IoT Based Anti Poaching of Trees and Protection of Forest

E. V. Kameswararao, M. Jaya Shankar, T. V. Sai Lokesh, and E. Terence

Abstract Theft of the world's most valuable trees, such as sandalwood, lumber, teak, rosewood, and pinewood, presents a huge danger to forest resources, causes substantial economic harm, and has a terrible impact on the ecosystem across the globe. These trees are very pricey and scarce around the globe. These trees are employed in both medicinal and cosmetics research. To stop such smuggling and conserve the world's forests, various preventative measures must be created. Many incidences of tree cutting occur as a result of the higher amount of money involved in selling such trees. This study presents an anti-poaching system based on IoT and WSN technologies. Three sensors are used in the structural framework: a tilt detector (to detect the tendency of a tree while it is being cut), a fire sensor and a smoke detector (to detect timberland fires), and a sound detector Detection of even the sound of a tree being hacked down may be used to catch illegal loggers, for example WSN technology is commonly employed in remote monitoring applications (where monitoring is difficult).

Keywords Threat · Devasting · Restrict · Preventive measures · Frame work · Unlawful logging

1 Introduction

Timber theft of ecologically and commercially significant tree species in wooded regions—such as Teakwood, coast redwood, Sandalwood, Pine, and Rosewood—has expanded considerably as a result of poaching or smuggling. To address these issues, several players, including the Indian government, have launched a number of initiatives. Anti-poaching observers and/or private/government security guards may

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be recruited, trained, and deployed around woods to help with this. Strict punishment for convicted criminals, as well as unique incentives for smuggling operations (Five Year Plan 2012–2017), were all aimed at putting a stop to the threat. However, the punitive measures have mostly been ineffectual, and poachers have thrived as a result [1–4].

The most effective option is to Build a real-time, wireless sensor network (WSN) and data recording system, a complex and low-cost contemporary technology that will make monitoring more robust, effective, and feasible. The Wireless Sensor Network (WSN) is a novel technology. That is already being utilised in a variety of industrial applications, including monitoring, disaster observation (such as forest fires), living space surveillance, maintenance, security and control, and remote monitoring applications. WSNs are commonly utilised in forest regions for detecting forest fires, detecting tree smuggling, environmental monitoring, and other purposes [5].

Wireless Sensor Networks are simple to set up and maintain, and they save money by eliminating the usage of expensive wires. We can adopt the method that was used to reduce the degree of smuggling in the forest regions with the aid of WSN and other detectors. Poaching isn't only a problem in India; it's also a problem in China, Australia, and certain African countries. In India, sandalwood, rosewood, and pine food tree cost between 12,000 and 13,000 INR per kg, whereas Red Sanders costs INR 10 focus for each ton in the global market. The Indian sandalwood tree has become more interesting as of late, provoking the Indian government to endeavor to restrict sandalwood exports in order to combat the tree's potential hardship. According to the government, the maximum allowable weight gain for an individual is three.8 kg. If the tree is presently under government control, its removal will be banned, regardless of whether it is for personal or sanctuary reasons. The primary purpose of this project is to create a framework that may be used to prevent sandalwood, pine, and teak timber trees from being stolen.

The proposed work is arranged in the following order:

i. Introduction
ii. Related works
iii. Proposed work
iv. Results
v. Conclusion and Future work
vi. References.

2 Related Works

Khandare et al presents the design of a system for detection of vibration and sound for prevention of cutting of trees, detection of temperature and fire for prevention of forest fires. The sensing device can sense the vibration, sound and temperature, fire and then information sent them over zig-bee network to forest office. The fundamental disadvantage of this system is its reliance on batteries for continuous monitoring and data transmission to a central server [6].

Baraddi a technique that may be utilised to prevent smuggling. Three sensors are used in the design system: a sound sensor, a tilt sensor, and a temperature sensor. The Blynk App continually monitors the data collected by these sensors. In terms of sensors, the relay switch turns on the sensors' output devices. A signal is sounded for the slant and sound sensors, and a water siphon is incited for the temperature sensor. The Wi-Fi module saves the created information in Blynk Server. The main drawback of this system is it Can't be communicated to long distance [7].

Narasimman this system is a reliable and low-cost wireless vibration monitoring system. Vibration was measured using a 3-axis digital output MEMS Accelerometer sensor. Vibrations as low as 0.0156 g and as high as 8 g may be detected by the Accelerometer detector, with 1 g equalling 9.81 m/s2. The AT-mega328p microcontroller on the Arduino UNO board is used to connect with the MEMS Accelerometer detector. The primary disadvantage of this technology is that it is susceptible to higher frequency noise [8].

