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AUTONOMOUS SYSTEM FOR PROTECTION OF VALUABLE TREES FROM SMUGGLING USING ZIGBEE

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Abstract - *In recent years poaching of valuable trees has been extremely increased. The purpose of this paper is to design an autonomous system which is useful for protecting forest areas. The poaching and illegal movement of commercial trees like sandal woods, teak, sag wan etc., is also reason in reducing forest flora and fauna. The suggested system will consist of two units sensing unit and monitoring unit at forest area. The sensing unit has an electronic division which consist of microcontroller, four sensors, ZigBee module, GSM , RF transmitter and receiver. This sensing unit will give information to the monitoring unit, which has a personal computer. The authorized person receives the information from monitoring unit will take action to provide security of trees.*

Key Words: Autonomous, Protection, microcontroller, sensing, sandal woods, Smuggling, ZigBee …

1. INTRODUCTION

1.1 General

Forest constitutes approximately 30% of the global area. They provide habitat for both humans and some species that share the valuable ecosystem's goods. Managing a forest has become an extremely hard task. Illegal logging represents one of the biggest challenges of forest sustainability. Forestry departments in many countries such as Brazil and Malaysia thought of digitizing trees and hence transforming forest management to a high tech process using RFID tags. In recent years poaching of valuable trees has been extremely increased due to man's selfish needs. There have been several initiatives undertaken by different organizations, and in particular government of India, to ease this problem.

This includes employment, training and deployment of anti-poaching watchers across forests. Strict punishments for convicted offenders, as well as giving special punishment for anti-poaching were aimed at eradicating the hazard. However, many of the measures have remained largely useless. The most promising resolution is –"Protection of valuable trees from smuggling using ZIGBEE and sensors" which will be robust, valuable and realistic technology for monitoring. In order to prevent this smuggling, in this project we use various sensors like continuity sensor and vibration sensor. And we use GSM module and ZIGBEE protocol for communication purpose.

We are forming a system which can be used to avoid the smuggling of the trees which would in turn stop the deforestation and uphold the Environment 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 Microcontroller, accelerometer sensor, Temperature sensor, ZIGBEE and GSM module. Tree cutting will be detected by accelerometer sensor. Communication between the trees and server will be done by GSM modules. The system consisting of two stages: A. Tree unit B. Control unit

Sensing unit: The sensing unit would be the primary unit for the implementation of the system. This unit would consists of four sensors to give the information of getting Cut Down the trees, Damage with fire, etc.

Monitoring unit: The monitoring unit mainly concentrate for controlling purpose. In monitoring unit the datas are received in pc using zigbee technology and the sms is send to the predefined number, the respective authoritty will take actions.

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1.2 Objective

Our project mainly focuses on developing a autonomous system for the protection of valuable trees which would be more securable.

- To prevent smuggling of valuable trees like Sandal wood, Teak wood, etc. in the reserved forest area by designing and implementing an autonomous sensor network.
- An application to use WSN for monitoring and tracking of trees is proposed in this work.

2. LITERATURE REVIEW

Narhari R. Kotkar et al., Many days we are reading 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 use 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 resist such smuggling and to save the forests around the globe some preventive measures need to be displayed. We are developing such a system which can be used to resist this smuggling.

R. Dhayabarani, R.K. Chandraleka, D.Gowthami et al., As the biggest plants on the planets, they give us oxygen, carbon dioxide, stabilize the soil and give life to the world wildlife. Hence, we are coming across the smuggling of trees which are highly expensive like Sandal, Sagwan etc. To avoid such type of smuggling and to save the forest around the globe some preventive systems need to be developed. We are forming a system which can be used to restrict this smuggling.

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3. SYSTEM DESCRIPTION

3.1 System Description

The system design is a complete document that contains all of the information needed to develop the system. It is a structured collection of information that embodies the requirements of a system.The system consists of three units for construction of the whole unit. They are input unit, output unit and control unit. The input unit consists of sensor modules, the output unit consists of zigbee module and pc and the control unit consist of a controller.

Fig -1: General Block diagram

Input Unit

The input unit consists of power supply and sensor modules. The sensor unit consists of PIR sensor for detection of presence of human, the temperature sensor to detect the temperature level in the atmosphere, the 3 axis accelerometer is used to check whether the tree has fallen if it exists the threshold angle.

