Sandalwood Tree Protection Using Bluetooth Version 4.0

Santhosh Hebbar[1], Praveenraj Pattar[2], Rajeshwari Madli[3], Varaprasad Golla[4]

[1]Department of Electrical and Electronics Engineering, B.M.S. College of Engineering, Bengaluru-560019,India. Email: [1]santhoshshebbar@gmail.com.

[2, 3,4]Department of Computer Science and Engineering, B.M.S. College of Engineering, Bengaluru-560019, India. Email: [2]praveenraj.pattar.1989@ieee.org, [3]m.rajeshwari1626@gmail.com, [4]drvaraprasad@gmail.com

***Abstract*- Sandalwood trees are known for their fragrance and medicinal value due to which they enjoy the highest commercial advantage compared to other trees. In recent years there has been an increase in the number of sandalwood robberies as there is no pertinent solution available for protecting sandalwood trees, thus, making them endangered. This paper proposes a protection mechanism that makes use of Bluetooth 4.0. A model has been designed that takes care of most of the problems faced by sandalwood owners in protecting their trees against unauthorized axing. The implementation leverages Bluetooth 4.0 characteristics and uses the most efficient way to communicate with the owner in case of robberies. Whenever robbers try to cut sandalwood trees or try to destroy the protection system, the proposed system alerts the owner or the concerned authorities by sending an alarm to their mobile phones, so that they can initiate necessary actions. One of the attractive features of this model that is worth a mention is its durability that lasts up to a year. The proposed model can be implemented using two architectures; cluster architecture and distributed architecture. With help of these architectures a complete field of sandalwood trees can be protected successfully.**

Keywords- Sandalwood trees, Bluetooth 4.0, Master Node, Slave Node, Cluster architecture and Distributed architecture.

I. INTRODUCTION

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. The report of Institute Wood Science and Technology [1] says that, current price of heartwood is INR 3500-5000/Kg in India, but the international price is nearly INR 100,000/Kg which is 20% higher than in India. Apart from being a source of aromatic fragrance, sandalwood is also one of the leading ingredients in medicines due to its antiseptic and anti-inflammatory properties. The other properties of sandalwood that add medicinal value include – hypotensive, sedative, carminative and diuretic. It helps in curing diseases such as fever, gastrointestinal diseases and skin diseases. Because of its medicinal value, sandalwood has been used in Ayurveda for treating ailments.

Other sandalwood products such as bathing soaps, perfumes, idols and mementos, fragrance sticks, beauty oils, creams and powders are world famous even today. Indian sandalwood oil was a prime source of foreign exchange in the 1970s and 1980s [2], and this led to the indiscriminate felling of sandalwood trees and sandalwood smugglers started emerging in India and other parts of the world. Protection of sandalwood trees has become a major responsibility of the Government today as the trees can soon become extinct with the increased number of sandalwood smugglers. The model proposed in this paper attempts to reduce the act of unauthorised axing by alerting the concerned person(s), as soon as the sandalwood trees are under threat. Section 2 discusses the solutions that are available for protecting sandalwood trees and the related technical background. Section 3 explains the proposed system and the two architectures used in implementing the model. Section 4 describes details about implementation and section 5 gives conclusion and future scope.

II. LITERATURE SURVEY

Sandalwood trees are axed and stolen for commercial purposes since hundreds of years. To curb the act of stealing sandalwood trees, government of India has drafted a bill [3], which reduces the illegal usage of sandalwood trees by penalising those who commit this crime. The article by S.M.C.U.P. Subasinghe [4], emphasizes on how the Sri Lankan government has taken precautionary measures by adding sandalwood tree to the list of the protected flora and fauna, thus, preventing its extinction. Since the sandalwood trees have low natural germination, the illegal harvesting has become a more serious threat to the government. The paper highlights the effects of the different seed treatments on germination, effects of seed storage on germination and effects of seedling host on initial growth of the tree. The result of different seed treatments showed that by using gibberllic acid (GA) the effect on germination was high. The result of seed storage showed that after 20th week both water and GA resulted in same amount of germination. Lastly, the result of seedling host on initial growth showed that, Alternanthera species as a host was found to be the best host to grow up in seedling stage. The main experiment was done at the Badulla-Welimada region of Uva province of Sri Lanka, as the region contains high concentration of sandalwood trees. According to ACIAR Technical report [5], 75% of Republic of Vanuatu is covered with natural vegetation, and the main source of revenue is exporting timber and agricultural products. As sandalwood adds more value to the revenue, illegal sandalwood growers increased. A committee was formed which makes people aware of the importance of the sandalwood tree and educates them on generating legal revenue out of it. This report does not emphasise on the issue of illegal growth of sandalwood trees. The concepts in the papers [4][5][10][11] do not address the problem of protecting sandalwood trees.