Rohan devised a system that can be used to prevent tree smuggling, thereby forestalling deforestation and keeping up with natural strength. Each tree is furnished with an electronic division, which includes sensors such as the Raspberry Pi, accelerometer sensor, Micro Controller, Fire sensor, Flex Sensor, and GSM/GPRS module. The flex sensor and accelerometer sensor will be used to detect forest tree cutting. GPRS/GSM modules will be used to communicate between the trees and the server. The biggest disadvantage of this method is the price. In comparison to other systems, it is somewhat costly [9].

Mhaske developed a method that can be used to control and restrict tree smuggling, which would eliminate deforestation, reduce wood theft, and maintain environmental stability, all of which would assist with lightening one of the difficulties of a worldwide temperature alteration. A Micro Controller, Flex Detector, Accelerometer Sensor, Temperature Detector, Zigbee and GSM module are just some of the sensors and controllers that are included into each tree. A flex sensor and an accelerometer sensor will be used to detect tree chopping in order to avert it. GSM modules will communicate with the server and the trees. TWO phases comprise the system: 1. The tree unit The main server unit is referred to as B. The primary disadvantage of this technology is that it is susceptible to higher frequency noise [10].

Raghavendra et al the fundamental goal of this method is to reduce and prevent smuggling, conserve precious trees, and minimise wood theft in request to keep a decent eco-framework by diminishing deforestation. The technique use GPS technology to pinpoint the position of the tree where poaching occurs. The system uses a chip (micro controller board) with embedded sensors (flex sensor and fire sensor) that are controlled via IoT. These sensors monitor and control parameters such as tree tilting, burning, and cutting, and they can be accessed via an Android App on an Android phone. The biggest disadvantage of this technique is that it's tough to keep track of the forest [11].

Arunprasath et al author created a methodology that may be used to reduce sneaking. Detecting illegal logging, for example, involves listening for noises generated when cutting down a tree. Other uses for the temperature and tilt sensors include detecting forest fires (to recognise the tendency of tree when its being cut). The web page/app continuously monitors the data generated by these sensors. Sensors' yield devices are activated by a hand-off switch, which is a relay switch. A ringer is established for the inclination and sound sensors, while a water siphon is impelled for the temperature sensor. The Wi-Fi module is utilized to save the information made in the cloud server. The fundamental disadvantage of this system is its reliance on batteries for continuous monitoring and data transmission to the central server [12].

Sudharani et al to limit sneaking and screen trees, author structure can be made using gyro locater (to perceive the inclination of tree when it is being cut), temperature pointer (NTC 10 k thermistor), Wi-Fi Module (esp8266), and GSM Module. The data accumulated by these sensors is ceaselessly noticed using the ThingSpeak cloud stage, which is sent from a microcontroller (Arduino Uno). The data is saved in ThingSpeak Server through the Wi-Fi module. The main disadvantage of this system is that it is inflexible. Long-distance communication is not possible [13].

Hingane et al author designed a system using some sensors like flex sensor, pH Sensor, Fire Sensor, Ultrasonic Sensor, Node MCU(microprocessor) Relay, Water pump, Buzzer to monitoring the forest continuously for avoid the smuggling and save the forest from forest fire when forest is in fire. The main drawback of this system is fetched (cost). It is very expensive as compared to other systems [14].

Kirangond suggested an anti-poaching system that includes an archetype of an IoT model that monitors trees and alerts the base station in [15]. When the tilt values change, the base station and the registered cell phone number get the coordinates of the poached tree. In comparison to the current plans, the suggested model reduces human involvement. GSM module, Raspberry Pi board, and accelerometer sensor GPS module are included in the proposed model, which will aid in tree monitoring. This document presents the proposed model's working theory, which will aid in the improvement of the current system while also acting as a resiliency for the proposed system. Small places, such as private property, and vast areas, such as national reserves, may both benefit from the suggested approach. The system's biggest flaw is that it's far away. When compared to other systems, it is rather pricey [16].

3 Proposed Work

The proposed system will be made up of two modules: one with sensors and controllers that will be installed in the tree, and the other with an Android phone or computer. We created an application that would receive sensor data on a constant basis. This is an IoT-based project in which sensor data is regularly uploaded to the biodots cloud. Tilt sensor and sound sensor is used to determine whether the tree is cut down or not. Similarly, fire/flame sensor and smoke sensor is used to determine whether the forest is on fire or not. The sensed data continuously uploaded in the biodots cloud for every 30 s. The block diagram of the proposed architecture is shown in Fig. 1.

