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CONTENT

SAFEGUARDING SANDALWOOD: REAL-TIME IOT MONITORING AND PROTECTION SYSTEM DESIGN

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ABSTRACT: The recent increase in sandalwood thefts poses a major threat to this treasured tree species. Sandalwood trees have a commercial edge over other tree varieties due to their distinct scent and valuable therapeutic characteristics. However, the current lack of a strong protective measure has jeopardized these trees.Most of the systems are developed to ensure the security for trees implementing various sensors.but The suggested system design prioritizes security, protecting the plantation with features such as CCTV and infrared sensors. It goes beyond security, though, by incorporating plantation management. Moisture sensors are used to ease drip irrigation and ensure the health of the plants.The method enters its second phase when the trees reach around 6 years of age. Through RFID tags, this phase incorporates complete tree-specific information management, including fertilization. Furthermore, the installation of vibration and temperature sensors improves security. These sensors improve tree protection, assuring their safety and health. The system effectively maintains the plantation by merging data from multiple sensors, giving a comprehensive approach to both security and plant care.All the sandalwood plantations will be under observation and control through 24*7 Automation updating the frequent data into the cloud and app

Keywords : IoT ,Sensors,Drip irrigation,RFID & Cloud .

INTRODUCTION

In recent times, there has been a surge in news reports concerning the illicit trade of valuable trees. These trees hold significant importance in the fields of medicine and cosmetics, making them prime targets for smuggling. Unfortunately, the substantial profits associated with their sale have led to an alarming increase in incidents of unauthorized tree cutting and smuggling. This issue is not confined to India alone; countries like Australia, China, and Africa are grappling with similar problems. To put the financial aspect into perspective, Indian sandalwood is currently valued at approximately 12,000 to 13,000 INR per kilogram, while Red Sanders, highly sought after in the international market, can command prices of around 10 core INR per ton. Regrettably, Indian sandalwood trees are now under the threat of extinction, prompting the government to impose export restrictions in a bid to protect them. Despite these measures, there continue to be reports of sandalwood smuggling and trade.

A significant challenge is the lack of an effective method or system to detect and combat illegal tree cutting and logging. To safeguard the status of your trees, it is advisable to establish a monitoring system within your working environment. Such a system has been developed to address this problem by identifying and alerting us to potential issues, enabling us to take immediate action. The ultimate goal of this system is to assist us in our mission to preserve nature. Throughout the ages, the sandalwood tree has been regarded as one of the world's most invaluable treasures.

LITERATURE REVIEW

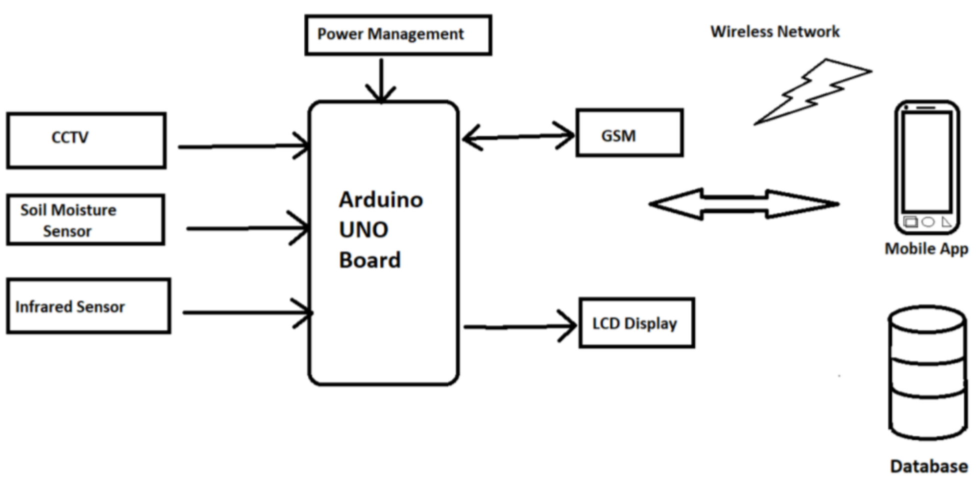
Recent literature describes several projects that aim to create IoT-based systems for safeguarding priceless trees, notably sandalwood, in forested areas. These systems employ a variety of sensors and communication technologies to identify and prevent unlawful operations like illicit logging, forest fires, and tree cutting. The shared research goal of these initiatives is to strengthen tree security and notify relevant authorities or owners when unauthorized activities are discovered, helping to safeguard forest ecosystems.

