

IOT Based Illegal Trees Cutting Prevention and Monitoring with Web App Using Raspberry Pi

Lakshmi Devi P¹, Radhika B², Nikitha Kalashetty³Assistant Professor, Department of Electronics and Communication Engineering, CIT Engineering College, Gubbi¹UG Student, Department of Electronics and Communication Engineering, CIT Engineering College, Gubbi, India²UG Student, Department of Electronics and Communication Engineering, CIT Engineering College, Gubbi, India³

ABSTRACT: For many days we are reading in the newspapers about smuggling of the trees. These trees are very costly. These are mostly useful in the medical sciences as well as cosmetics. Because of huge amount of money involved in selling of such tree woods and lots of incidents are happening of cutting of tree and their smuggling. This problem isn't related to India only, in China, Australia and African countries are also struggling with same issues. Putting cost in mind, Indian sandalwood costs 12000 to 13000 INR per kg whereas in international market Red Sanders command a high price of INR 10 core per ton. An application to use IOT for monitoring and tracking of sandalwood tree is proposed in this paper. In case of emergency, the alert information is transmitted through GSM/GPRS modem as SMS to the forest authorities for fast response and remedial action. Cellular architecture is used for implementing RF link station antenna. RF Tag transmits data to the reader and port number where it is collected. Based on the received tag number, it is possible to identify proper cell and location of the tree. This data is carried to microcontroller link unit and then it is given to the Zig-Bee module to connect with the central server.

KEYWORDS: IOT, GSM/GPRS, Zig-Bee, RF Tag .

I. INTRODUCTION

The tree is already government controlled, and removal is prohibited whether on private or temple grounds until the tree is thirty years old. But even though some corner of newspaper shows us the same title. The problem what observed is there is no system or any medium to detect illegal logging and cutting of trees. A mean by which, at your workplace, you will know what's happening with my trees should be installed. Such system will help you to detect and will alert you so that you can take actions. Putting this problem in mind, a system is designed which help us to achieve our goal i.e. to protect nature.

Sandalwood is a precious commodity and red sandalwood is rarer. The cost of sandalwood is estimated to be more than gold. In India, illegal cutting and smuggling of sandalwood is controlled by forest department. But illegal cutting and smuggling of sandalwood continues unabated. The Government of India estimates the sandalwood smuggling market to be Rs 10,000 Crores annually (approximately US\$2 billion). Government is designing various methods to control this menace of sandalwood smuggling. In recent days, dogs are used to control and identify theft. But it is not flexible and it needs more skilled manpower and trained pet animals. If all objects in the world are equipped with identifying devices, daily life may undergo a sea change. Inventory management, tracking of stolen and mislaid objects and ability to interact with objects may become easier. Internet of things (IOT) is expected to change the scenario. The technology roadmap for IOT predicts proliferation of applications in various fields such as surveillance, security, healthcare, transport and the like; ubiquitous position of things may become a reality. Earlier mobile technologies sought to provide communication from 'anywhere, anytime and anyone'. With new IOT, a new dimension is added to this, namely 'by any things'. An application to use IOT for monitoring and tracking of sandalwood tree is proposed in this paper.

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For monitoring large areas, this method is not expected to give satisfactory result. So, there is a need for an automated system for longer lasting solution. For tracking applications, GPS is used nowadays but this is facing severe accuracy issues in indoor environment due to satellite visibility problems. It is not cost effective. There is a need for more add-on components like memory device, control device, etc., to work on this module. Some applications were developed using passive radio frequency identification (RFID) tags.

They are more economical but coverage is limited to 10 cm to 10 metres. In this method, the tag is cheaper but reader is expensive and it is not possible to integrate sensors. Moreover, with this system, it is not possible to identify theft at the time of cutting. So, it is being proposed to use active RF tagging method and wireless networks to solve these issues. Customised RF tag with sensors is used in this study. It is expected to offer better results in aspects like long read range, more sensor integration and less expensive than GPS-based tracking. It is possible to get read range up to 500 metres and more than two sensors can be added for triggering applications. The reader cost and number of reader required is much less compared with passive tag method.