Output Unit

The output unit consists of zigbee for the transmission of data from the controller to the pc. In the output, continuous monitor of the temperature and humidity level and alert system if the human entered, tree has fallen if it exist the threshold angle and the continuity is cut.

Control Unit

The control unit consists of power supply and the controller. The control unit is responsible for controlling the whole unit.

3.2 BLOCK DIAGRAM

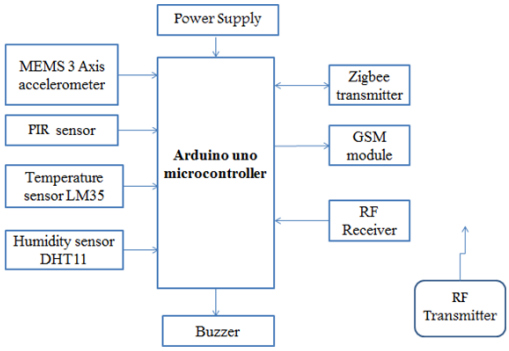

Fig -2: Block Diagram Sensing Unit

Fig -3: Monitoring Unit

4. HARDWARE DESCRIPTION

The hardware description refers to the identification of the system physical components and their interrelationships. This description, often called a hardware design model, allows hardware designers to understand how their components fit into system architecture. Hardware architecture is the representation of an engineered electronic or electromechanical hardware System, And the process and discipline for effectively implementing the design for such a system.

4.1 Pir Sensor (Hc-Sr501)

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) radiation being emitted from objects in its field of view. They are most often used in PIR-based motion detectors. The term PIR is the short form of the passive infrared. The term "passive" indicates that the sensor does not actively take part in the process, which means, it does not emit the referred IR signals itself rather passively detects the infrared radiation coming from the human body in the surrounding area.

Fig -4: 1 Pir Sensor

4.2 Mems Accelerometer

Micro Electromechanical systems are the integration of mechanical elements, sensors, actuators, and electronics on a common silicon substrate through micro fabrication technology. While the electronics are fabricated using integrated circuit process sequences, the micromechanical components are fabricated using compatible "micromachining" processes that selectively etch away parts of the silicon wafer or add new structural layers to form the mechanical and electromechanical devices.

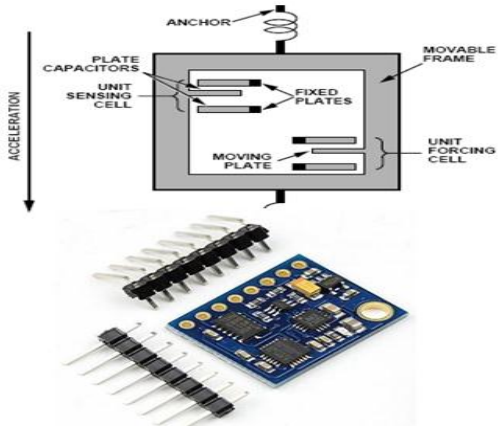

Fig -5: MEMS accelerometer

4.3 Temperature Sensor

The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. The lm35 thus has an advantage over linear temperature sensors calibrated in kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^0$c at room temperature and $\pm 3/4^0$C over a full - 55 to $+150^0$C temperature range, low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies or with plus and minus supplies. As it draws only 60μa from its supply, it has very low self heating, less than 0.1^0c in still air.

4.4 Humidity Sensor

A humidity sensor measures and regularly reports the relative humidity in the air. It measure both the moisture and temperature. They express the relative humidity as a percentage of the ratio of moisture in the air to the maximum amount that can be held in the air at the current temperature. Most humidity sensor uses capacitive measurement to determine the amount of moisture in the air. The humidity sensor module has three pins. These connection should be made to connect the sensor module with Arduino i.e., positive to 5v, negative to ground, out to Analog pin of Arduino.

