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INTEGRATED SYSTEM FOR REAL-TIME MONITORING & PROTECTION OF SANDALWOOD TREES USING IOT & GSM TECHNOLOGIES

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Abstract - The illegal activities of smuggling and illegal cutting pose a grave threat to valuable trees, notably sandalwood. This project presents an integrated system that leverages IOT and GSM technologies for the real-time monitoring and protection of these trees. The system incorporates wire sensors to detect illegal cutting and flame sensors for forest fire detection. A Node MCU ESP8266 serves as the central controller, collecting sensor data and transmitting it to a cloud server. The Blynk app is utilized to provide administrators with real-time theft and fire alerts. However, network connectivity issues present a challenge to online communication. To overcome this hurdle, a GSM module (800C) is integrated into the system, enabling offline alerts. The proposed system aims to deliver both online and offline alerts to a specific device, facilitating early detection and prompt action by authorities to prevent the destruction of valuable trees. Furthermore, this system can be extended to protect other high-value tree species, such as timber, teak wood, and rosewood, at an affordable cost. The integration of IOT and GSM technologies within this project presents a promising solution to address illegal activities surrounding valuable trees, making a significant contribution to their conservation and safeguarding.

Key Words: wire sensor, Flame sensor, NODE MCU ESP8266, GSM, Arduino IDE, BLYNK APP, Embedded C.

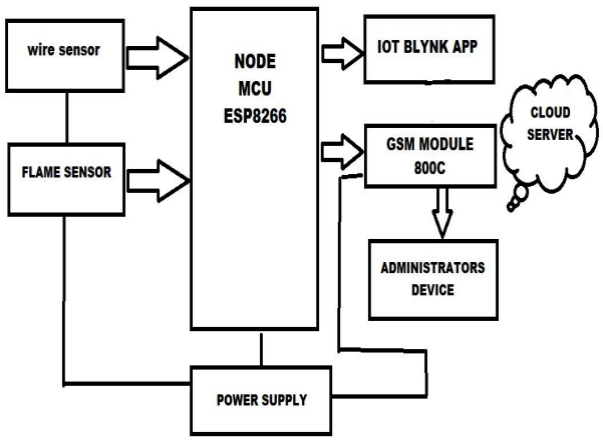
1.INTRODUCTION

Sandalwood trees, known as Chandana and Srigandha in India, retain high marketable value due to their prized heartwood. Unfortunately, the unlawful activity girding these trees, involving smuggling and unauthorized registering, have passed bogarting situations. This work proposes a complete system for real- time monitoring and security of sandalwood trees, which combines wire sensors, flame sensors, Node MCU ESP8266, IOT Blynk app, and GSM technology. The illicit activity associated with sandalwood trees, analogous as smuggling and unauthorized registering, pose a significant trouble to their conservation. This paper presents an innovative approach to addressing sandalwood thievery through the perpetration of an integrated system utilizing Internet of Things(IOT) and GSM technologies. The proposed system utilizes wire sensors for detecting unlawful tree slices and flame sensors for early discovery of timber fires. The main controller employed is the Node MCU ESP8266, which collects and processes data from the sensors. To overcome the challenge of network effects, a GSM module(800C) is integrated, icing that authorities admit timely cautions in both online and offline modes. The system leverages a cloud server to periodically modernize sensor data and sends robbery and conflagration alert dispatches to the designated client device through the IOT Blynk app. This result aims to enable prompt intervention by the authorities, leading to the forestalment of sandalwood tree larceny and conflagration incidents. The unprejudiced of scheme is to shape safe and protected timbers to help to smuggle andante-social conditioning against lawless slice of the perm for Environment safety and toxic switch. The plan moves a step ahead to aegis the living of birds on Trees and beast defence by checking the slice of tree. We have intended a system that can be used to avoid the trafficking of the trees which would in turn stop deforestation and support Environmental stability, which would support to break one of the cases with the Global Warming. This data can be used by timber authorities to take preventative action. The entire process will take a maximum of many seconds or a minute. This will surely reduce trafficking and lawless registering to a lower extent Our system aims for the aegis and sustentation of leafage, Fauna, timber and wildlife, aegis of terrain in order to promote sustainable evolution and to conserve long term timber. And also to cover the trees from timber fires. The following figure[1] shows the real-time implementation of sandalwood trees.