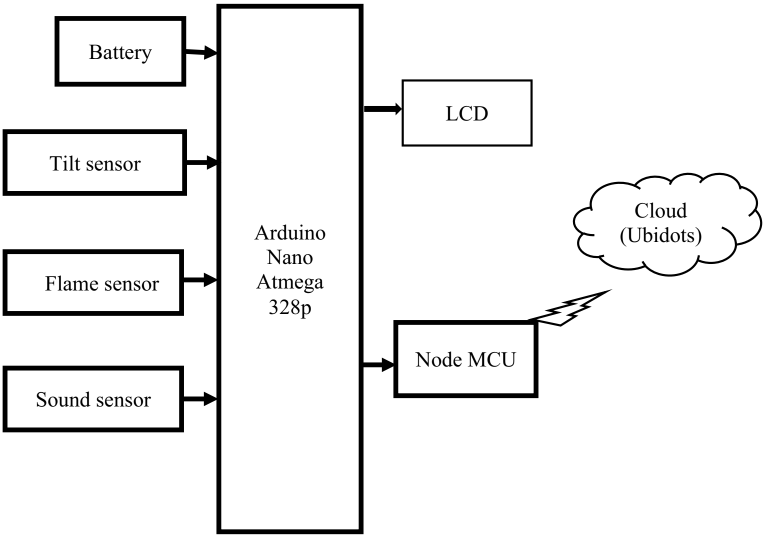

Fig. 1 Block diagram

The major objective of this project is to construct a portable wireless sensor node that may be utilised in a Wireless Sensor Network. An Android phone or computer with sensors and controls will be embedded in a tree as part of a planned two-modular system.

We created an application that would receive sensor data on a constant basis. This is an IoT project in which we regularly upload sensor data to the ubidots cloud. Tilt sensor and sound sensor is used to determine whether the tree is cut down or not similarly Fire/Flame sensor and smoke sensor is used to determine whether the forest is on fire or not. The sensed data continuously uploaded in the ubidots cloud for every 30 s. We can able to know the actual GPS location of the sensors. When a sound is detected, the sound sensor generates an output voltage signal. A microcontroller receives voltage and begins doing the required processing. The process flow diagram is shown in Fig. 2.

Noise levels in decibels (dBs) may be measured by the sound sensor at frequencies between 3 and 6 kHz, which is about where the human ear has sensitivity. It reacts to sound intensity in the same manner that the human ear does. It accurately monitors sound levels across a single range of 55–110 dB to within 3 dB. There are noise levels in the forest owing to trees and animals, so if a tree falls, the noise level is abnormal, which is reported to the forest officer, and there is a distinction between tree fall down due to natural disasters and tree fall down due to unlawful methods.

Table 1 shows the threshold value of tilt and smoke sensor and Table 2 on flame and sound sensor.

A smoke sensorr is a device that senses smoke (air particles of different gases or fire), typically as an indicator of fire. Smoke sensor do not have a listed spacing. They have a recommended spacing of 30 feet between sensors. However, smoke sensor

