforest area and also indicate the signal to the zone control via LoRa transmitter. LoRa receiver is fitted in the zone control to send the affected tree with zone to thecontrol room through Arduino UNO. Thus the control room gets a detail about thesmugglers activity or tree status wirelessly to protect the tree smuggling in forestareas. Thus this project is going to implement with the three sections thereby thecost of the implementation is very low for each tree. This project is low cost andinnovativeworktoprotectthetreesandsave thenature.

Keywords:*Arduino UNO, LoRa, MEMS, WSN*

I.INTRODUCTION

Often there is a news in the newspapers about smuggling of the trees like sandal “Sagwan” etc. These trees are very costly as well as less available in the world. These are used in the medical sciences as well as cosmetics. Because of huge amount of money involved in selling of such tree woods lots of incidents are happening of cutting of trees and their smuggling. To restrict such smuggling and to save the forests around the globe some preventive measures need to be deployed. Such a system can be developed which can be used to restrict this smuggling. This topic is related to prevention of trees and wildlife. In today’s life the value of trees is very important and atmosphere is present because of trees. Valuable oxygen is obtained because of trees so the protection of trees is very important in our life. So the project is introduced 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 is used between 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 slave circuit is used which will receive the force & location signals. It consists of transmitter and receiver unit. Every tree will be equipped with one small electronics unit which consists of Micro Controller,3 Sensors and LoRa module. There will be one sub server unit for particular area of jungle. The data of different tree units can be collected by this unit. The sub server unit will send the data to main server using LoRa.

II.METHODOLOGY

Theft of Sandalwood trees have been a major issue for our country which leads to loss of our precious forest green cover. Studies shows that the number of sandalwood trees lost due to inhuman activities is increasing year by year making safety of the sandalwood trees a major concern. The module developed is an integration of hardware and software. Hardware is developed using sensors–sound sensor, tilt sensor, flame sensor and infrared sensor. Solar panel also connected to the module. Sensor continuously monitor the tree spot and send the information to control unit, which is fixed at forest officer room.

The main idea presented in this paper is to design a portable wireless sensor node which is a part of wireless sensor Network. It will be mounted on trunk of each tree, capable of detecting theft as well as automatically initiate & send alarm signals if any to remote terminal through wireless media. This project proposes a two control section which is protecting trees from smugglers and uses the renewable energy. The system will be a low power design, so it will more effectively work with rechargeable batteries which can charge up by natural solar system i.e. solar panel. A solar energy harvesting system is used for recharging node's batteries to avoid frequent manual change batteries.

III.SYSTEM DESCRIPTION

The major components are:

1. Accelerometer or MEMS
2. Relay
3. Vibration sensor
4. Fire sensor
5. CO sensor
6. LoRa

MEMS

This sensor works on 12v. It gives Digital high (5V)output whenever vibration is detected.The Vibration Sensor Detector is designed for the security practice When Vibration Sensor Alarm recognizes movement or vibration, it sends a signal to either control panel Developed a new type of Omnidirectional high sensitivity Security Vibration Detector with Omni-directional detection. It works on electromechanical principle. Vibration velocity

sensors operate in accordance with the electrodynamics principle and are used for measuring the bearing absolute vibration based on the piezoelectric effect. Change in resistance due to the force acting on it and convert it into 4 - 20 mA.. We can also use shock sensor to detect vibrations. An accelerometer is a device that measures proper acceleration ("g- force"). Proper acceleration is not the same as coordinate acceleration (rate of change of velocity).an accelerometer at rest on the surface of the Earth will measure an accelerating= 9.81 m/s2 straight upwards. By contrast, accelerometers in free fall orbiting and accelerating due to the gravity of Earth will measure zero.An accelerometer behaves as a damped mass on a spring. When the accelerometer experiences an acceleration, the mass is displaced to the point that the spring is able to accelerate the mass at the same rate as the casing.Piezoresistive accelerometers are preferred in high shock applications. Capacitive accelerometers typically use a silicon micro-machined sensing element. Their performance is superior in the low frequency range and they can be operated in servo mode to achieve high stability and linearity.