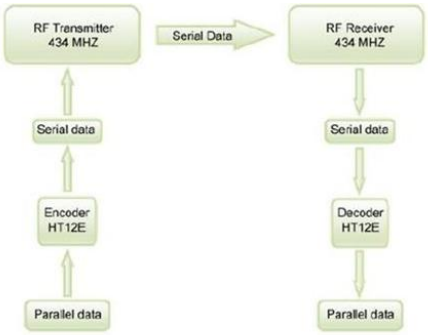

Fig -6: Flow of encoder and decoder

4.5 Encoder

Encoder IC (HT12E) receives parallel data in the form of address bits and control bits. The control signal from remote switches along with 8 address bits constitutes a set of 12 parallel signals. The encoder HT12E encodes these parallel signals into serial bits. Transmission is enabled by providing ground to pin14 which is active low. The control signals are given at pins 10-13 of HT12E. The serial data is fed to the RF transmitter through pin 17 of HT12E transmitter, upon receiving serial data from encoder IC (HT12E), transmits it wirelessly to the RF receiver.

4.6 Decoder

The receiver, upon receiving these signals, sends them to the decoder IC (HT12D) through pin2. The serial data is received at the data pin (DIN, pin 14) of HT12D. The decoder then retrieves the original parallel format from the received serial data.

4.7 GSM Modem

GSM (Global System for Mobile)/GPRS (General Packet Radio Service) TTL- Modem is SIM 900 Quad-band GSM/GPRS device, works on frequencies 850 MHZ, 900 MHZ, 1800 MHZ and 1900 MHZ. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V and 5V DC TTL interfacing circuitry, which allows user to directly interface with 5V DC TTL interfacing circuitry, which allows user to directly interface with 5Vmicrocontrollers (ARM, ARM CortexXX, etc.). The baud rate can be configurable from 9600- 115200 bps through AT(Attention) commands. This GSM/GPRS TTL Modem has internal TCP/IP stack to enable user to connect with internet through GPRS feature. It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface.

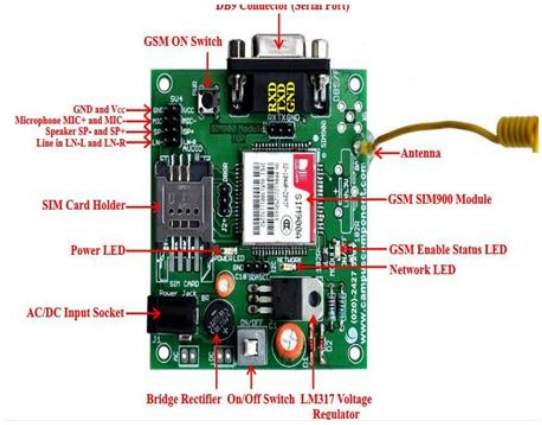

Fig -7: GSM modem

5. SOFTWARE DESCRIPTION

The software description in a document that contains the information needed to develop the software of the system. The information embodies the requirement of the software development.

An sad usually accompanies an architecture diagram with pointers to detailed feature specifications of smaller pieces of the design. Practically, the description is required to coordinate a large team under a single vision, needs to be a stable reference, and outline all parts of the software and how they will work. The data design describes structures that reside within the software. Attributes and relationships between data objects dictate the choice of data structures. The Architecture design uses information flowing characteristics, and maps them into the program structure. The transformation mapping method is applied to exhibit distinct boundaries between incoming and outgoing data. The data flow diagrams allocate control input, processing and output along three separate modules.

The interface design describes internal and external program interfaces, as well as the design of human interface. Internal and external interface designs are based on the information obtained from the analysis model. The procedural design describes the structured programming concepts using graphical, tabular and textual notations. These design medium enable the designer to represent procedural detail that facilitate translation to code. This blueprint for implementation forms the basis for all subsequent software engineering work.

5.1Programming Tools

A program for Arduino may be written in any programming language with compilers that produce binary machine code for the target processor. Atmel provides a development environment for their microcontrollers, AVR studio and the newer Atmel studio. The Arduino project provides the Arduino Integrated Development Environment (IDE), which is a cross-platform application written in the programming language java. It originated from the IDE for the languages processing and wiring. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, brace matching, and syntax highlighting, and provides simple one-click mechanisms to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons for common functions and a hierarchy of operation menus.

5.2 Algorithm

Step 1: start the program
Step 2: Getting signals from various sensors like MEMS, PIR sensor, Humidity sensor, temperature sensor, etc.

