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"IoT BASED ANTI-POACHING ALERT SYSTEM FOR VALUABLE TREES"

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Abstract: Illegal poaching of valuable trees such as Red Sandalwood (Pterocarpus santolinas), Teak (Tectona grandis), and other endangered species has emerged as a major ecological, economic, and conservation concern across the world. These trees hold immense value due to their aromatic properties, medicinal applications, and use in high-quality furniture and construction industries. However, rampant illegal logging and smuggling activities have led to rapid depletion of forest resources, biodiversity loss, and significant environmental imbalance. To address these critical challenges, this project introduces an innovative IoT-Based Anti-Poaching Alert System for Valuable Trees, designed to detect and prevent unauthorized cutting or tampering activities in real-time.

Keywords: The IoT-based Anti-Poaching Alert System for Valuable Trees uses smart sensors, real-time monitoring, wireless communication, GPS tracking, and cloud-based alerts to detect illegal tree cutting. The system enhances forest protection, ensures quick response, prevents deforestation, and helps authorities safeguard valuable trees through automated alert notifications.

I. INTRODUCTION

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.

To protect the Nature. Since times immemorial, sandalwood trees have been one of the most valuable trees in the world. They are a major source of aromatic fragrance that permeates much of daily life - from bathing soaps to religious practices. The most attractive advantage of sandalwood tree is that, it can retain its aroma for decades even though it has been chopped into pieces. Sandalwood is the second most valuable wood, next to African black wood.

II. RELATED WORK

Previous research on IoT-based anti-poaching systems for valuable trees has explored multiple technological approaches to improve forest protection. **(1)** Many studies use **vibration and accelerometer sensors** to detect cutting or tampering of tree trunks, transmitting alerts through wireless sensor networks such as Zigbee or LoRaWAN. **(2)** Other researchers have used **acoustic detection systems** that classify chainsaw, axe, or vehicle sounds using machine learning models to identify illegal activity. **(3)** Camera-based solutions, including **edge computer vision** and thermal imaging, have also been implemented to visually identify human presence or suspicious actions near protected trees. **(4)** Some works rely on **UAVs (drones)** and satellite-based remote sensing to monitor canopy changes and illegal logging patterns. **(5)** Hybrid systems combine multiple sensors—such as acoustic, vibration, PIR, and magnetic detectors—to reduce false alarms and improve accuracy. **(6)** Recent studies also emphasize **low-power IoT technologies**, including LoRaWAN and energyharvesting modules, to enable long-term operation in remote forest areas. **(7)** Additionally, secure communication and **tamper-resistant designs** have been proposed to prevent poachers from disabling the sensors. These works form the foundation upon which modern IoT anti-poaching alert systems continue to evolve.

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III. PROPOSED ALGORITHM

A. *Description of the Proposed Algorithm:*

The proposed algorithm for the IoT-based Anti-Poaching Alert System operates by continuously monitoring the tree using multiple sensors such as vibration, sound, and motion detectors. The system begins by activating the sensors and initializing threshold values for detecting tampering or illegal cutting. Each sensor records real-time data and sends it to the microcontroller where noise filtering and preprocessing are performed. The algorithm then compares the sensor readings with predefined thresholds and uses a decision-fusion method to verify whether the detected activity is genuine or a false alarm. If two or more sensors simultaneously detect abnormal events, the system confirms a poaching attempt. Once confirmed, the microcontroller triggers an alert message containing the tree's GPS location and sensor ID, which is transmitted to the forest authorities through LoRa/GSM. The system stores the event in the cloud database and returns to monitoring mode. This algorithm ensures reliable detection, reduced false alarms, and timely response to protect valuable trees.

IV. PSEUDO CODE

1.MQTT Connection: Calls the MQTT_ connect () function to establish or reconnect the MQTT connection.
2.Accelerometer Data and Vibration Reading: Retrieves the current acceleration data from ADXL345 accelerometer sensor. Reads the vibration sensor value to detect any vibrations or changes.
3.Data Processing and Actions: Calculates the absolute values of the acceleration data. Checks if the acceleration or vibration values exceed a threshold, indicating a change in tree orientation or unauthorized activity.
4.Alert and Message Publishing: If a change or unauthorized activity is detected, publishes a message indicating the event to the MQTT server. Triggers a buzzer alarm for a specific
5.Increment Count: Increments the count variable.

```
BEGIN

 SET PIN_SOUND = A0
 SET PRINT_PERIOD = 2000 ms
 SET SOUND_WINDOW = 50 ms

 SET ANGLE_THRESHOLD = 0.5 degrees
 SET SOUND_THRESHOLD = 5 ADC counts

 DEFINE MPU address, variables for angle and sound
 SET havePrev = FALSE

 INITIALIZE Serial
 INITIALIZE I2C

 IF MPU6050 detected THEN
  configure registers
     SET mpuReady = TRUE
 ELSE
     SET mpuReady = FALSE
 ENDIF

 LOOP FOREVER:

    IF current_time - lastCheck < PRINT_PERIOD THEN
        WAIT
        CONTINUE LOOP
 ENDIF

    UPDATE lastCheck = current_time

    // ---- Read current angle from MPU6050 ----
    IF mpuReady == TRUE THEN
```