Smuggling and Illegal logging causes enormous damage to forests, economics of producer countries and local communities. It's a very serious and comprehensive problem. Despite the economic importance of trade in timber and forest products, most of the international countries have no legal mean to stop or halt such activities because technically it's very hard to identify illegally smuggled timber and other trees. Therefore, some normative acts against illegal trading of timber and other trees, is missing. Scientific methods to pinpoint the geographic origin of timber are currently under development. Possible actions should meet with WTO regulation of non-discrimination to restrict imports. They must be arranged in bilateral agreements. Study conducted by UK-Indonesian countries on illegal logging in 1998 suggested that about 40-45% of timber trading was illegal. This had caused more than \$365 million loss to countries. If we include and compare with legal harvesting plus exports suggest that near about 88% is illegal in some way. From Indonesia most of the illegal wood production is being carried out in Malaysia. This is key transit country. Whereas in Brazil, Amazon area holds 80% illegal trading this violates government controls. At the core of illegal logging is widespread corruption often called as 'Green Gold'. In Brazilian state of Para this problem is deeply rooted. This investigation was carried out by Greenpeace. As like timber, for mahogany there is no reliable legal way exists till date and key players in its trade are still activate in those regions.

An electronic system to solve this problem is proposed. A special active RF tag is developed to monitor the trees. It is developed with sensors to alert cutting of the trees. Tags are attached to the trees and placed internally by drilling tools. There are two subsystems for data collection. They are link station and data collection/alert server. The tag is designed to transmit data regularly say, once in every hour. If the tree is cut by unauthorised persons, the sensor in the tag will trigger it to transmit tag identity and cut alert signal to the central server through link station. Then the server will send alert information to the concerned authorities. To monitor the regular status of the forest range from the remote office dynamic web page and database is used. In case of emergency, the alert information is transmitted through GSM/GPRS modem as SMS to the forest authorities for fast response and remedial action.

II. PROPOSED SYSTEM

The purpose of the paper is to save valuable trees which have high demand in market like teak, Sandalwood, etc. Every tree will be equipped with one small electronics unit which consists of Micro-controller, Piezo sensor and Wi-Fi module. The data of different tree units can be collected and will send the data to main server. This data can be used by concern forest authorities to take preventive action. The whole process will take maximum of few seconds or a minute. This will surely reduce smuggling and illegal logging to a greater extent.

The system is divided into 2 distinct units. Each tree will consist of a unit which will be mounted on each tree. This tree unit consist of different component which helps to understand server unit. Every time when a person tries to cut the tree, it will sense by Piezo sensor. The Piezo sensor is a unique component that changes resistance when bent. This kind of sensor is also used as pressure or force sensor. So at the time of cutting certain amount of force and pressure will sense by the Piezo sensor. Micro-controller is used to establish the processing of data obtain from sensors. This wireless device operates over 2.4 GHz frequencies which does not required license. Receiver at main unit will processes the data with microprocessor.

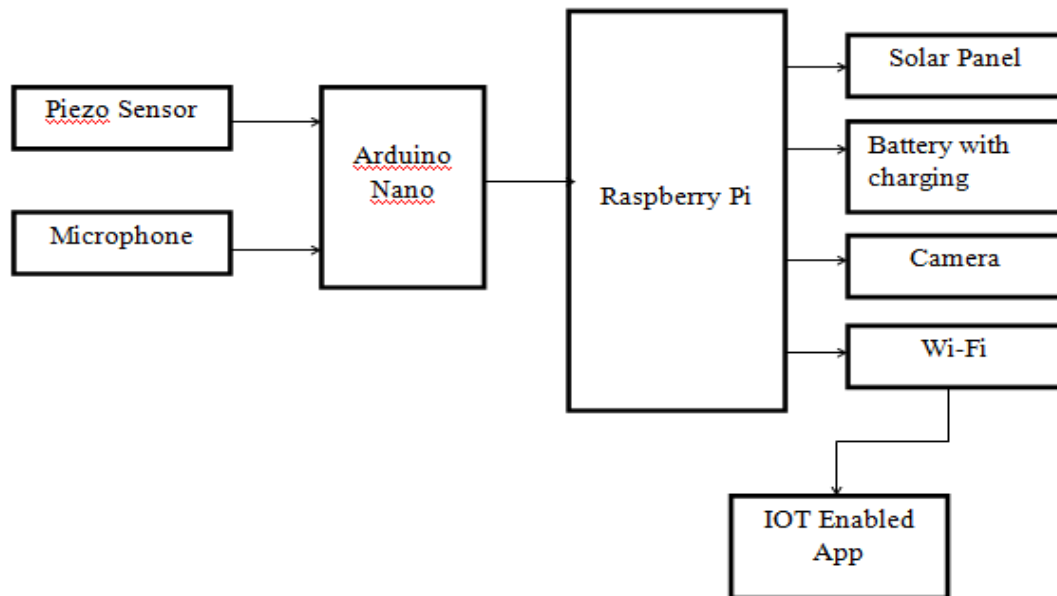


Fig.1 Block diagram of proposed system.