RELAY

A relay is a switch worked by an electromagnet. It is useful if we want a small current is one circuit to control another circuit containing a device such as a lamp or electric motor which requires a large current, or if we wish several different switch to be operated simultaneously.

Fig No.1 Relay

A relay is a switch worked by an electromagnet. It is useful if we want a small current is one circuit to control another circuit containing a device such as a lamp or electric motor which requires a large current, or if we wish several different switch contacts to be operated simultaneously. When the controlling current flows through the coil, the soft iron core is magnetized and attracts the L-shaped soft iron armature. This rocks on its pivot and opens, closes or changes over, the electrical contacts in the circuit being controlled it closes the contacts. The current needed to operate a relay is called the pull-in current and the dropout current in the coil when the relay just stops working.

When the current in the coil of a reed switch falls to zero, a large voltage is induced in the coil due to its inductance. This voltage could damage any transistor used to control the current in the coil. However, if a diode is connected in reverse bias for the supply voltage it offers an easy path to the induced voltage and stops it building up to a high value.

Earth-leakage (or residual current) circuit breaker

This is sometimes present as a safety device in mains electrical circuits. In one variety, current passes to earth through a relay-type ‘trip coil’ when for example; the metal case of the appliance becomes ‘live’ due to a fault. As a result the rod in the coil opens the switch, which can be set to break the circuit before the case rises above say 25V.

VIBRATION SENSORS

Vibration sensors have proven to be versatile tools for the measurement of various processes. They are used for quality assurance, process control and for research and development in many different industries. Since then, this measuring principle has been increasingly used and can be regarded as a mature technology with an outstanding inherent reliability. It has been successfully used in various applications, such as in medical, aerospace, nuclear instrumentation, and as a pressure sensor in the touch pads of mobile phones. In the automotive industry, piezoelectric elements are used to monitor combustion when developing internalcombustion engines. The sensors are either directly mounted into additional holes into the cylinder head or the spark/glow plug is equipped with a built in miniature piezoelectric sensor. Even though Vibration Sensor are electromechanical systems that react to compression, the sensing elements show almost zero deflection. This is the reason why Vibration Sensor are so rugged, have an extremely high natural frequency and an excellent linearity over a wide amplitude range.

Fig.2 Vibration sensor

FIRE SENSOR

Thermistors are semiconductor devices that are used to measure temperature. The name comes from a combination of the words "resistor" and "thermal". Thermistors have an electrical resistance that is proportional to temperature. From a general physics course on electricity and magnetism, you may have learned that this is a property typical for all conductors. For example, devices such toasters, heaters, and light bulbs operate on this principle. Thermistors are different in that they are created to deliberately exploit this effect, and hence are more temperature sensitive than usual.

The Mathematical Model

The basic mathematical model used for thermistors is the Steinhart-Hart equation, discovered by oceanographers I.S. Steinhart and S.R. Hart. In its simplest form it is:

$1/T = a + b(\ln R) + c(\ln R)^3$

where T is the temperature, a, b, and c are coefficients that are measured, ln is the natural log, and R is the resistance in ohms.

Thermistors are used in science and engineering applications. They are also useful in medicine as clinical temperature sensors or as probes during surgery. There are two types: PTC (Positive Temperature Coefficient of Resistance) and NTC (Negative Temperature Coefficient of Resistance).

NTC thermistors have temperatures that vary inversely with resistance such that as the temperature increases, the resistance decreases, and vice versa. They are very often used for temperature control and indication, and for current suppression. Common materials used in their construction include oxides of materials such as nickel, manganese, copper, iron, and cobalt. Some are also made from silicon and/or germanium. They are usually packaged in an epoxy, and are the most common type of thermistor.

PTC thermistors are the opposite of NTCs in that they have a resistance that increases with rising temperature and decreases with falling temperature. They are used to protect circuits from overload, and can function as thermal switches or as ordinary thermometers. PTCs are constructed using semiconductors combined with ceramics or polymers.