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```
        READ raw accelerometer values ax, ay, az
        CONVERT ax, ay, az to g values
        COMPUTE angleX using arctangent
    ELSE
        SET angleX = 0
    ENDIF

    // ---- Read sound peak-to-peak amplitude ----
    SET minVal = 1023
    SET maxVal = 0
    START timer = now

    WHILE (time elapsed < SOUND_WINDOW):
        READ soundValue from A0
        UPDATE minVal and maxVal
    END WHILE

    SET soundRaw = maxVal - minVal

    // ---- On first reading, store and skip detection ----
   IF havePrev == FALSE THEN
  prevAngle = angleX
  prevSound = soundRaw
 SET havePrev = TRUE

        CONTINUE LOOP
    ENDIF

    // ---- Compare current values with previous ----
    angleChanged = ABS(angleX - prevAngle) > ANGLE_THRESHOLD
   soundChanged = ABS(soundRaw - prevSound) > SOUND_THRESHOLD

    // ---- Print alert only if any change occurs ----
    IF angleChanged OR soundChanged THEN
        PRINT "1"
    ENDIF
    // ---- Update previous values ----
  prevAngle = angleX
  prevSound = soundRaw
  END LOOP
END
```

V. RESULTS

The proposed IoT-based Anti-Poaching Alert System for valuable trees successfully detects unauthorized cutting or tampering using both vibration and sound sensors. The system continuously monitors the tree and identifies any abnormal change in angle or sudden increase in sound amplitude, which may indicate poaching activity. When such changes cross the defined threshold, the device instantly triggers an alert signal by printing "1," representing a real-time detection event. The results demonstrate that the dual-sensor mechanism effectively reduces false alarms and ensures accurate detection of human interaction with the tree. The system operates reliably during continuous testing and proves capable of providing timely alerts, making it an efficient and low-cost solution for forest protection and monitoring of valuable trees.