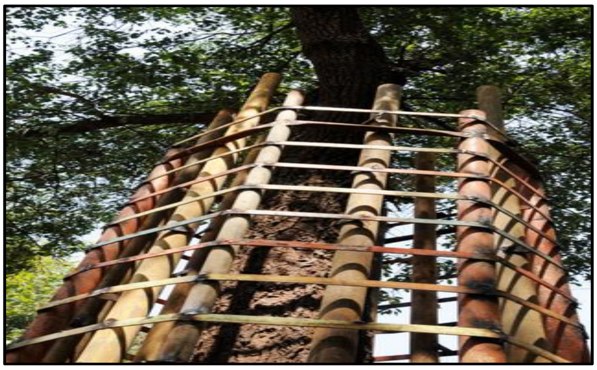

Fig.1. Iron fencing around sandalwood tree for protection against axing.

“Internet of things” (IoT) is the phrase coined given by Kevin Ashton who is also called as father of IoT [6]. The applications of IoT coupled with the latest technologies are in huge demand today. Since these type of implementations are not only stipulated to some group of applications, but are also widely used in every technical field today. The beauty of such applications is that, the remotely sensed data can be uploaded to the central database for further analysis. It is arduous to connect all the IPv6 based wireless sensor nodes to the current IP based networks [7]. According to this communication letter, Internet Engineering Task Force (IETF) has to come up with standards that help IPv6 based devices to connect to the current IP based networks. The applications should be implemented in adherence to the standards laid down by IEFT for IoT applications. In India, the department of forestry has taken many precautionary measures for preventing the sandalwood robbery. According to The Hindu report [8], in Tamil Nadu, the corporation has erected iron tree-guards for several sandalwood trees so that the robbers find it difficult to cut the trees. But forest officers have expressed scepticism about how effective this protection measure will be. Figure 1 shows iron guards around a sandalwood tree.

The IEEE standard for Bluetooth is 802.15.1 [9], which belongs to the family of 802.15. The 802.15 IEEE Standard is meant for Wireless Personal Area Network (WPAN) which not only sticks to Bluetooth, but also covers most of the personal area networks [9] such as body area network, smart utility, RFID, high rate and low rate PAN such as ZigBee, 6LoWPAN, WirelessHART and visible light communication. Bluetooth uses a technology called frequency-hopping spread spectrum [9]. It makes use of 79 channels dedicated to transfer the packets. Version 4.0 of Bluetooth is called as Bluetooth Smart, as it includes the basic Bluetooth, high speed and low energy protocols. Version 4.1 is a software update of version 4.0. The characteristics of version 4.0 offer IoT support and flexible connectivity. Version 4.0 comes with a coin cell of 2V and runs for a duration of about a year. Other characteristics include low cost chips, easy integration with devices and reliable point-to-multipoint data transfer with advanced and secure encrypted connections at the lowest possible cost. Till now the power saving applications were implemented either using Wi-Fi, ZigBee or lower version of Bluetooth. The cost of power consumption is more for Wi-Fi and ZigBee as compared to Bluetooth 4.0. Also, the solutions need to be monitored on a regular basis for its correct operation.

III. ARCHITECTURE OF THE PROPOSED SYSTEM

The sandalwood protection mechanism proposed in this paper can be implemented using the following two types of architectures:

A. Cluster Architecture

The working of the cluster architecture is shown in figure 2. It is a master-slave architecture in which each tree is treated as a slave node. The mobile phone installed at the centre of the field acts as a master node. The master node is installed in a safe zone so that it is not easily visible. The master node monitors all slave nodes continuously and sends an alert to the owners whenever it loses contact with any of the slaves. Another important responsibility of master node is to log the health details such as connection status of each slave node. All slave nodes are equipped with a protection circuit that communicates with the master node. Bluetooth 4.0 is used for communication between the master node and slave nodes. It has a communication range of 200 meters and all slave nodes and the master are within a closed loop of 200 meters in the field as shown in figure 2.