Step 3: Sending the various values attained from the sensors to the Arduino.
Step 4: If the angle exceeds, temperature sensor and also the continuity breaks, the ZIGBEE transmitter sends the signal to the ZIGBEE receiver.
Step 5: Captured image and ZIGBEE received signal given to the PC and it generates the alert message and send to the stored mobile number.

5.3 Arduino

Arduino is an open source electronics platform based on easy to use hardware and software. Arduino boards are able to read inputs-lights on a sensor, a finger on a button, or a twitter message and turn it into an output activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on wiring) and the Arduino software (IDE), based on processing. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers students, hobbyists, artists, programmers, and professionals has gathered around this open source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

6. ZIGBEE WIRELESS COMMUNICATION PROTOCOL

Arduino communicates through ZigBee communication protocol. The microcontrollers are used for communicating with one or more peripheral devices quickly over medium distances. It can also be used for communication between two microcontrollers. The ZigBee communication is divide into the major four layers as physical layer, MAC layer, Network layer and Application layer.

Physical Layer: This layer does modulation and demodulation operations up on transmitting and receiving signals respectively. .

MAC Layer: This layer is responsible for reliable transmission of data by accessing different networks with the carrier sense multiple access collision avoidance (CSMA). This also transmits the beacon frames for synchronizing communication.

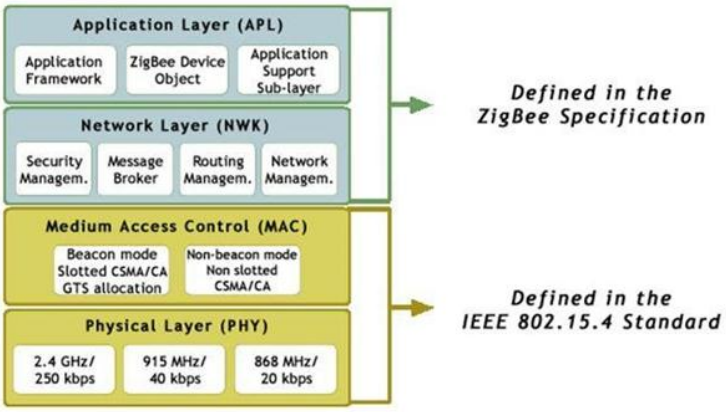

Fig -8: Layers of ZigBee communication

6.1 Facts of ZigBee

ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. Though its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. ZigBee is typically used in low data rate applications that require long battery life and secure networking (ZigBee networks are secured by 128 bit symmetric encryption keys).

ZigBee has a defined rate of 250kbit/s, best suited for intermittent data transmissions from a sensor or input device. Applications include wireless light switches, electrical meters with in-home-displays, traffic management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. ZIGBEE is a new wireless technology guided by the IEEE 802.15.4 Personal Area Networks standard. It is primarily designed for the wide ranging automation applications and to replace the existing non-standard technologies. The ZIGBEE specification is a combination of Home RF Late and the 802.15.4 specification.

The specification operates in the 2.4GHz (ISM) radio band - the same band as 802.11b standard, Bluetooth, microwaves and some other devices. It is capable of connecting 255 devices per network. The specification supports data transmission rates of up to 250 Kbps at a range of up to 30 meters. ZIGBEE's technology is slower than 802.11b (11 Mbps) and Bluetooth (1 Mbps) but it consumes significantly less power. 802.15.4 (ZIGBEE) is a new standard uniquely designed for low rate wireless personal area networks. It targets low data rate, low power consumption and low cost wireless networking, and its goal is to provide a physical-layer and MAC-layer standard for such networks. Wireless networks provide advantages in deployment, cost, size and distributed intelligence when compared with wired networks.

This technology allows users to set up a network quickly, and allows them to set up networks where it is impossible or inconvenient to wire cables. Wireless networks are more cost-efficient than wired networks in general. Bluetooth (802.15.1) was the first well known wireless standard facing low data rate applications.

The effort of Bluetooth to cover more applications and provide quality of service has led to its deviation from the design goal of simplicity, which makes it expensive and inappropriate for some simple applications requiring low cost and low power consumption.