However, there are research gaps in these initiatives. This includes assessing scalability, cost-effectiveness, and the ecological effects on larger forest regions and different tree species. Further inquiry is also needed into the dependability of communication infrastructure in distant forest locations. Furthermore, possible weaknesses in these systems, as well as techniques for improving their robustness, must be investigated and addressed.

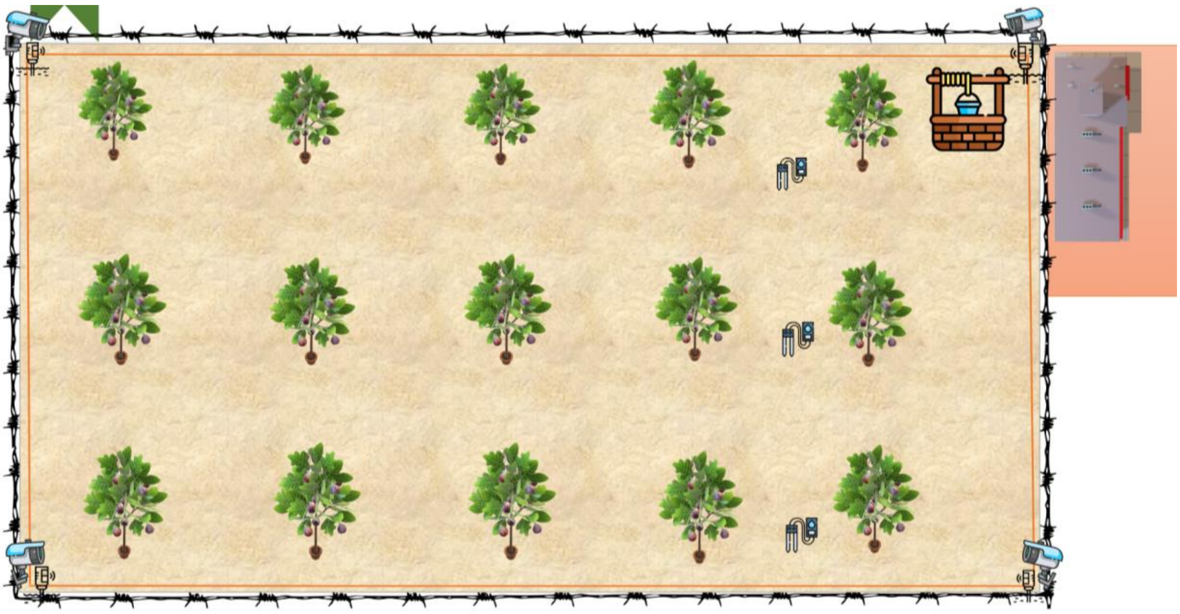
The primary research goal of these initiatives is to use IoT technology to improve the security and monitoring of valuable plants, particularly sandalwood, in forest environments. They intend to use a variety of sensors and communication systems to prohibit criminal harvesting, tree cutting, and forest fires. The suggested technologies are designed to warn relevant authorities or tree owners when unauthorized activities are discovered, allowing for quick responses to protect the forest environment.

METHODOLOGY

First Phase Architecture



In the first phase of this architectural system, several input devices are integrated to monitor and collect information. These devices include a Closed-Circuit Television (CCTV) camera, a Soil Moisture Sensor, a Lesser Sensor (assuming this refers to a light sensor), and a Detector (presumably for some specific purpose). These sensors and the CCTV camera are connected to an Arduino UNO Board, a microcontroller capable of processing and managing data from these sensors. The power supply for the Arduino UNO Board and all the sensors is provided through a dedicated power source to ensure continuous operation. The Arduino UNO Board acts as the central hub for data processing and control in this setup.



First Phase of the system

Here's how the system works step by step:

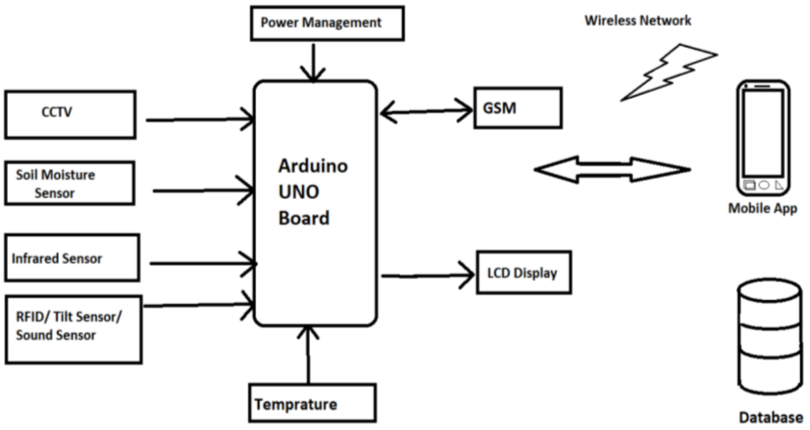
1. Data Acquisition: The CCTV camera continuously captures video footage, the Soil Moisture Sensor measures soil moisture levels, the Lesser Sensor monitors ambient light conditions, and the Detector senses specific events or conditions based on its purpose.
2. Data Processing: The Arduino UNO Board receives data from these sensors and processes it in real-time. For example, it can analyze video streams from the CCTV camera, process analog data from the sensors, and perform any necessary calculations or logic.
3. Display: The processed data is then displayed on an LCD screen. This display provides real-time information to anyone viewing it, allowing them to monitor the current state or conditions being sensed by the various sensors.
4.Data Storage: Simultaneously, the collected data is sent to a ThingSpeak cloud-based storage system. This storage system can be hosted on the internet and is accessible from anywhere with an internet connection. It ensures that historical data is preserved and can be retrieved for analysis or reference at any time.
5.User Interaction: To provide user interaction and access to the collected data, a mobile app is developed. Users can install this app on their smartphones or tablets. The app

communicates with the cloud-based storage to retrieve and display real-time and historical data from the sensors and the Arduino UNO Board.
6.Wireless Connectivity: The wireless network, typically WiFi, serves as the communication medium that connects the Arduino UNO Board, the cloud-based storage, and the mobile app. It enables seamless data transmission and user interaction over a local or remote network.

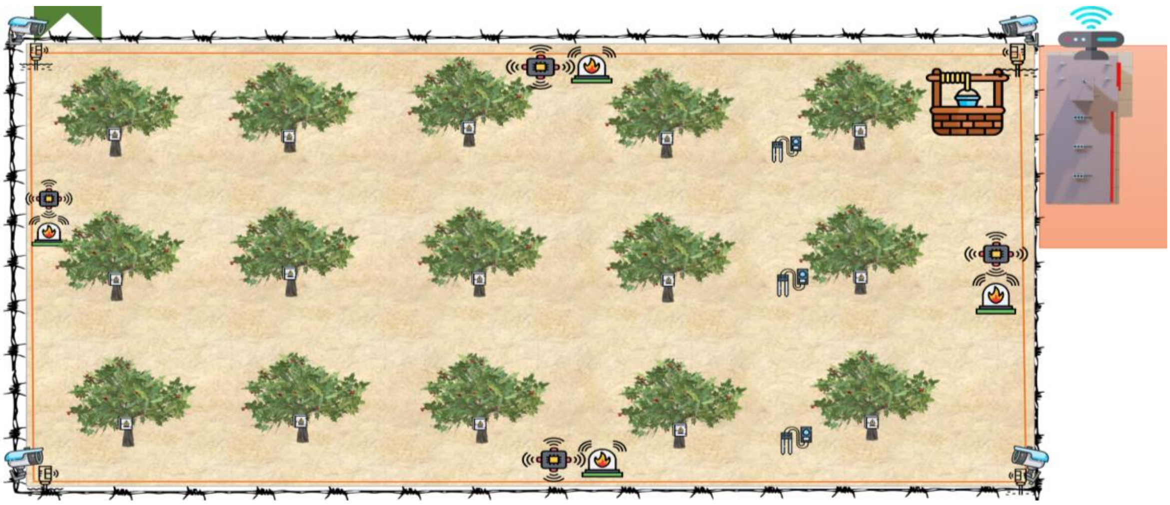
This architecture allows for the real-time monitoring and control of various sensors through an Arduino UNO Board, with data displayed on an LCD screen. It also provides remote access and interaction with the collected data through a mobile app, facilitated by a wireless network, and ensures data persistence and accessibility in the cloud.

2. Second Phase Architecture

After six years of plantation, the second phase of the architecture was implemented to incorporate advanced monitoring and control systems.