III. SYSTEM REQUIREMENTS

1) HARDWARE REQUIREMENTS

➤ **Arduino NANO**

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything that Diecimila/Duemilanove has (electrically) with more Analog input pins and onboard +5V AREF jumper.

➤ **Raspberry Pi**

Raspberry Pi is a credit-card sized computer manufactured and designed in the United Kingdom by the Raspberry Pi foundation with the intention of teaching basic computer science to school students and every other person interested in computer hardware, programming and DIY-Do-it Yourself papers.

➤ **Microphone Module**

VS1003 is a single-chip MP3/WMA/MIDI audio decoder and ADPCM encoder. It contains a high-performance, proprietary low-power DSP processor core VS_DSP4, working data memory, 5 KiB instruction RAM and 0.5 KiB data RAM for user applications, serial control and input data interfaces, 4 general purpose I/O pins, an UART, as well as a high-quality variable sample-rate mono ADC and stereo DAC, followed by an earphone amplifier and a common buffer.

➤ **Piezo Sensor**

Piezo Vibration Sensor is suitable for measurements of flexibility, vibration, impact and touch. The module is based on PZT film sensor LDT0-028. When the sensor moves back and forth, a certain voltage will be created by the voltage comparator inside of it. A wide dynamic range (0.001Hz~1000MHz) guarantees an excellent measuring performance.

➤ **Battery 3.7V**

The XC6805 is a Constant-Voltage (CV) and Constant-Current (CC) type charging IC for linear charging of single-cell Li-ion batteries and Li-polymer batteries. The basic charging cycle consists of trickle charge mode followed by main charge mode.

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➤ Solar Panel

Solar cell is the basic unit of solar energy generation system where electrical energy is extracted directly from light energy without any intermediate process. The working of a solar cell solely depends upon its photovoltaic effect hence a solar cell also known as photovoltaic cell.

➤ Charging Module

The L6924D is a fully monolithic battery charger dedicated to single-cell Li-Ion/Polymer battery packs. It is the ideal solution for space-limited applications, like handheld equipment, and digital cameras.

➤ Web Camera

A webcam is a video camera that feeds or streams its image in real time to or through a computer to a computer network. When "captured" by the computer, the video stream may be saved, viewed or sent on to other networks via systems such as the internet, and emailed as an attachment.

2) SOFTWARE REQUIREMENTS

➤ Python

Although the Raspberry Pi's operating system is closer to the Mac than Windows, it's the latter that the desktop most closely resembles. It might seem a little alien at first glance, but using Raspbian is hardly any different to using Windows (barring Windows 8 of course). There's a menu bar, a web browser, a file manager and no shortage of desktop shortcuts of pre-installed applications. Raspbian is an unofficial port of Debian Wheezy armhf with compilation settings adjusted to produce optimized "hard float" code that will run on the Raspberry Pi.

➤ Php

PHP started out as a small open source paper that evolved as more and more people found out how useful it was. RasmusLerdorf unleashed the first version of PHP way back in 1994.

IV. EXPERIMENTAL RESULTS

The scale of illegal cutting trees in forest is difficult to accurately estimated, but more than half of all logging activity in the most vulnerable forest. The proposed system includes sensing devices which sense the vibration and provide effective solution to the problem of illegal cutting trees detection. Main improvement of the system is: fast reaction when logging occurs & permanent monitoring of critical areas in forest. Several million acres of forest are getting destroyed because of illegal cutting trees. In forest due to heavy rain trees getting affected and collapse. The suggested system will consist of two modules which are described below, 1) Tree Unit 2) Main Server Unit (base station). Each tree unit will give the information to base station and main server GUI using one authorized person whom received the message and he will taking action to provide security. This data can be used by concern forest authorities to take preventive action.