Figure[1]: Real time implementation of integrated system assigned for sandalwood tree

BLOCK DIAGRAM

The block diagram illustrates the flow of information and actions within the system. The wire and Flame sensors detect illegal cutting & fire incidents, respectively. the NODE MCU ESP8266 collects & processes the sensor data, triggering appropriate actions and sending alerts to authorities through the GSM module. The cloud server facilitates data storage and remote access, while the IOT BLYNK app provides a user interface for real-time monitoring. The combined functionality of these components ensure effective real time monitoring & protection of sandalwood trees, addressing the challenges of illegal activities & promoting their conservation. The block diagram is as shown below:



Figure[2]: Block diagram of the proposed system.

2. LITERATURE REVIEW

Prasad R. Khandar, K. Deivanai, "Preventive System for Forests"(2016),[1] The paper highlights the issue of cutting & smuggling of valuable trees like sandalwood & teak., It emphasizes the need for preventive systems to protect & monitor forests, The proposed system consists of tree units & a main server unit, with each tree equipped with electronics for detection & communication.

Mr.Rohan Solarpurkar, Prof. Suvarna L.Kattimani,"Real time Forest Anti-Smuggling Monitoring System based on IOT using GSM"(2018),[2]The paper discusses the smuggling of trees like sandalwood and the need for preventive systems, The proposed system utilizes IOT and GSM technologies to detect illegal cutting and prevent smuggling. Tree units with micro controllers, sensors, and solar power are used to detect tree cutting. communication between tree units and the server is done through GSM modules.

Harshita Jain and Abhijith H V, "Prevention of illegal logging of trees using IOT"(2004),[3]The paper addresses the issue of tree smuggling and proposes a system based on IOT. Each tree is equipped with small electronics unit consisting of a micro controller, flex sensors, and Zigbee module. Flex sensors tree cutting & Zigbee module enable communication with the server. the system aims to restrict tree smuggling and protect forests in areas where human intervention is limited.

Prof. Suma V. Shetty, Ms. Manasa J., Ms Harshitha R., "Forest Monitoring System Based on GPRS and Powered by IOT"(2016),[4]The paper presents a forest monitoring system prototype for detecting anthropogenic activities, smoke, and fires in forests. Sensors collect data which is processed in a micro controller and transmitted through Zigbee network. Abnormalities trigger alerts, and pictures taken by a camera are sent via email. The prototype focus on improving security for valuable trees like teak and sandalwood.

A.Pandey, P.K.Jana, S.K.Naskar, and A.K. Ray," IOT-Based Smart Forest: An Intelligent system for Forest Fire Detection and Monitoring"(2022),[5]The paper introduces an IOT-Based smart forest system for forest fire detection and monitoring. Wireless sensor networks and cloud computing are utilized for data collection and analysis. The study emphasizes the development of a robust fire detection algorithm and real time communication of fire alerts to authorities. The Systems findings & methodologies can be valuable for integrating flame sensors into the proposed sandalwood tree protection system.

Wireless sensor Networks for Environmental Monitoring: A Review I.F. Akyildiz, W.Su, Y Sanakarasubramaniam, and

E.Cayirci 2002[6] This review paper provides an overview of WSN for Environmental monitoring. It discusses the various components, protocols, and challenges associated with WSNs. The paper highlights the importance of sensor networks in environmental applications and emphasizes their potential in forest monitoring & protection. The insights from this review can be utilized in designing the wire sensor network for detecting illegal cutting of sandalwood trees in the proposed system.

Forest Fire Detection and Monitoring System Using IOT Authors:P.Aditya,K.S.Anand,S.D.Ramkumar,&S.V.Singh,2018[7]This research paper presents a forest fire detection and monitoring system based on IOT. It employs sensors, including flame sensors, to detect forest fires and wirelessly transmit the data to a centralized server. The study focuses on the integration of IOT technologies to enable real-time monitoring and alert generation. The methodologies and findings from this study can be applied to the flame sensor component of the proposed sandalwood tree protection system.