In the second phase of the architecture, an expansion of the system takes place by introducing additional sensors and components. RFID technology is incorporated, with RFID tags being utilized for identification and tracking purposes. These RFID tags are monitored by an RFID antenna, enhancing the system's capabilities for asset tracking and identification. Furthermore, a tilt sensor, temperature sensor, sound sensor, and vibration sensor are seamlessly integrated into the setup, providing a broader spectrum of environmental data and event detection. These new sensors are connected to the existing Arduino UNO Board, which serves as the central processing unit. As before, the Arduino UNO Board processes data from all connected sensors, displaying pertinent information on the Mobile Application. Simultaneously, this data is transmitted to the cloud for storage and is made accessible through the mobile app, ensuring a comprehensive and integrated monitoring system. Wireless network connectivity, such as WiFi, continues to enable real-time data transmission and user interaction for an expanded range of sensor inputs. This phase enhances the system's capabilities by incorporating RFID technology and additional environmental sensors for a more comprehensive monitoring and control solution.



Second phase of the system

Components

CCTV

The purpose of CCTV cameras in this real-time IoT monitoring and protection system is to provide continuous visual surveillance, enabling the real-time monitoring and recording of activities in sandalwood plantations, storage areas, and access points. These cameras serve as a crucial deterrent to theft and unauthorized access, as well as a means to gather evidence in case of security breaches. Their high-resolution imaging, motion detection, and remote access capabilities empower security personnel to promptly respond to potential threats, ensuring the security and safeguarding of valuable sandalwood resources around the clock.

Soil Moisture Sensor

The purpose of soil moisture sensors in this real-time IoT monitoring and protection system is to provide essential data regarding the moisture levels in the soil surrounding the sandalwood plants. These sensors help ensure optimal growing conditions for the sandalwood by enabling precise irrigation management. By continuously monitoring soil moisture levels, the system can trigger automated irrigation processes when the soil becomes too dry, thus promoting healthy plant growth and mitigating the risk of drought stress. Additionally, this data can be integrated with the broader IoT system to enable proactive decision-making and conserve water resources, ultimately contributing to the overall health and sustainability of the sandalwood plantation.

5HP Motor

A 5HP (Horsepower) motor plays a crucial role in this real-time IoT monitoring and protection system for safeguarding sandalwood by powering various equipment and processes. One primary application is for the irrigation system, where the motor can drive water pumps to ensure a consistent and efficient water supply to the sandalwood plantation. It's responsible for drawing water from a source, like a well or reservoir, and distributing it through the irrigation network to maintain optimal soil moisture levels.

RFID Antenna

Placed strategically at key locations such as access points and storage facilities, the RFID antenna interacts with RFID tags affixed to sandalwood logs or containers. When tagged assets pass through or near these antennas, it triggers automatic identification, allowing the system to monitor the movement and location of each sandalwood resource in real-time.

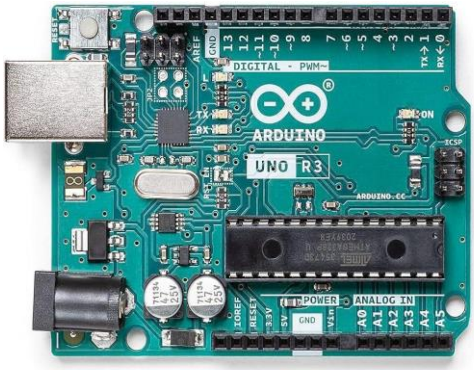
RFID Reader

The RFID reader is a pivotal component within the real-time IoT monitoring and protection system for safeguarding sandalwood. Placed at critical checkpoints, storage facilities, and access points, the RFID reader actively communicates with RFID tags attached to sandalwood logs or containers. This interaction enables the system to accurately identify, track, and manage each individual sandalwood resource. By instantly recognizing the RFID-tagged assets as they move through the system, it ensures precise inventory control and security monitoring.

RFID Tag

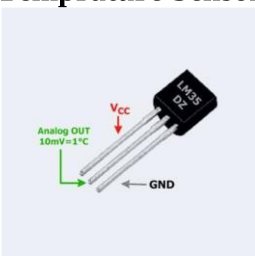
RFID tags are an essential component of the real-time IoT monitoring and protection system for safeguarding sandalwood. These tags are securely attached to individual sandalwood logs or containers, enabling unique identification of each resource. As these tagged assets move through various checkpoints, access points, and storage facilities, RFID readers interact with the tags, collecting critical data about their location and status in real-time.