The purpose is to save valuable trees which have high demand in market like teak, Sandalwood, etc..Every tree will be equipped with one small electronics unit which consists of Micro-controller, processor, flex sensor and microphone module. There will be one sub server unit for particular area of forest. The data of different tree units can be collected by this unit. The sub server unit will send the data to main server, GUI using will create alert about threads with exact tree location. This data can be used by concern forest authorities to take preventive action. The whole process will take maximum of few seconds or a minute. This will surely reduce smuggling and illegal logging to a greater extent. At control station where main unit is fixed, detected signal is successfully received. For displaying purpose GUI is maintained which will display a message or alarm indicating that particular tree is undergoing non-bearable pressure.

The environment we live in is a beautiful place. Let us not destroy our environment for our selfish needs. Love plants and trees. Respect them. Plant them and care for them and see for yourself, the positive effect you can create, for the environment and for yourself.

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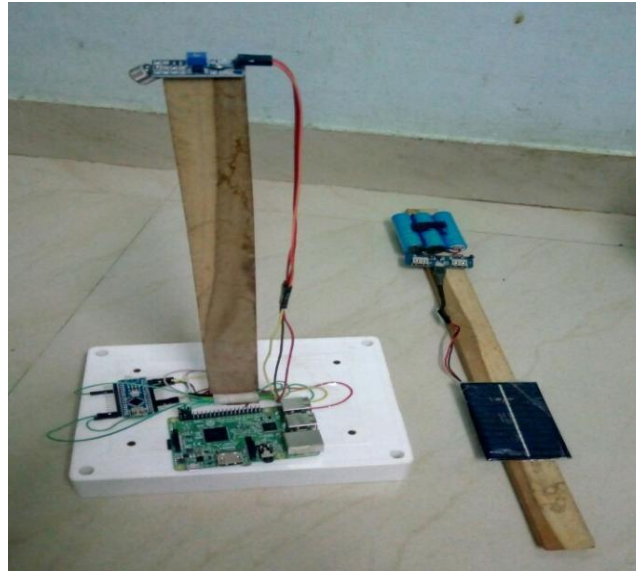


Fig.2 Implementation Setup

The system keeps monitoring the situation every moment and the data will be updated to main server centre for further actions to take place. As soon as the intruder pass through the tress the image of the intruder is captured via camera setup on every tree and the data will be sent to the main station.

```
Python 2.7.13 (default, Nov 24 2017, 17:33:09)
[GCC 6.3.0 20170516] on linux2
Type "copyright", "credits" or "license()" for more information.
>>>
===== RESTART: /home/pi/Desktop/project/illegal_tree_monitor.py =====
intruder Detected
intruder Detected
intruder Detected
```

Fig. 3 Displaying of the data

Similarly as soon as the intruder starts logging of the tree through any equipment then the information of the intruder will be sent to the server unit as intruder has turned on the machine and is about to log of tree as shown in below figure.

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Vol. 8, Issue 7, July 2019

```
intruder has turned on machine
1
1
1
1
1
1
0
intruder has turned on machine
1
1
1
1
1
0
intruder has turned on machine
|
```

Fig. 4 Detected Information

```
intruder is cutting tree
1
1
1
1
1
1
1
0
intruder is cutting tree
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
1
0
intruder is cutting tree
|
```

Fig. 4 Event Detected Information

V. CONCLUSION

The purpose of this is to save valuable trees which have high demand in market like Sagwaan, Sandalwood 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. Here we have developed a system which prevents the smuggling of valuable trees and save the money of nation. This system consists of three different units Tree Unit, Sub-Server Unit, and Main Unit along with Flex sensor. The Flex Sensor detects the smuggling activity at the tree unit, and then this signal is passing to the sub server unit. The sub-server unit is located for particular area oh forest, as it receives the EVENT DETECTED signal from tree unit and passes it towards the main unit which is located at forest office, this data received at main unit is use by the forest officers to take preventive action and this whole process is done within one minute.

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VI. FUTURE SCOPE

If we use GPS (Global Positioning System) along with current system then it could become improved version of this paper, and provide actual location of the smuggling area by providing its GUI along with latitude and longitude in forest could also be possible if we used temperature sensors along with this device, this can also avoid wastage of valuable trees. In future we can use this system anywhere in the corporate field for monitoring multiple numbers of units. The system developed here is dedicated model specially design for preventing the smuggling and illegal logging in forest. Such kind of system can be employ in any area of forest which is highly affected by smuggling and illegal cutting. No need to travel complete forest to guard it. We can see complete picture of forest on server unit. Exact location of tree cutting can be found easily.

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