Prevention of Theft of Sandalwood trees using IOT and Arduino

Ketaki Vinod Patil, Chakka Sai Abhishek

Abstract: ***With the advancement in the technology and increasing dependency of humans on smart devices, with the rising concern for security systems available to the society in day to day life, it has become very important to have a technology which can monitor and protect the green cover in our society using IOT. Our paper 'Prevention of Theft of Sandalwood trees using IOT and Arduino deals with embedded technologies which incorporates the inbuilt structure and script code for Arduino in this paper we present an efficient solution to safeguard sandalwood trees which are the pride of our society. The sensors used here are connected with Arduino. The safety statistics of sandalwood trees is continuously synced with cloud storage using the wireless module which can be monitored easily by the concerned forest official who can also enable and disable the sensors. The accelerometer depends on the vibrations to control the signals. Our proposed system will link the leading technology to bring the features of security to completely safeguard our precious Sandalwood trees present in our environment.***

Index Terms*: Arduino, vibrational sensors (embedded accelerometer), microwave transmission, Internet of Things (IOT), Global positioning System (GPS)*.

I. INTRODUCTION

Today, the expansion sought after of administration over the web required the information accumulation and trade in effective way. In this sense web of things (IOT) has guaranteed the capacity to give the proficient information stockpiling and trade by associating the physical gadgets by means of electronic sensor and web. The IOT has made a revolution throughout the world and fascinatingly it has turned out to be essential piece of life. Thus, this paper uses Arduino [1] essentials and some sensor to facilitate the manner in which we screen the safety of the Sandalwood trees. This is done by connecting sensors like flex sensor, accelerometer, microcontroller-based system like Arduino SW 420. The values from the sensors and the data collected will be seen on the cloud platform [11].

According to India Today report, an estimated of 100 – 150 Sandalwood trees are being lost in just Karnataka by uncertain means which counts a huge loss in crores of Indian rupees.

This project uses Internet of Things (IOT) as a solution to the problem of Theft of sandalwood trees using present day technologies and also upcoming technologies like Global Positioning System (GPS) [3]. The main project behind this is to develop a nonintrusive system which can detect any illegal activity and issue a warning to alert the forest officials which reduces the risk of a catastrophic damage. The development of technologies for preventing this fatigue is a major challenge. To prevent the theft of the Sandalwood Trees, we try to install the sensors in every tree and detect any unusual rise in the frequency of vibrations [7] which will be stored in the cloud [16] and can be accessed easily by the forest officials. For the communication of mobile and email with the vibrational sensor[7], the concept of IOT comes into the picture, there is a system of physical gadgets which are installed with hardware, programming, sensors, actuators, and availability empowering these articles to associate and trade information which helps in efficient monitoring facilities and provides a reliable security system[8].

Section II throws light on the problem statement which inspires to design the solution through this paper, Section III is about the detailed specifications and functionalities of the components used, section IV gives a brief description on the methodology used and Section V, VI gives about the results and discussions and Section VII discusses on the conclusion and future scope.

II. PROBLEM FORMULATION

Theft of Sandalwood trees have been a major issue for our country which leads to loss of our precious forest green cover. Studies shows that the number of sandalwood trees lost due to inhuman activities is increasing year by year making safety of the sandalwood trees a major concern. Neglecting the forest green cover and no proper monitoring and safety measures [13] implemented is one of the major causes of theft in which the government official's lack of concentration have led to fatigue. Internet of Things (IoT) coupled with Sensors, Arduino [2]

Revised Manuscript Received on April 24, 2019

Chakka Sai Abhishek, Information Science Engineering, RNS Institute of Technology, Bangalore, India.
Ketaki Vinod Patil, Information Science Engineering, RNS Institute of Technology, Bangalore, India.

concepts, aims to minimize the thefts of the sandalwood tree that occurs in our country and to increase the life span of the trees which helps the environment and richness of the forest monitoring and safety measures [13] implemented is one of the major causes of theft in which the government official's lack of concentration have led to fatigue. Internet of Things (IoT) coupled with Sensors, Arduino [2] concepts, aims to minimize the thefts of the sandalwood tree that occurs in our country and to increase the life span of the trees which helps the environment and richness of the forest development in our country. This proposed System is designed to reduce any type of illegal activities on the sandalwood trees.