Arduino Uno



The Arduino Uno R3 board serves as a versatile and programmable control hub within the real-time IoT monitoring and protection system for safeguarding sandalwood. Its role involves processing data from various sensors and devices, such as soil moisture sensors, RFID readers, or even CCTV cameras, and making real-time decisions based on this data. Additionally, the Arduino Uno R3 can facilitate communication between these devices, execute automation tasks like controlling irrigation or security alerts, and transmit data to a central server for analysis. Its flexibility and compatibility with a wide range of sensors and actuators make it an ideal choice for orchestrating and optimizing various functions within the system, ensuring efficient sandalwood management and protection.

Temprature Sensor



The temperature sensor is a critical component in the real-time IoT monitoring and protection system for safeguarding sandalwood. By continuously measuring the ambient temperature in the sandalwood plantation, it provides crucial environmental data that aids in making informed decisions. Monitoring temperature variations helps optimize the sandalwood's growth conditions, ensuring they are within the ideal range. Extreme temperature fluctuations can indicate potential stress or disease in the plants, allowing for prompt intervention.

Tilt Sensor

The tilt sensor plays a role is strategically positioned to detect any unauthorized tampering or movement of sandalwood logs or containers.

When a tilt or movement beyond a predefined threshold is detected, the sensor triggers immediate security alerts. This functionality is crucial in preventing theft and ensuring the security of valuable sandalwood resources.

Sound and Vibration Detector

The Sound and Vibration Detector sensor positioned strategically in key locations, this sensor continuously monitors the acoustic and vibrational environment around sandalwood assets, such as storage facilities or access points. It is particularly valuable for detecting unauthorized activities like attempted break-ins or tampering. When abnormal sounds or vibrations are detected, the sensor triggers immediate security alerts, enabling swift responses to potential threats.

5000 mAh battery

The 5000mAh battery monitoring system for safeguarding sandalwood, especially when tilt and temperature sensors are attached to each tree. In the event of a power cut or outage, this high-capacity battery ensures uninterrupted operation of the sensors, allowing them to continue monitoring and transmitting data from the

sandalwood trees. This resilience ensures that critical data related to tree orientation (tilt) and environmental conditions (temperature) remains accessible even during power disruptions. Consequently, the system can maintain real-time monitoring and security alerts, ensuring the ongoing protection and well-being of the sandalwood resources, regardless of power interruptions.

Laser Sensor and Detector

The Laser Sensor and Detector sensor are strategically deployed throughout the sandalwood plantation to detect smaller and less obvious movements or disturbances. Whether it's detecting minor soil shifts, subtle fluctuations in microclimatic conditions, or small animal activity.

Buzzer

The Buzzer sensor serves as an important alerting mechanism within the real-time IoT monitoring and protection system for safeguarding sandalwood. Strategically placed in key areas, this sensor is programmed to generate audible alarms in response to security breaches or critical events, such as unauthorized access,

tampering, or adverse environmental conditions. When triggered, the buzzer sensor emits a loud sound, instantly alerting security personnel or nearby individuals to the situation at hand.

Application Manager

The application manager serves as the central control, It provides a user-friendly interface where authorized personnel can access comprehensive information about each sandalwood tree, including real-time data from tilt and temperature sensors. Additionally, the application manager facilitates live access to CCTV camera feeds, enabling users to monitor the sandalwood plantation and storage facilities remotely. It also manages notifications and alarms, promptly alerting users to security breaches, environmental anomalies, or any other critical events.

Cloud Storage: Cloud storage is serves as the secure repository for storing and managing vast volumes of critical data generated by sensors, CCTV cameras, and other devices. By utilizing cloud storage, the system ensures the preservation and accessibility of historical and real-time data from multiple sources. This data can be easily retrieved, analysed, and shared with authorized personnel, providing valuable insights for decision-making, security audits, and compliance reporting. Moreover, cloud storage enhances data redundancy and security, reducing the risk of data loss or tampering compared to traditional physical storage methods.

CONCLUSION

The concept aimed at preventing the management of critical trees in a protected jungle area and devised a streamlined approach by deploying sensors and microcontrollers around these trees. The latest technology, This initiative seeks to expand this system to encompass a network of such intelligent trees, effectively creating an Internet of Things (IoT) ecosystem. These trees are under constant surveillance, akin to having nerves, ensuring their well-being. This approach involves constructing structures that protect trees in remote areas, especially those towering high, where traditional security measures are impractical. In essence, this innovative program aims to tackle deforestation, preserving the ecological balance, and combatting one of the primary contributors to global warming often associated with remote forest areas.

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