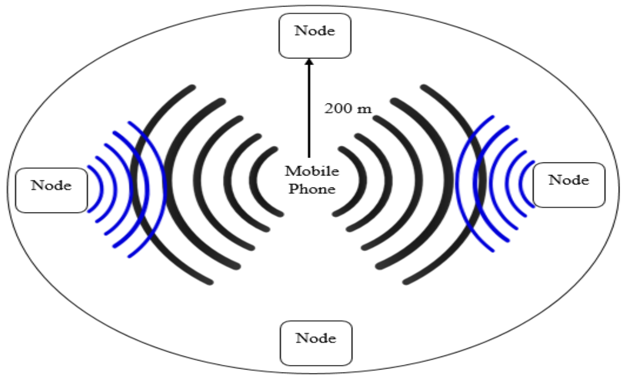

Fig 2. Cluster architecture.

B. Distributed Architecture

Figure 3 gives an overview of the distributed architecture. It is a collection of clusters described in cluster architecture. For a particular master node, the other master nodes act as slaves. The master present in each cluster collects and stores the status of their slave nodes periodically. The log details stored in the master node of each cluster are then updated in the central database (cloud). This data can be accessed by all the authorised users for the purpose of monitoring, planning and analysis. The main aim of implementing the distributed architecture is to protect the entire field of sandalwood trees spread over several acres. All the master nodes are under continuous monitoring which protects the master nodes from being stolen or damaged.

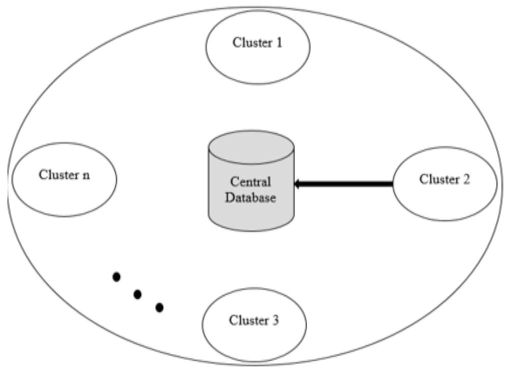

Figure 3: Distributed Architecture.

IV. IMPLEMENTATION OF THE PROPOSED SYSTEM

As described in section II, there are papers that give information about sandalwood trees and its usages, but none of the papers gives any idea about their protection. The proposed system offers a cost effective solution for protecting sandalwood trees from being robbed. It is a common practice followed by the farmers to grow sandalwood trees in the farms away from their homes, and it becomes difficult to continuously safeguard the trees. The proposed protection system makes use of Bluetooth and GSM to alert the sandalwood owners (or concerned authorities) in case of sandalwood robbery. The model is implemented and installed in such a way that the owners get an immediate alert on their mobile phones when the trees are being axed by robbers. The system also alerts the authorities when the protection model itself is destroyed by the robbers. It consists of two parts; protection circuit and the mobile application.

A. **Protection Circuit:**

This circuit consists of Bluetooth 4.0 SoC (System on Chip) which is programmed to serve the functions of a slave node and powered by a 3V battery. It helps the slave node to synchronise with the master with the help of a beacon signal. This circuit is installed on top of the tree and a thin conducting wire runs from one end of the circuit to cover the entire length of the tree trunk. This circuit gets disconnected when the conducting wire is cut while axing the tree. As a result the slave node loses contact with the master node. The conducting wire may get tampered due to abrasion caused by the wild animals. To avoid this the tree trunk can be covered by iron guards as shown in figure 1. Figure 4 shows the protection circuit installed on slaves. Figure 5 shows a disconnected protection circuit.

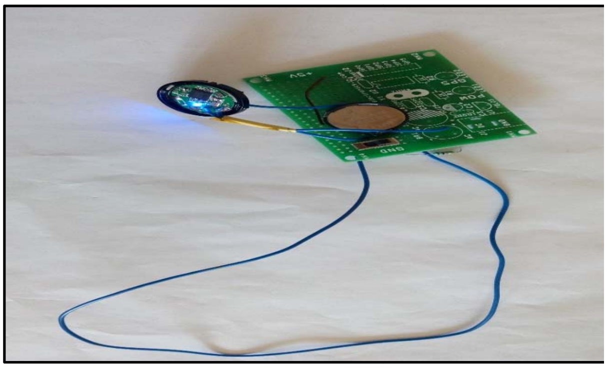

Fig 4. Protection Circuit designed for protecting sandalwood trees

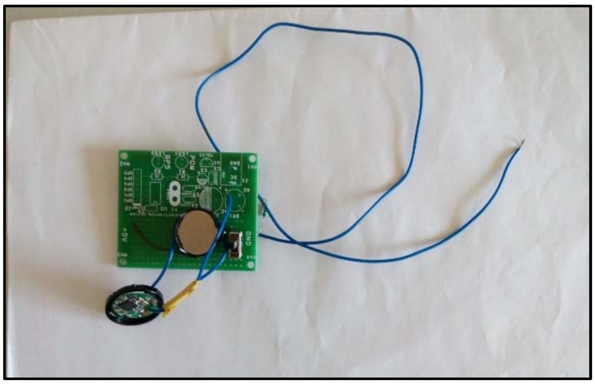

Fig 5. Disconnected protection circuit that raises an alarm indicating threat to sandalwood trees.