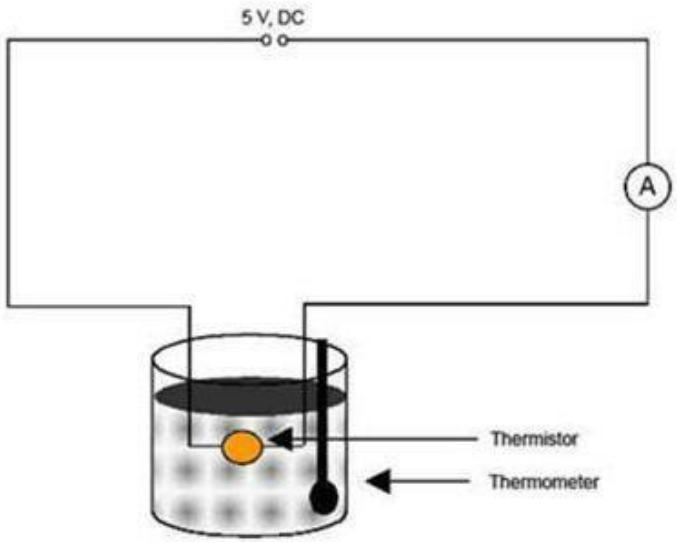


Fig.3 Thermistor circuit diagram

For an experiment you can do if you have the proper equipment and are experienced with circuits, The Effect of Temperature on a Thermistor, where you place a thermistor and a thermometer into a beaker of hot water, and then compare and plot their results as the water cools. Remember to observe the basic safety rules for handling circuits.

CO SENSOR

A **carbon monoxide detector** or **CO detector** is a device that detects the presence of the carbon monoxide (CO) gas in order to prevent carbon monoxide poisoning. In the late 1990s Underwriters Laboratories (UL) changed their definition of a single station CO detector with a sound device in it to a carbon monoxide (CO) alarm. This applies to all CO safety alarms that meet UL 2034; however, for passive indicators and system devices that meet UL 2075, UL refers to these as carbon monoxide detectors. CO is a colorless, tasteless and odorless compound produced by incomplete combustion of carbon-containing materials. It is often referred to as the "silent killer" because it is virtually undetectable without using detection technology and, in a study by Underwriters Laboratories, "Sixty percent of Americans could not identify any potential signs of a CO leak in the home".[1]Elevated levels of CO can be dangerous to humans depending on the amount present and length of exposure. Smaller concentrations can be harmful over longer periods of time while increasing concentrations require diminishing exposure times to be harmful.

ARDUINO UNO Atmega328

A microcontroller is a computer system on a chip that does a job. It contains an integrated processor, memory (a small amount of RAM, program memory, or both), and programmable input/output peripherals, which are used to interact with things connected to the chip.In the proposed system, Arduino UNO Atmega 328 is used. The ATmega328/P is a low-power CMOS 8-bit microcontroller based on the enhanced RISC (reduced instruction set computer) architecture

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. It has 14 digital input and output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. Its operating voltage is 5V.Here the Arduino UNO is connected to the pH meter as an input and is processed for NPK calculations in the soil sample. The output pin is connected to LCD and the output is also displayed in the webpage and is also notified in the registered mobile application.

LoRa (Long Range)