III. COMPONENTS USED

Embedded Accelerometer, Addressable sounder base – 3379 alarming device, vibrational sensor [15] SW 420, ESP WIFI sensing module for IOT, GPS receiver module[4], microwave transmission, Horus software for alarm monitoring, Arduino SW 420 interface, ESP 8266 flash and node MCU firmware, cloud software for storage.

i. Embedded accelerometer

Figure 1. Accelerometer

This accelerometer is used to provide the user with a continuous vibrational output that is generated usually as a 4-20mA signal. Changes in the monitor signal will allow the user to spot vibration changes in the part of the tree to which the sensor is attached, such conditions include hitting the tree, trying to damage the tree. The vibrations are further sent to the portable vibration analyzer [15] which stores the threshold vibrational frequencies that are used for comparison against the obtained vibrational frequency. This requires immediate attention and alerting the forest officials to take preventive measure and required actions for preserving precious Sandalwood.

The accelerometer is capable of sensing any type of vibrations which is made of on the sandalwood tree. This device plays a main role in our idea which helps to safeguard the green cover in the society.

ii. Addressable sounder base 3379

Figure 2. Addressable sounder base

This is used for installing an alarm device which is used to raise the necessary sound that alerts the officers. After the applications of the accelerometer here there are three different sound or priority levels which are connected directly on the COM loop Programmed for any kind of trigger condition this is tested and approved according to EN54-3 and VdS approval: G210028 , CPR: 0786-CPR-20954 approved.

iii. SW – 420 Vibrational Sensor Arduino interface

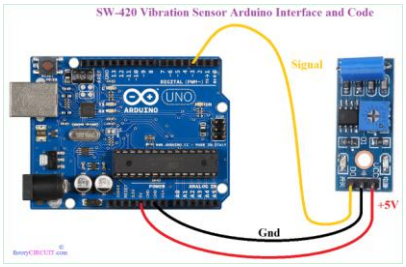


Figure 3. Vibrational Sensor interfaced with Arduino

Any uncertain activity on the Sandalwood tree can create vibrations which can be measured by the Vibration level but sensing vibration accurately is a difficult job. This particular instrument gives the importance about vibration sensor SW-420 and Arduino [2] interface. This electronic instrument helps you in constructing hassle free measurement for vibrations produced. This sensor SW-420 has integrated circuit component which has the comparator LM 393 and a potentiometer for calculating the sensitivity and another LED is used for signal indication. Whenever any force or external energy greater than the threshold energy is exerted it calculates the vibrations generate. The output given by this device depends on the vibrations exerted on the Sandalwood tree, it gives a high amount in the output if the vibrations are exerted more or else low output is generated.

iv. ESP8266 Wi-Fi Module

Figure 4. Wi-Fi Module

This electronic device is made up of 32 bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz. This electronic device is used to transmit the signals in long distances, it has External flash memory that is capable of processing with various signals that helps in transmitting the signals to wider horizons. This device is used as an endpoint

communication between the government office and the location of the tree.

v. GPS Module

Figure 5. GPS Module

Global **P**ositioning **S**ystem (GPS) [3] is a satellite-based framework that utilizations satellites and ground stations to quantify and register its situation on Earth. These GPS satellites [6] transmit data signal over radio frequency (1.1 to 1.5 GHz) to the (recipient) forest officials, With the assistance of this got data, a ground station or GPS module can figure its position which in turn gives the position of the tree which is under damage by the attacker. This system lets the forest officials to easily track the position of the sandalwood tree in a particular region.

Vi . Microwave Transmission Devices

Microwave radio, a type of radio transmission that utilizes ultra-high frequencies which are used to transmit the data in long distance which are easily reachable from the trees to the forest department office. Microwave offers considerable data transfer capacity, frequently more than 6 Gbps. This can be deployed for very large distance covering areas which helps the signals to easily reach every corner in the forest.

vii. Horus Software

Horus is an alarming software which is used to process real time inputs and deliver and produce alarming signals which can be modernized with various options to enhance the securing options. This software also provides us GPS [12] support and provides various handling methods for alarming modules.

viii. ESP8266 flash and NodeMCU firmware

Figure 6. Node MCU Firmware

NodeMCU is an open source IoT stage [19]. It incorporates firmware which keeps running on the ESP8266 Wi-Fi[7] and equipment which depends on the ESP-12 module. The firmware utilizes the Lua scripting language. This is a low cost WIFI microchip which are used in TCP/IP stack and microcontroller, this efficiently produces the WIFI signals [9] which is used to send the signals.