Figures 6 show the real-time installation of the protection circuit on the sandalwood tree long with the conducting wire. Figure 7 shows the conducting wire being cut when the tree is axed by the robbers.

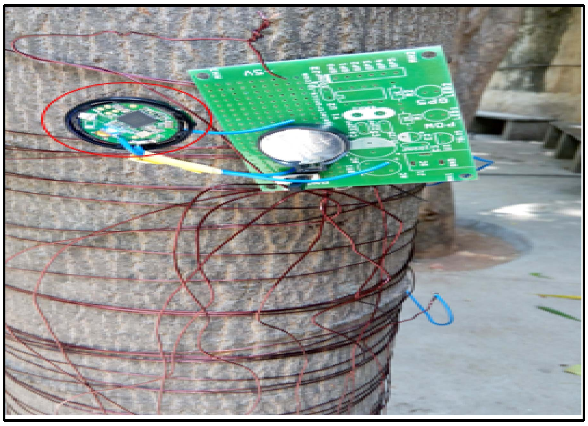

Fig 6. Protection circuit installed on sandalwood tree.

Fig 7. Protection circuit being disconnected due to axing.

B. Mobile Application:

This is an android application installed in every master node and manages the monitoring of all slave nodes. The settings options provided by this application helps to configure the master node and assign slave nodes to it. Figure 8 shows the settings tab that configures the slave nodes. The various options included are alert setting, phone alert, alarm duration and alarm tone. Alarm settings configures the number of times it rings. If phone alert option is on, the owner is notified with the help of a phone call. The duration of the alarm and the type of tone can also be selected. With the help of the master application it is also possible to locate the slave nodes on the maps and know its status such as connected or disconnected. This status screen is shown in figure 9.

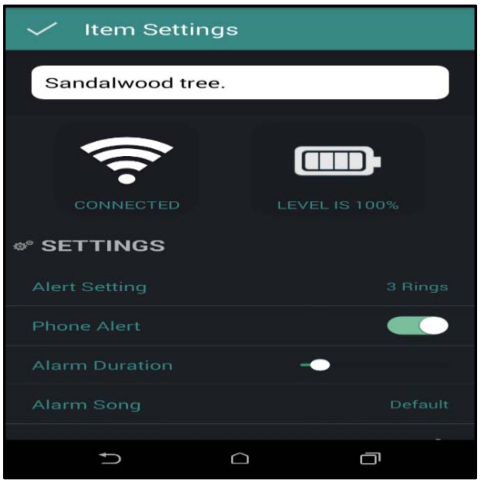

Fig 8. Settings provided by mobile application.

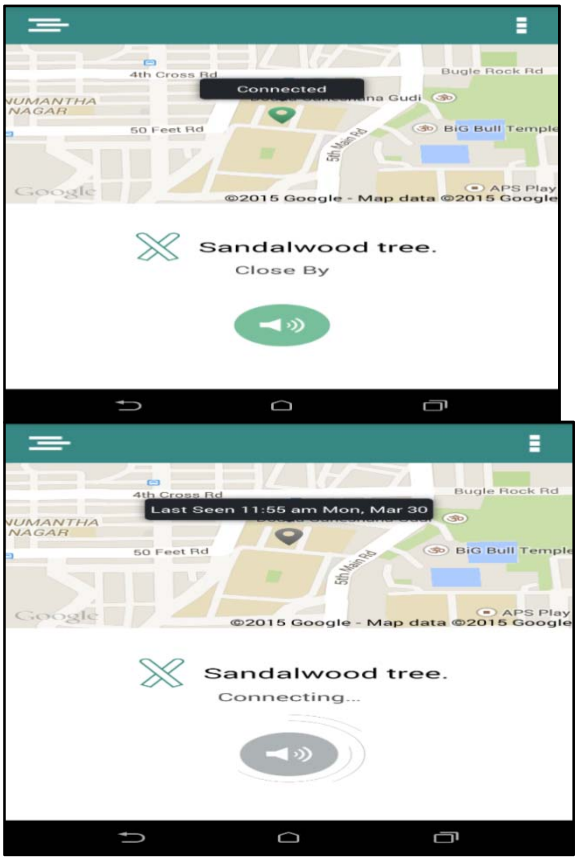

Fig 9. Master application showing the status of slave nodes.