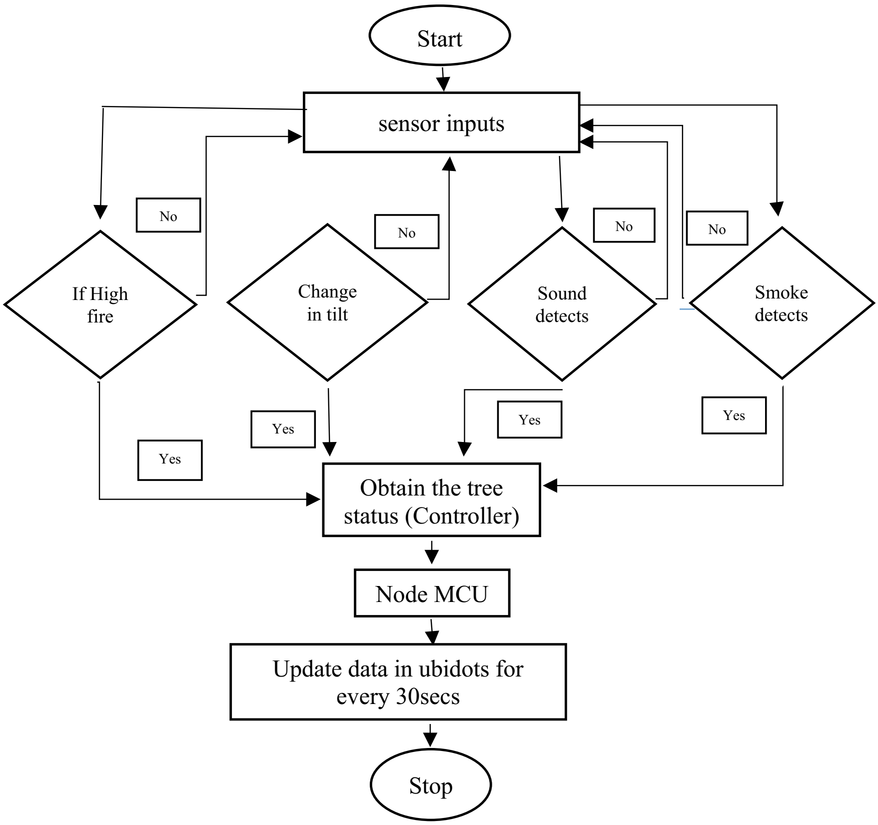

Fig. 2 Flow chart

Table 1 Threshold values of tilt and smoke sensor

Sensor name	Threshold value
Tilt sensor	430(When it is NOT tilted)
Smoke sensor	212

Table 2 Threshold values of flame and sound sensor

Sensor name	High	Low
Flame sensor	1 (Presence of fire)	0
Sound sensor	1 (Presence of sound)	0

can be installed up to 41 feet. A fire locator is a sensor that recognizes and answers the presence of a fire or fire, making fire identification conceivable. They operate at moderate speed with a range of up to 200–250 feet from the flame source.

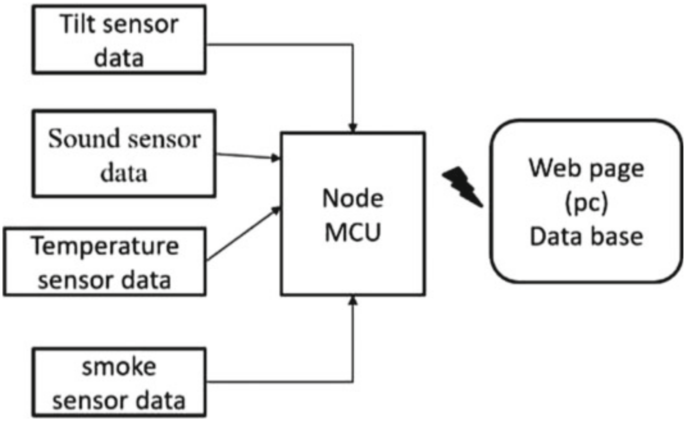

Fig. 3 Node MCU architecture

Initially, when it is NOT tilted position, it shows the fixed threshold value 430 in the LCD as well as in the web pageWhen it is inclined in a particular direction or angle, it shows value of tilting position of a tilt sensor on the LCD as well as in the web page. If we tilt the sensor in the left side direction the values are decreased. Similarly, if we tilt that sensor in right side direction the values are increased. It can detect the values of tilting position of a tree in between 20 and 60°. Node MCU architecture is shown in Fig. 3.

The sensed data, sends to controller. After receiving the data, the controller starts processing and perform the necessary operations in it. The Wi-Fi module receives data as well. The controller sends data to the Wi-Fi module, which subsequently sends it to the cloud through the internet (Ubidots). We can monitor the data in Ubidots cloud.

4 Results

Figures 4 and 5 shows the only either Left—Right side direction or Front—Back side direction. The tilt sensor works from 0 to −70° as well as from 0 to 70°. The remaining angle position −70 to 180 and 70–180° is uncertain region. If the tilt sensor is NOT tilted position (i.e., at 0°), it shows the actual threshold value 430 in the LCD and as well as in the Web page. If the sensor tilted left (i.e., it bends to −20–−70°), it shows the value of decreasing threshold and varies according to bending angle and if it is tilted right (i.e., 20–70°), it shows the value of increasing threshold and varies according to bending value. It is shown in the Web page. If the angle between −20 and −70 and 20–70°, the tree is tilted heavily and we can conclude that it indicates like there is something illegal happening. Similarly in front and back directions also same. The front direction indicates the right-side direction and backside direction indicates the left side direction. The results are getting from right and front directions are same, similarly in left and backside directions are same. Table 3 shows the practical values of tilt sensor.