IV. METHODOLOGY

The whole implementation of our idea would be more integrated and concentrated in every part of the forest to give micro level protection. The entire forest area consisting of our rich sandalwood tree regions are divided into sub areas. These sub areas will have equal amount of area and all the sub areas are under the control of the forest department office which is present in that area. Each subarea is further divided into sectors covering equal number of sandalwood trees in each sector which helps in easy monitoring of the regions. Each tree is installed with a vibrational sensor(accelerometer) which is fixed firmly and can withstand any amount of vibrations produced.

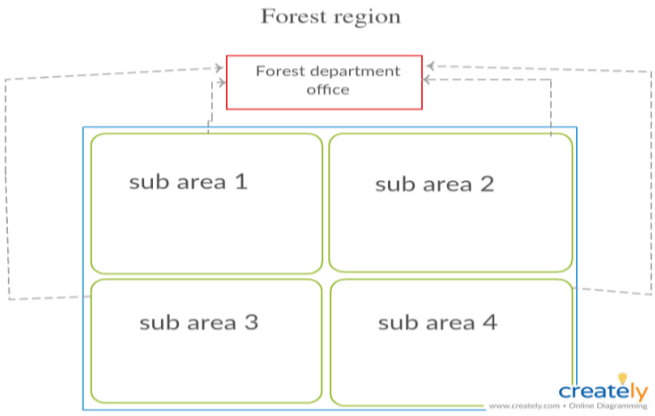
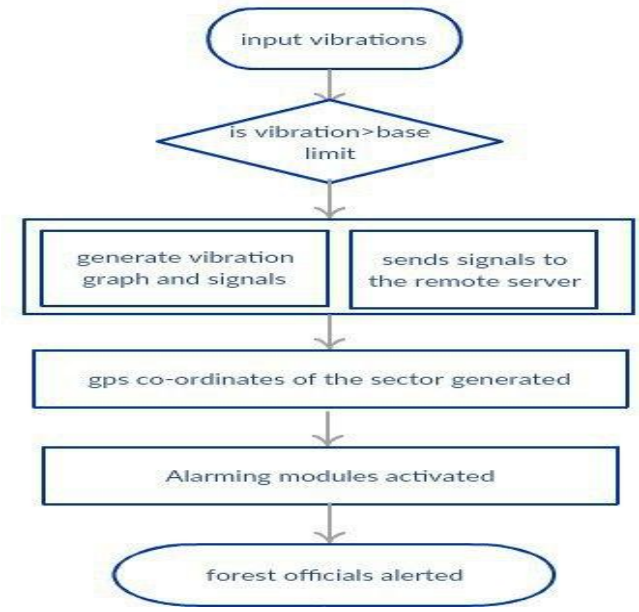


Figure 7 Area Partition Diagram

Initially the vibrations are obtained from the sensors when there is no external pressure applied on the tree. These vibrations are fed as threshold to the system. Each sector has one alarming module, GPS modules [3] implemented and a vibrational analyzer which alerts the concerned officials.

During any activities performed on the trees like trees being cut by an axe or using machines, in such type of situation there will be huge amount of vibrations produced which is greater than the usual limit(threshold). It can be detected immediately by the vibrational sensor (accelerometer) which constantly notes down the frequency and can plotted in a graphical way. The uncertain rise in the frequency of vibrations is monitored and immediate signals are sent through the WIFI module to bring it to the notice of the forest officials.

So here this complete methodology setup wouldn't cost more if we compare the loss of the of sandalwood in our regions in forests. Our proposed methodology will be effective and efficient in many ways. We have presented a detailed way of the flowchart of this theory below.