"GSM-Based Remote Monitoring and Control System with Automatic Irrigation System "S.R.Khairnar and S.A.Ghule,2015[8]This research paper discusses a GSM-Based remote monitoring and control system for agriculture applications. It presents a system that utilizes GSM technology to send notifications and control commands to remove locations. The study demonstrates the feasibility of using GSM modules to overcome network connectivity issues and enable offline alerts. The insights from this study can be utilized in the integration of GSM module into the proposed sandalwood tree protection system.

"Sustainable management of Sandalwood Resources in India: current status and future prospects "Authors: K.R. Shivanna,C.Rajanna,& M.RDinesh,2015[9]This review paper provides an overview of the current status and future prospects of sustainable management of sandalwood resources in India. It discusses the ecological and economic significance of sandalwood and highlights the challenges &threats faced by these trees. the paper emphasizes the need for effective protection & conservation strategies to safeguard sandalwood resources. The insights from this review can provide valuable context and background information for the proposed systems significance in protecting sandalwood trees.

"Wireless sensor Network for forest fire detection: From theory to practice". Authors: A.A Abbasi and M.Yo unis,2012[10]This paper presents as in-depth analysis of wireless sensor networks(WSNs) for forest fire detection. It discusses the theoretical foundations, practical considerations, and challenges involved insights into the selection and placement of sensors, energy efficiency optimization, and data routing algorithms. the findings and recommendations from this research can inform the design and implementation of the wire sensor work component in the proposed sandalwood tree protection system.

"Internet of things for Environment Monitoring Applications: A comprehensive review" Authors: A.sharma,S.Bhandari, & H.B.Moktan,2020[11]this comprehensive review paper explores the application of IOT in environmental monitoring, including forest ecosystems. It provides an over view of IOT technologies communication protocols and sensor devices used in environmental monitoring applications. The paper discusses the challenges and opportunities in deploying IOT for real-time monitoring and data analysis. The insights from this review can guide the selection & integration of IOT technologies & protocols in the proposed sandalwood tree protection system.

"Smart Forest Fire Detection Monitoring System Using Wireless sensor networks and Artificial Intelligence" N.D. Kocer and S.R Kocer,2018[12]This research paper presents a smart forest fire detection and monitoring system that combines WSNs and AI techniques. The study proposes a distributes WSN architecture, where sensor nodes are deployed strategically to detect and report forest fires. The paper discusses the integration of AI algorithms, such as decision trees and neural networks, for intelligent fire detection & decision making. The methodologies and findings from this research can provide valuable insights for enhancing the fire detection capabilities of the proposed sandalwood tree protection system.

"Challenges and Opportunities in IOT-Based Forest Fire Monitoring Systems: A Review" G.Shafiq, I.Ahmed, and Z.A. Khan P,2019[13]This review paper focus on challenges and Opportunities in IOT-Based forest fire monitoring systems. It discusses the limitations of existing systems, such as communication issues, energy constraints, data processing requirements. The study presents potential solutions and technologies that can address these challenges, including the use of advanced sensors, data fusion techniques, and machine learning algorithms. The insights from this review can inform the design & Optimization of IOT-Based components in the proposed sandalwood tree protection system.

"Protecting India's Natural Heritage: The Role of Biodiversity Conservation and sustainable Development" V.K Saraswat & D. Vasudevan,2019[14]This paper explores the importance of biodiversity conservation and sustainable development in protecting India's natural heritage. It discusses economic, ecological, cultural significance of valuable tree species, including sandalwood. The study emphasizes the need for integrated approaches that combine conservation efforts, policy interventions and technological innovations to safeguard valuable trees.