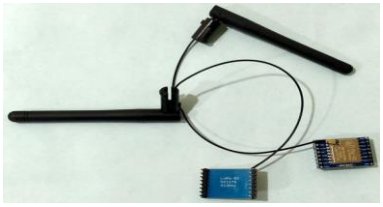


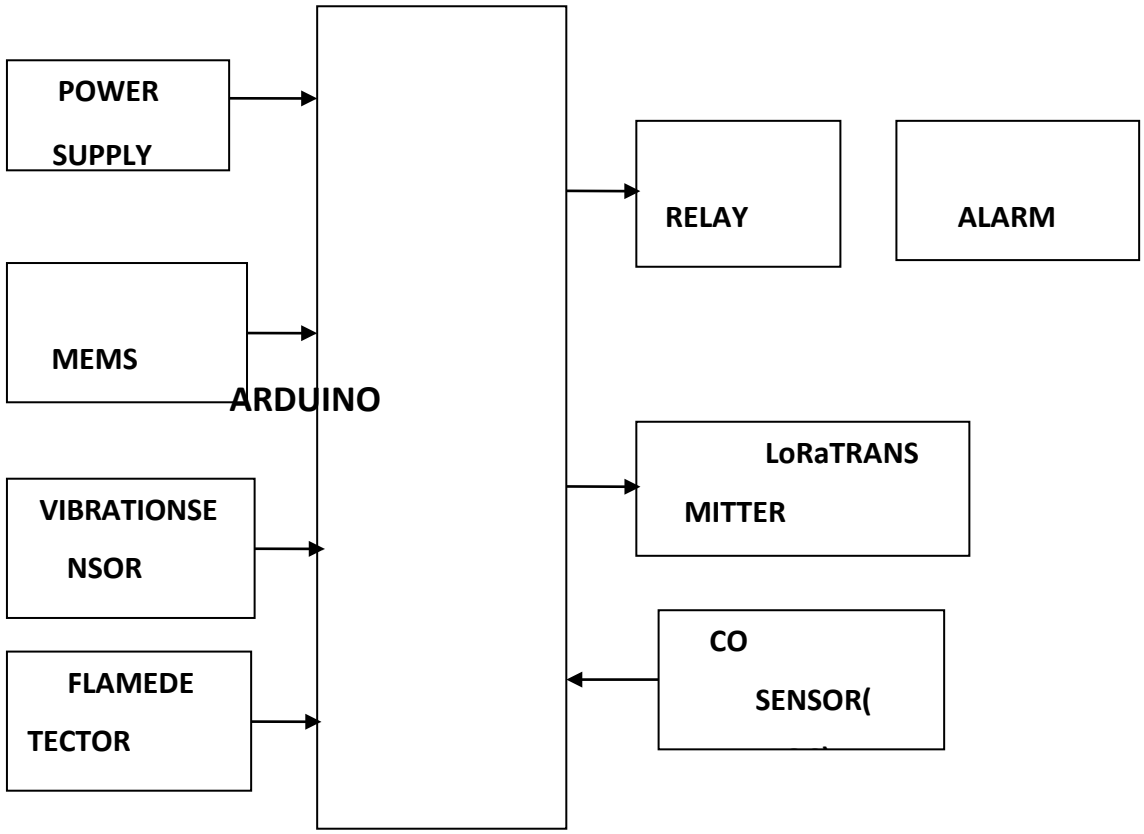
Fig.4 LoRa

LoRais a method for transmitting radio signals that uses a chirped, multi- symbol format to encode information. It's a proprietary system made by chip manufacturer Semtech; its LoRa IP is also licensed to other chip manufacturers. Essentially, these chips are standard ISM band radio chips that can use LoRa (or other modulation types like FSK) to convert radio frequency to bits, without any need to write code to implement the radio system. LoRa is a lower-level physical layer technology that can be used in all sorts of applications outside of wide area.

Key features of LoRa technology

- Long range: >15 km / 9 mi range
- Low-power: 5-10 year expected battery lifetime
- Low-cost: from end-node sensor cost to upfront infrastructure investment
- Secure: with embedded end-to-end AES-128 encryption of data
- Geolocation: enables indoor/outdoor tracking without GPS

IV.BLOCK DIAGRAM



TREE UNIT

Fig No. 5Blockdiagramoftreeunit

CONTROL UNIT

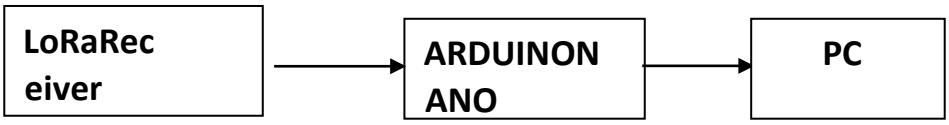


Fig No.6 Block diagram of control unit

V.EXPERIMENTAL SETUP

The tree unit has detected an abnormality and the results are obtained in real time formats in the PC. These results will be more helpful for the forest department to track the poachers from smuggling and rescue the valuable trees from forest which helps to save the nature as well as reduces deforestation, global warming and helps to save habitats of wildlife.