Simultaneously signals are sent to the alarming module which produces sounds that are heard from a far distance also. GPS modules calculates the co-ordinates of the location from where the signals were generated. Here we try to interface the GPS with the arduino[17]. Satellites transmit three bits of information then the GPS receiver captures these signals, GPS receiver uses this to find out the exact distance between the place and the GPS satellites[18]. When the signals are collected from three or four, then the GPS receiver can calculate it's distance where both latitude and longitude are calculated. GPS receiver can also determine the 3D position which includes the coordinates of latitude, longitude and elevation and also with the help of a certain code, we can interface the GPS module system [12] with Arduino [10] the equation to find the distance between the satellite and GPS receiver is

$$d_i = \sqrt{(x - x_i)^2 + (y - y_i)^2 + (z - z_i)^2}$$

The above equation represents the basic distance equation which the GPS module uses. With the co-ordinates received to the government officials, the latitude, longitude can immediately access the position by searching those co-ordinates in any geographical map analyzing application. Upon receiving the co-ordinates, the officials can easily reach the sub area in the forest and can take appropriate actions to safeguard the sandalwood trees. The officials have complete authority to view the data stored in the cloud storage [5], they can anytime have the permission to enable or disable the sensors in a particular tree.

V. Results and Discussion

When there is any situation of theft of Sandalwood trees there will be few vibration measurements made, or frequency analyses are performed, this gets stored immediately in the cloud storage for accessing where the officials can detect the rise in the sudden graph which gets noted suddenly. A digital recorder is used which will capture the vibrations and generate the signals. This plotting of values is generated and can be seen as shown below:

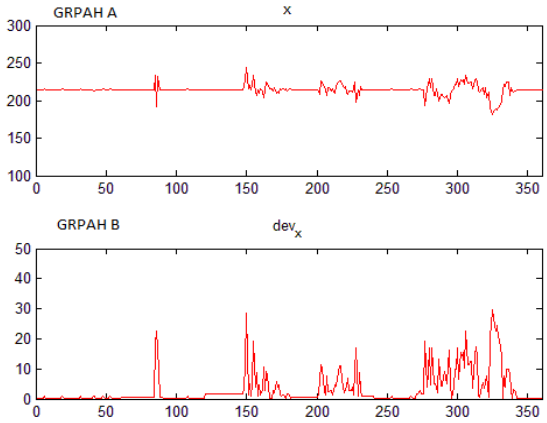


Figure 9. Graphical Plotting of Vibrations

In the above graphs,we can see that Graph A depicts plotting of the accelerometer when there is no external force is applied, Graph B shows that it has a huge increase in the vibrations when external force applied on the tress which immediately alerts the remote vibrational analyzer by sending signals. The equation for motion in an accelerometer is given by:

$$m\ddot{\eta} + c_v\dot{\eta} + k\eta = -m\ddot{y}_{object}$$

The remote vibrational analyzer after receiving the signals from the particular sector which has the tree prone to theft or any illegal activity, this remote vibrational analyzer will generate a gps co-ordinates[6], it uses 4 satelites which is used to find the geographical position (latitude, longitude, and time) GPS reciever will convert the received signals into position and transmits to the governement officials which can be tracked easily. The co-ordinates recived to the governement officials are in the form of :

```
Location:   6.849861,75.817466
Location:   6.849861,75.817466
Location:   6.849861,75.817466
```

Using these co-ordinates the officials can track the spot easily by any application software. After sensing the increase in the graph the alarming module, i.e the addessable sounder base will increase the volume on more the vibrations produced. Genral tabulation of the alarming module is shown below:

Sound No	Type of the sound DIP SW 1,2,3,4,5	Activation mode	Nominal frequency	Frequency of the activation mode
1	On,On,On,On,On	Sequence	554/440	2Hz (100mS/400mS)
2	Off,On,On,On,On	Sequence	800/970	1Hz
3	On,Off,On,On,On	Sequence	800/970	2Hz
4*	Off,Off,On,On,On	Increasing ring	2400-2850	1Hz
5*	On,On,Off,On,On	Increasing ring	2400-2850	1Hz
6*	Off,On,Off,On,On	Increasing ring	2400-2850	1Hz
7	On,Off,Off,On,On	Sequence	660	

On increasing sounds generated by the sounder base the government officials can easily reach the location based on the co-ordinates received also.

CONCLUSION AND FUTURE SCOPE

Theft of Sandalwood tree has been a primary issue and with this proposed idea we can save huge number of sandalwood trees from any type of illegal activities which gives the utmost safety features. Here we incorporated the process to its best efficiency which can be easily monitored and tracked by the officials.

We can enhance this project by implementing advanced procedures like linking the mobile applications for tracking and receiving the notifications of the anomaly detected. This can be portable and handy which reduces efforts in monitoring using standalone computer.