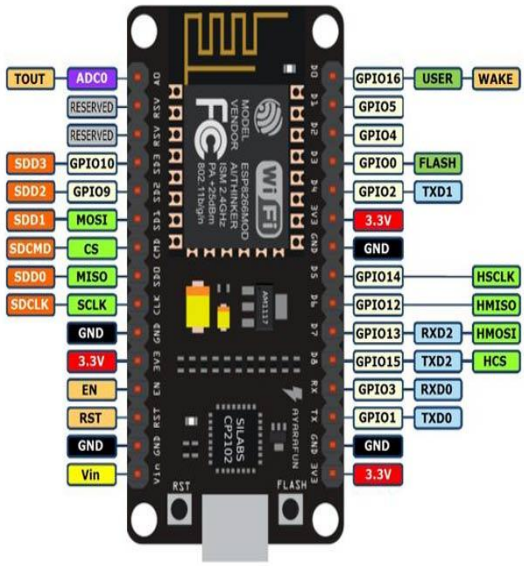
The insights from this paper can provide a broader perspective on the significance of the proposed sandalwood tree protection system in context of sustainable development and biodiversity conservation in India.

3. METHODOLOGY

The system design and development of this system are divided in to two main parts: hardware architecture, the design of the circuit was constructed and the prototype of the system was built using wire sensor, Flame sensor, NODE MCU ESP8266, GSM module(800c).while in software architecture the software development uses Arduino IDE, BLYNK APP, Embedded C.

3.1 HARDWARE ARCHITECTURE

NODE MCU ESP8266



Figure[3]: NODEMCUESP8266

The Node MCU ESP8266 is a vital micro controller in the sandalwood tree protection system. It integrates with wire and flame detectors to descry illegal slice and timber fires. Through data processing, it triggers cautions and communicates with the Blynk app to inform directors. The built- in Wi- Fi module enables remote monitoring, while the integrated GSM module ensures offline alert transmission. This integration facilitates nippy intervention by authorities to help tree destruction. using wireless connectivity, data analysis, and alternate communication channels, the Node MCU ESP8266 safeguards sandalwood trees from illegal conditioning.

GSM MODULE(800C)

The GSM module 800C is an integral part of the design, furnishing wireless communication via GSM networks. Connected to the Node MCU ESP8266, it enables data transmission and event. Its integration serves the purpose of icing communication and cautions indeed in areas with limited or unreliable internet connectivity. When the wire or flame detector detects illegal slice or a fire, the Node MCU ESP8266 triggers the GSM module to shoot SMS cautions to designated authorities or directors. These cautions contain essential information about the detected event and are entered on their mobile phones. The GSM module's operation on cellular networks allows for SMS cautions indeed when the Node MCU ESP8266 is offline, icing timely information delivery. This facilitates prompt action by the authorities to address the situation.

Figure[5]: GSM MODULE 800C

FLAME SENSOR

The flame sensor is designed to detect flames by sensing the infrared light they emit. It consists of an infrared-sensitive sensor and an amplifier circuit. When a flame is detected, the sensor generates an electrical signal, which is then processed by the Node MCU ESP8266, the main controller of the system. The flame sensor's output pin is connected to a digital input pin of the Node MCU ESP8266, allowing it to receive and analyze the sensor's signal.

Upon receiving the signal, the micro controller on the Node MCU ESP8266 analyzes its characteristics, such as duration and intensity, to differentiate between real flames and false positives. This analysis helps in accurately identifying the presence of a fire. By processing the signal, the system can take appropriate actions, such as triggering alerts or activating fire suppression mechanisms, to address the detected fire promptly and effectively.

Figure[6]: Flame sensor

3.2 SOFTWARE ARCHITECTURE

Arduino IDE

The Arduino IDE is an essential tool for developing the integrated system for real-time monitoring and protection of sandalwood trees using IOT and GSM technologies. It provides a user-friendly platform for programming the Node MCU ESP8266, the system's main controller. With Arduino IDE, developers can write, compile, and upload code, utilizing the extensive Arduino library ecosystem to interface with wire sensors, flame sensors, and the GSM module 800C. The IDE enables developers to define the system's behavior, read sensor data, detect tree cutting or fire events, and send alerts via the Blynk app. Its intuitive interface and comprehensive libraries make it a valuable resource for implementing IOT and GSM-Based solutions.