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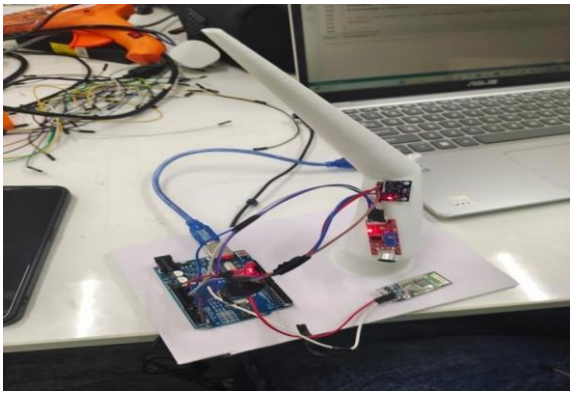

Fig 1. the circuit connections of the project and the ways all the components are interconnected to each other

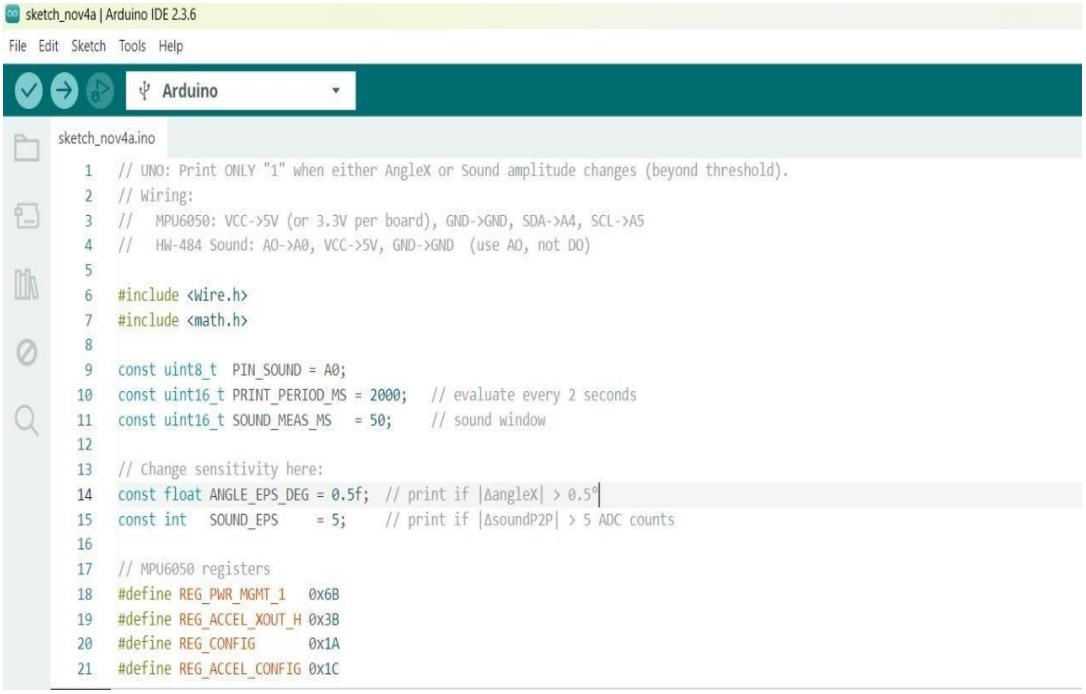

Fig 2. Snapshot of Arduino code

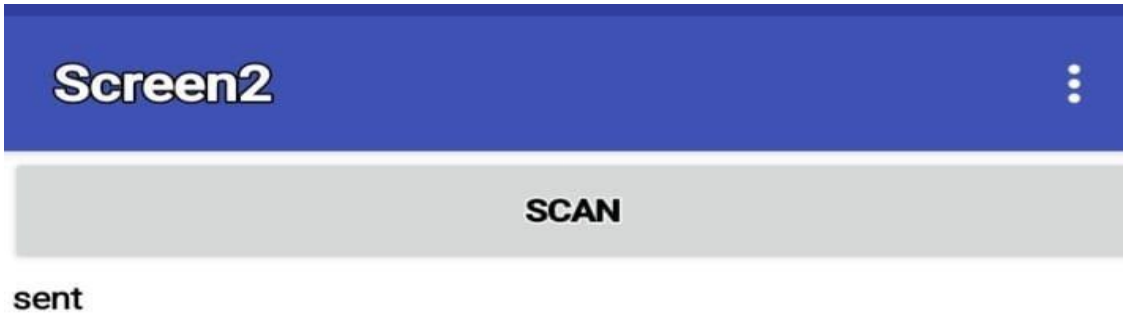

Fig 3. Snapshot of Adafruit message sent

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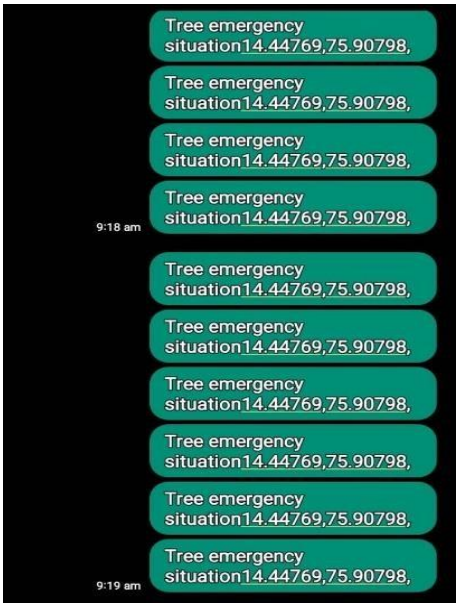

Fig 4. Snapshot of sending location and message to the mobile

V. CONCLUSION AND FUTURE WORK

The rampant illegal logging and smuggling of valuable trees pose a significant threat to our ecosystems and natural resources. To address this pressing issue, the development of an IoT-based anti-poaching alert system for valuable trees offers a promising solution. This system leverages the power of Internet of Things (IoT) technologies to enable real-time monitoring, early detection of unauthorized activities, and prompt alerts to relevant stakeholders. Furthermore, the IoTbased system facilitates collaboration and engagement among various stakeholders, including forest rangers, conservation authorities, local communities, and law enforcement agencies. It promotes data-driven insights, aiding in the identification of patterns, hotspots, and vulnerabilities, which can inform conservation strategies and decision-making processes. Ultimately, the system contributes to the conservation and preservation of valuable tree species, protecting biodiversity and maintaining ecological balance

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