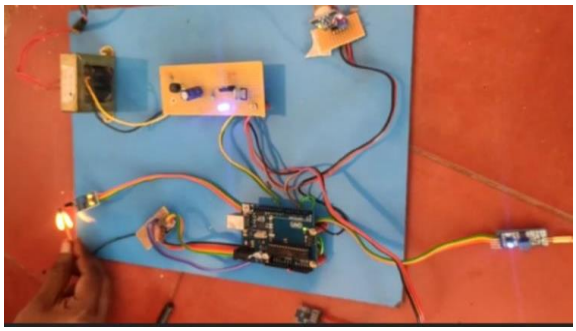


Fig No.7 Tree kit

The above figure shows the tree unit working and sensing the abnormalities. The results obtained are shown below.

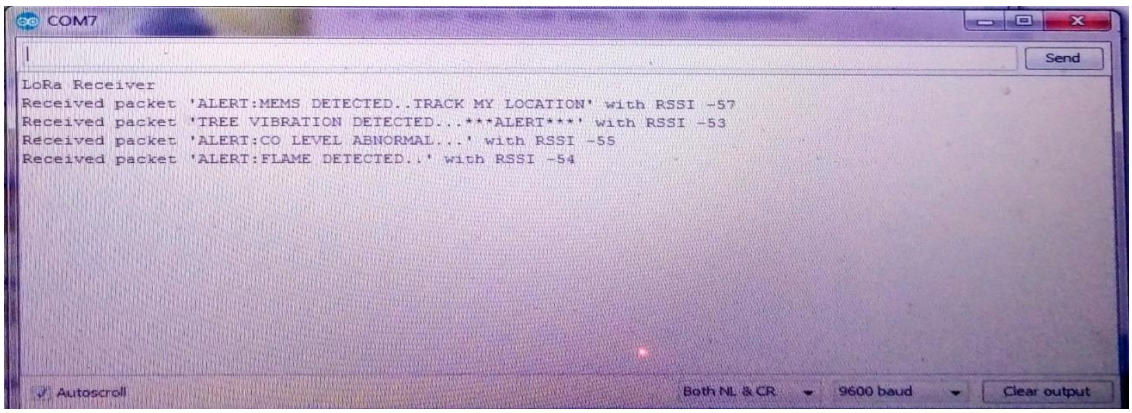


Fig No.8 Results obtained

VI.CONCLUSION

Today world is progressing rapidly. The class, design and the technologies being used is very advanced. With the change of technologies there is lack in forest management. People try to fulfil their needs by cutting the trees but they are not bothered about the effects on the earth which will in turn cause effect on living beings. This undertaking presents a Microcontroller, vibration sensor and LoRa based WSN hub to distinguish robbery/sneaking adding to the insurance of vital and expensive types of tree. Reproductions and trial results have been contrasted with the approved proposed structure. The shared correspondence between the hub and the PC is executed here. Thus the effective and reliable system helps in controlling and stopping the smuggling activities. Apart from the main objective the system also helps in reducing the global warming to the great extent. The natural habitat of the wildlife is preserved indirectly The trees can also be protected from forest fire using this system. This in turn helps in reducing the deforestation. Thereby the ecological balance is maintained.

The future extent of work is execution of Multi-hub system and fuse of mouthpiece, movement identifier sensor and temperature sensor to make frameworks increasingly powerful to obtain information of such human or creature obstruction, fire location. The implementation of CAN bus in the future will be more helpful to connect several nodes in the same unit which makes the monitoring and detection as an easy task.

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