These are the kind of applications this new standard is focused on. It's relevant to compare here Bluetooth and ZIGBEE, as they are sometimes seen as competitors, to show their differences and to clarify for which applications suits each of them. The data transfer capabilities are much higher in Bluetooth, which is capable of transmitting audio, graphics and pictures over small networks, and also appropriate for file transfers. ZIGBEE, on the other hand, is better suited for transmitting smaller packets over large networks; mostly static networks with many, infrequently used devices, like home automation, toys, remote controls, etc.

Fig -9: ZigBee module

Network Layer: This layer takes care of all network related operations such as network setup, end device connection and disconnection to network, routing, device configurations, etc.

Application Support Sub-Layer: This layer enables the services necessary for ZigBee device object and application objects to interface with the network layers for data managing services. This layer is responsible for matching two devices according to their services and needs.

Application Framework: It provides two types of data services as key value pair and generic message services. Generic message is a developer defined structure, whereas the key value pair is used for getting attributes within the application objects. ZDO provides an interface between application objects and APS layer in ZigBee devices. It is responsible for detecting, initiating and binding other devices to the network.

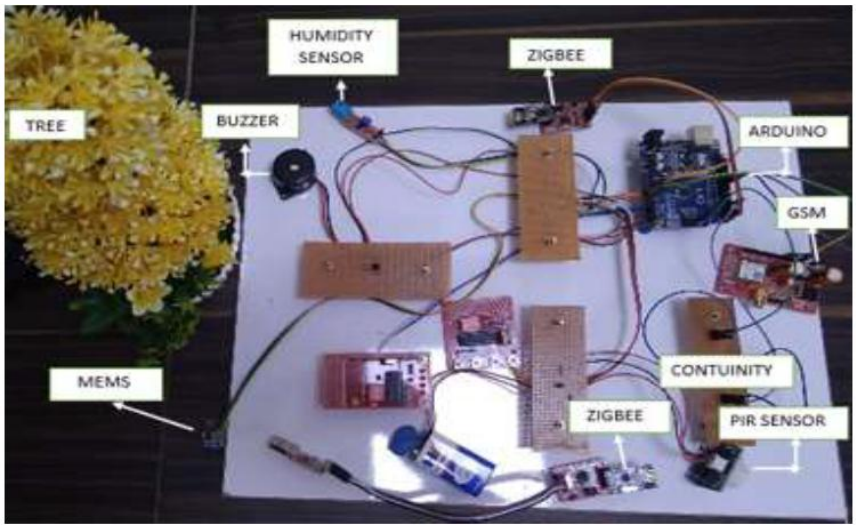

Fig -10: Final modal

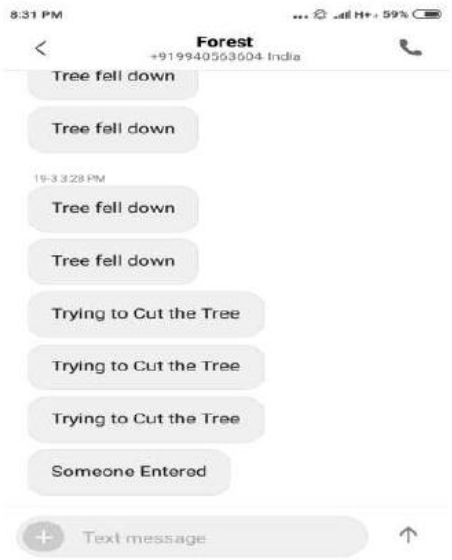

Fig -11: Output of GSM

7. CONCLUSIONS

The outcome of this project is to avoid deforestation permanently in the forest area. This project deals with a ZigBee based tag design for protection of trees in forest. In this manner we are increasing the system which able to control the smuggling if trees in forestry where human are not capable for providing security. It presented the improvement of an already existing system through the addition of ZigBee location technology. ZigBee network is used to monitor forest areas relative parameters such as MEMS, fire, Intruder (PIR) and humidity concentration. Finally monitoring center obtains the data from server and through ZigBee Wireless Network. The successful connection between ZigBee networks makes the functional complementarities of several networks and implements remote access to the data of forest monitoring region. Compared to traditional forest fire monitoring system, the program is good at flexible structure, low onetime cost, easy operation, wide expansion and better promotional value. By this the forest officer can take necessary steps against the undesirable activities.

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