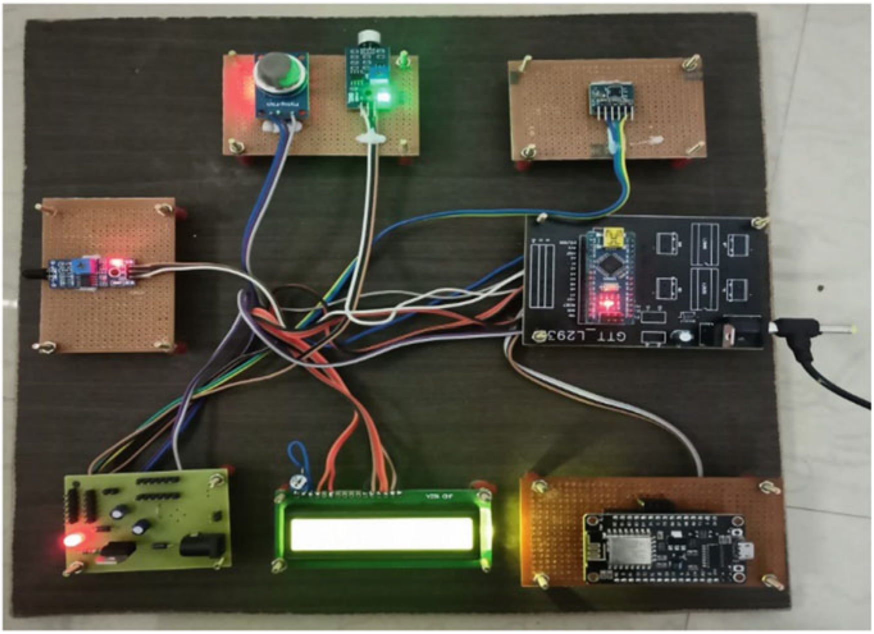

Fig. 4 Result

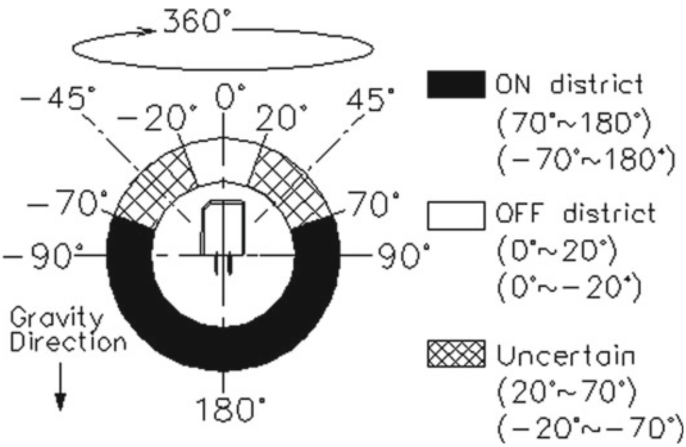

Fig. 5 Working position of tilt sensor

Table 3 Data table of tilt sensor

Direction	Actual angle	Practical value
Left (or) Back	0° (When it is NOT tilted)	430
Right (or) Front	−45°	362
	−60°	315
	0° (When it is NOT tilted)	430
	45°	488
	60°	510

Table 4 Data table of sound sensor

Sensor Name	Practical values	Condition
Sound sensor	0	Low
	1	High
	1	High
	0	Low

If sound sensor detects sound, it shows high value '1'.If there is no sound, it shows the value '0'on the Web page. Table 4 shows the practical values of sound sensor.

If flame sensor detects any fire near by its, it shows the 'High' value '1'. If there is no fire it shows 'Low' value '0'.in the LCD as well as in web page. Table 5 shows the practical values of flame sensor.

The smoke sensor threshold value is 212. If the smoke sensor value shows below threshold value, there is no much amount of smoke and less impact of fire. If the value is reaches above threshold value, there is a high chances of forest fire. Table 6 shows the output values of smoke sensor.

Figure 6 shows the LCD output.

Table 5 Data table of flame sensor

Sensor name	Practical values	Condition
Flame sensor	1	High
	1	High
	1	High
	1	High

Table 6 data table of smoke sensor

Sensor name	Threshold value	Practical value
Smoke sensor	212	216
		228
		237
		236

Fig. 6 LCD (output display)

5 Conclusion and Future Works

5.1 Conclusion

A portable wireless sensor network has been developed for save the forest from forest fire, deforestation and some important trees like Sandalwood, Teakwood, Pine and Rosewood etc. The motive of this design for keeping trespassers away and save the forest from timber mafia. For this reason, Different sensors like Tilt, Sound, Smoke, Fire sensors and Arduino Nano board, LCD, Wi-Fi module is used. To avoid the Trees cutting, Tilt and Sound sensor is used. To save the forest from forest fire, fire/flame and Smoke sensor is used. For remote terminal through wireless media, Wi-Fi module is used. We can monitor the data on LCD as well as in the Ubidots cloud.

5.2 Future Works

This study may be improved in the future by using a multi-node network with microphones, motion detector sensors, data collection systems may be improved by using temperature and human or animal interference sensors as well as sensors to monitor fires.

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