The master node stores this status information into its log, which is then uploaded to the central database in case of distributed architecture as shown in figure 3. When the master node loses contact with any of the slave nodes, the master mobile application sends an alert message to the owner or the concerned authority. An alert is sent even in cases when the protection circuit on the slave is damaged with the intension of robbing the trees. The screenshot of this alert message is shown in figure 10.

Fig 10. Message indicating that there is threat to the sandalwood trees

V. CONCLUSIONS AND FURTHER ENHANCEMENTS

The protection model proposed in this paper provides a power efficient and a cost effective solution for protecting sandalwood trees. Depending on the area of sandalwood field, either cluster architecture or distributed architecture can be implemented to assure protection. The use of Bluetooth 4.0 for monitoring and communication purposes has led to a durable and energy efficient model. With this type of protection model, it is possible to reduce illegal cutting of sandalwood trees and thus preserve the valuable natural resources. The proposed system sends alerts in general and does not consider to mention the cluster to which the tree belongs. It can be extended to include the cluster identification number and its geographic location, so that it becomes easier for the concerned authorities to reach the exact location and take necessary actions.

REFERENCES

[1] *Technology Package for Raising Sandal Plantations from Quality Planting Material (QPM) Stock of Sandalwood Seedlings,* Available Online: http://forum.icfre.org/admin/sliderFile/15_Tech_Package_QPM.pdf, Accessed: 02-04-2015.

[2] *Indian sandalwood production set to lose home ground edge*, Available Online: http://www.livemint.com/Home-Page/BDsfOQH2DCWR5ikaMVlaqI/Indian-sandalwood-production-set-to-lose-home-ground-edge.html. Accessed: 03-04-2015

[3] *DRAFT ALL INDIA POLICY FOR CONTROLLING SANDALWOOD/RED SANDERS SMUGGLING,* Available Online: http://iwst.icfre.gov.in/database/Redsanders/survey/rules/AP%20SWPolicy.pdf. Accessed: 25-03-2015

[4] S.M.C.U.P. Subasinghe "Restoration of Santalum album L Resource in Sri Lanka: Distribution, Seed Storage, Germination and Establishment", *Journal of Department of Wildlife Conservation*, pp. 155-164, 2014.

[5] Tony Page, Hanington Tate, Colin Bunt, Anna Potrawiak and Alick Berry, "Opportunities for the smallholder sandalwood industry in Vanuatu" Australian Centre for International Agriculture Research (ACIAR) Technical report, ISBN: 978 1 921962 63 9 (online), 2012.

[6] K. Ashton, "That 'Internet of Things' thing", *RFID Journal*., pp. 97–114, 2009.

[7] Zhengguo Sheng, Shusen Yang, Yifan Yu, Athanasios V. Vasilkos, Julie A. Mccann And Kin K. Leung "A Survey On The IETF Protocol Suite For The Internet Of Things: Standards, Challenges, And Opportunities" , IEEE Wireless Communications, pp. 91-98, 2013.

[8] *Iron guards to protect sandalwood trees,* Available Online: http://www.thehindu.com/todays-paper/tp-national/tp-tamilnadu/iron-guards-to-protect sandalwood-trees/article6403189.ece, Accessed: 03-04-2015.

[9] IEEE Std 802.15.1^{TM}-2005, pp. 1-580, Print ISBN 0-7381-4707-9 SH95323, IEEE Computer Society, http://standards.ieee.org/.

[10] Joha A. Stankovic, "Research Directions for the Internet of Things", IEEE Internet of things Journal, Vol. 1, No 1, pp. 3-9, 2014.

[11] Dede Rohadi, Retno Maryani, Made Widyana and Irdez Azhar, Reoprt on "A case study of the production-to-consumption system of sandalwood (Santalum album) in South Central Timor, Indonesia.", chapter 12, pp. 183-202, 2010.

[12] Yaw-Jen Lin, Heng-Shuen Chen , Mei-Ju Su, "A Cloud Based Bluetooth Low Energy Tracking System for Dementia Patients", In Proceedings of *IEEE International Conference on Mobile Computing and Ubiquitous Networking*, pp. 88-89, 2015.