REFERENCES

1. M. Banzi, “Getting Started with arduino", O'Reilly Media, Inc., 2009 .
2. Nawrath, Martin ”Arduino Frequency Counter Library” Laboratory for Experimental Computer Science at the Academy of Media Arts Cologne Germany.
3. Yanbo Zhao, Zhaohui Ye, "A low cost GSM/GPRS based wireless home security system", *IEEE Transactions on Consumer Electronics*, vol. 54, no. 2, 2008.
4. Global Positioning System: Signals, Measurements and Performance By Pratap Misra and Per Enge and GPS Positioning Guide Geodetic Survey Division, Natural Resources Canada, 1993.
5. Andrews,A.,P.,Weill, L.R.,and Grewal,S.G.(2007). Global Positioning System Inertial Navigation, and Integration. John Wiley&Sons.
6. Parkinson,B.W., and Spilker.j.j.eds.(1996). Global Positioning System: Theory and Practice. Volume I and II. Washington, DC: American Institute of Aeronautics and Astronautics, Inc
7. D.L.S. Andres, “Application of Vibrational Sensor”, pp.1-18, 2012.
8. J. Carlson, B.Creighton, D.Meyer, J.Montgomery, and A.Reiter, “White Paper on Internet Of Things: Security Research Study”, 2014.
9. CISCO, “802. 11ac: The Fifth Generation Of Wi-Fi”, Cisco Public Inf., no.march, pp. 1-25, 2014.
10. S. Deepika and M.N. Angeline, “Security Management For Controlling Theft Using Arduino Uno” , vol.3, pp. 101-106, 2017.
11. M.Lakshmi neelima and M.Padma, “A Study On Cloud Storage”, Int. J. Comput. Sci. Mob. Comput,. Vol.35, no. 5 pp.966-971, 2014.
12. G. S. Navstar, “ Standard Positionng Service”, p. 46, 1995.
13. L. Ren and D.Ph. “ IoT Security:Problems,Challenges and Solutions”, 2015.
14. E.Team, “ESP8266 Technical Reference”, Interface,pp.1-117, 2017.
15. W.S. Technologies,”Installation Of Vibration Sensors”, vol. 1, no. 301, pp. 1-7.
16. R. A. P Rajan, “ Evolution of Cloud Storage as Cloud Comuting Infrastructure Service”, IOSR J. Comput. Eng., vol. 1 , n0.1, pp.38-45, 2012.
17. P. Dhruvajyoti and J. Debashis, “GSM Based Fire Sensor Alarm Using Arduino “, Int. J. Sci. Eng. Res., vol. 7, no. 4,pp.259-262, 2016.
18. K. A. Salim and J.M. Idrees, “Design And Implementation Of Web Based GPS-GPRS Vehicle Tracking System”, IJCSET Dec, vol.3, no. 3, pp.5343-5345, 2013.
19. K. Rose , S.Eldridge, and L. Chapin, “ The Internet Of Things: An Overview-Understanding the Issues and Challenges Of A More Connected World”, Internet Soc.m no. October, p. 80, 2015.

AUTHORS PROFILE

Ms. Ketaki Vinod Patil *is currently* pursuing her Bachelor of Technology from RNS Institute of technology, Bangalore who is completely enthusiastic in leading technologies and has attended and worked on various technical workshops and also has represented in the Computer Society Of India competitions and has bagged 2nd prize in the leading IOT innovative idea and other Machine learning themed contest. She has done 2 internships on IOT and web technology, has actively participated in hackathons. She has also been the author and took the leadership in organizing for various technical events and the department of ISE technical journal “Ityukta” from past 2 years which gives a detailed knowledge about the booming technologies and has been completely successful which has bagged more viewership than any other technical magazine in RNS Institute of Technology

Mr Chakka Sai Abhishek *who is currently* pursuing his Bachelor of Technology from RNS Institute of Technology, Bangalore has played an active role in various technical events in Bangalore and has always been energetic in learning new edge technologies which redefines the essence of innovation. He represented in various technical fests and competitions and has bagged 2nd prize in the leading IOT innovative idea and another machine learning themed contest. He has 2 internships on 2 internships in IOT and web technology and has participated in hackathons and designing events and has also took the leadership of organizing the technical events and the Department of ISE technical journal “Ityukta” from past 2 years which has been successful technical journal referred by a many students and has bagged the highest viewership than any other technical magazine in the RNS Institute of Technology