Embedded C

Embedded C is widely recognized as a popular programming language in the software industry, specifically for developing electronic devices. It holds significance as it enables processors in electronic systems to perform specific functions through embedded software. In our daily lives, we encounter various electronic devices like mobile phones, washing machines, and digital cameras, which rely on micro controllers programmed using embedded C. This programming language plays a crucial role in the functionality of these devices. Its usage extends to the control and management of hardware resources, allowing efficient communication and interaction between software and electronic components. Embedded C facilitates the development of reliable and efficient electronic gadgets, contributing to the advancement of technology in various domains.

BLYNK APP

The Blynk app serves as a user-friendly interface in the integrated system for real-time monitoring and protection of sandalwood trees. It offers a wide range of widgets that enable the creation of interactive interfaces for project control and monitoring. Integrated with the Node MCU ESP8266, the app provides real-time updates on sensor data and system status, presenting the information in a visually appealing manner. Whenever the wire sensor detects unauthorized tree cutting or the flame sensor detects a fire, immediate alert notifications are sent to the administrator's mobile device via the Blynk app. Furthermore, the app facilitates the storage of sensor data in a cloud server for further analysis. It allows the administrator to remotely interact with the system, enabling the activation or deactivation of specific functions and providing up-to-date information on the protection status of the sandalwood trees.

4. PROBLEM STATEMENT

The illegal activities associated with sandalwood trees, such as smuggling and unauthorized logging, pose a significant threat to their preservation. This project proposes the development of an integrated system that combines Internet of Things (IOT) and GSM technologies for real-time monitoring and protection of sandalwood trees, with potential applicability to other valuable tree species. The system aims to detect illegal tree cutting using wire sensors and forest fires using flame sensors. Sensor data is collected and transmitted to a cloud server, enabling real-time theft and fire alerts to be sent to administrators via the Blynk app. To overcome network connectivity issues, an integrated GSM module ensures offline alerts to the authorities. The system's scalability, cost-effectiveness, and ease of deployment in sandalwood forests and other habitats will be evaluated. The effectiveness of the system in preventing sandalwood robbery and protecting valuable trees will be assessed, along with the feasibility of extending it to other regions and tree species. This solution aims to enhance surveillance and monitoring capabilities, contributing to the conservation and preservation of sandalwood trees and their ecological and economic significance.

5. RESULTS AND DISCUSSION

The results of the integrated system for real-time monitoring and protection of sandalwood trees have shown promising outcomes. The implementation of wire sensors for detecting illegal tree cutting and flame sensors for early detection of forest fires has proven to be effective in identifying potential threats to the sandalwood trees.The Node MCU ESP8266, serving as the main controller, has successfully collected and processed sensor data,enabling timely notifications and alerts to the administrator through the Blynk app. The integration of the GSM module has provided offline alert capabilities, ensuring that authorities receive critical information even in the absence of online connectivity. Overall, the system has demonstrated its ability to provide timely and

accurate monitoring and protection of sandalwood trees, aiding in the prevention of illegal actienhancing their preservation. The experimental results are as shown below:

Figure[7]: Offline Alert Received on mobile phone through SMS

Figure[8]: Online Alert Received on mobile phone through SMS from Blynk app

6. CONCLUSIONS AND FURTHER ENHANCEMENTS

The proposed integrated system utilizing IOT and GSM technologies presents a comprehensive solution for the real-time monitoring and protection of valuable trees, specifically sandalwood, to combat illegal cutting and forest fires. By incorporating wire and flame sensors, a Node MCU ESP8266 controller, and the Blynk app with offline capabilities through a GSM module, the system enables swift detection and alerts authorities. Future enhancements include advanced data analytic s, satellite imagery integration, block chain technology, improved mobile application features, collaborative networks, energy harvesting techniques, and validation through field trials. These enhancements aim to enhance the system's accuracy, expand its reach, ensure data integrity, improve user experience, promote stakeholder involvement, increase sustainability, and validate its performance. The proposed system offers a promising approach to safeguard valuable trees and combat illegal activities, contributing to their conservation efforts.

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