DESIGN AND IMPLEMENTATION IOT BASED FOREST MONITORING AND ILLEGAL TREE CUTTING PREVENTION SYSTEM

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ABSTRACT— *A constrained information is obtained as a result of tracking or monitoring wild animals through some traditional approaches. Large area characterization of biodiversity's prospect has been offered by remote sensing in a repeatable, systematic and spatially exhaustive manner. For effective valuation of forest resources, proficient investment, policies, and planning information and monitoring the forest sector would be more beneficial. Still, it's great difficult for preventing Red sanders, sandalwood, teak wood from deforestation. It is hard for saving trees in the forest which is a large area in spite of some advanced technologies. Even implementation be luxurious. In this paper, a system has been provided for forest monitoring and its vicinity that also includes avoidance of trafficking of trees with an IOT based WSN technology. Due to considerable vast area, it is still hard research for forest and surrounding area monitoring. And issues related to forest could be a life-threatening and inefficient even after deployment of sufficient manpower. For the prevention of forest mishaps, animal intrusion in surrounding areas, and illegal activities, a WSN based on IoT has been attempted which also eliminates manual power to a higher extent.*

I. INTRODUCTION

Significant damage has been caused to human and natural resources due to an uncontrolled forest fire or wildfire. Massive destruction is resulted due to a forest fire which spreads rapidly by a small ignition. Extreme hot and arid weather, severe drought, lightning and unawareness of humans are some major reasons for a forest fire. There was enormous destruction in the forest over the past decades and most of them caused due to forest fires. More than 50% of forest area is fire-prone and its obtained from India's forest data. Based upon forest records, Occasional fires caused 54.4% damage to the forest area, a moderate fire caused 7.49%, high incidence to 2.405% and 35.71% to some real significance. More than 558 forest fires occurred in India during the period of Jan 2019 to February 2019. In May 2016 3.5k hectares of forest land have been damaged by a forest fire that swallowed lives of seven humans and to many flora and fauna at Uttarakhand. The state across California was burned by a wildfire in 2015 where 893k acres of land were burned. The fire breakout at Vastmanland at 2014, august killed 2 people and caused a severe injury for 20. From all the above surveys it has been understood that there is no fire prevention system for protecting forest area. There is no automatic system to stop fire for most of the forest department. For reaching disaster point it takes a lot of time for the fire service. For fire detection and alert corresponding department, a system is required to take precautions or action before getting break out.

In forest prevention organizations it has become a great concern for preventing and monitoring forest fire and deforestation. Long-distance video monitoring, watching tower, ground patrolling, satellite monitoring and aerial patrolling are some of the traditional methods for forest fire and deforestation prevention methods. Due to unsatisfied monitoring results, material labor, and financial resources, these conventional methods are limited to their application.

Forest is been considered a major source of water supplies in the form of rivers, waterfalls and for the huge extent of biodiversity, pharmaceuticals and helps for rain, flood prevention, and poverty eradication. In recent studies on illegal logging estimates, 50-90percentage of key producers are forest in tropical countries and globally it comes around 15-30 percentage. There are so many forest fire prevention methods like some artificial way of looking, fire-watch, satellite monitoring, forest aircraft, and some automatic forest fire warning system. There are several challenges on currently used systems on monitoring logging activities, trees trafficking and forest fire based in remote sensing and satellite images. In the past 15 years, the groundwater level has been significantly reduced due to excess consumption of groundwater. So as a contribution to our upcoming generation we should be wise on using each and every drop of water. For renewable sources of energy, some new techniques should be invented. Thus the prototype detects smoke or forest fire and tree cutting action and the data are collected and processed in the microcontroller used then transferred over the network. This prototype of forest monitoring system increases forest security of fire and deforestation by the trafficking of valuable trees like teak sandals, red sanders, etc.

For forest fire detection, an alert system, also reduces illegal cutting of trees that leads to deforestation that helps for detecting fire and preventing the forest from disaster and to save valuable human life and their future. Fire symptoms and tree cutting have been detected by several sensors. Placing these sensors in the right place is the major part of a successful system. And these locations are estimated by several surveys and after placing sensors at the right place they will be activated. Similar to sensors controllers are placed and data collected from sensors reach the corresponding microcontroller. Data from sensors are processed and at the same time data has been transferred over

LITERATURE SURVEY

Arun Ganesh in his paper proposed a fire detection system based on satellites was depending on MODIS sent to space by NASA that captures the earth's surface and detects forest fires. But the scanning cycle is too large which is the major drawback of the system. For forest fire detection and analysis the device completely Takes two days for entire surface capturing and sending to the earth station. Due to its promising results, the system can be implemented over a large scale. To make the system to run for a longer period it can be upgraded with Zigbee of the higher version, low power elements, and a high-efficiency MPPT algorithm.

Kirubaharan proposed a system that detects fire in emergency cases and generates an alarm. It takes a very small period for the fire to get transited from one place to another. As a precaution for firing the nodes. An intermediate threshold between sensing and proximity threshold is used as a warning threshold.

Prasad.R, Deivanai, and Khadhar presented a preventive system for the forest. There was a very good plan while forming earth with its inner core and environment for a proper cycle. From the past few years increased process of cutting and smuggling of precious trees like teak, sandal, etc. since their woods are used for medical and cosmetic they are costly. In India especially in Tamil Nadu and Karnataka smuggling has become more prominent. Sandalwoods have become an endangered species.

Narhari R. Kotkar M.E [4]. Proposed an anti-smuggling system for trees in the forest using Zigbee and flex sensors. The smuggling of trees has become more prominent. Trees like sandal, teak, etc. are very costly and available in very less extent. There is a huge amount of money involved in the process. Some preventive measures are employed in saving trees. In this technique, small equipment with a microcontroller, flex sensor and Zigbee is nailed on every tree in the forest. And these flex sensors will detect cutting of trees. A server unit will be reflected in a Visual Basic front end. Communication takes through the Zigbee module. This equipment is placed in trees that are costlier like sandal, teak, and red sandal.

Harshita Jain and Abhijith H V [3] presented a paper for preventing illegal logging of trees like sandal and sagwan which is considered as one of the national issues. Since these trees are very expensive and availability is low. For avoiding cutting of these trees includes some preventive measures. A system based on IOT has been proposed here and this is should be completely taken over by the government.

II. METHODOLOGY

In this proposed system many sensors have been used for a detection forest fire, Cutting of trees, alerting animals and corresponding department for precautions. Sensors used are Flex sensor, sound sensor and vibration sensor for tree cutting detection, Temperature sensor for detecting high-temperature variations due to fire or high temperature that may lead to fire, Fire sensor for detecting fire, Smoke and gas sensor also include in detecting fire but in a very dense area where fire may not come out initially. A camera for capturing the situation, An alarm for alerting animals nearby, then a GPS for giving exact location details of the accident place, and the controller(raspberry pi) that takes control of all the devices and to transfer data collected by the sensor over the internet. These data will be analyzed by the corresponding department.

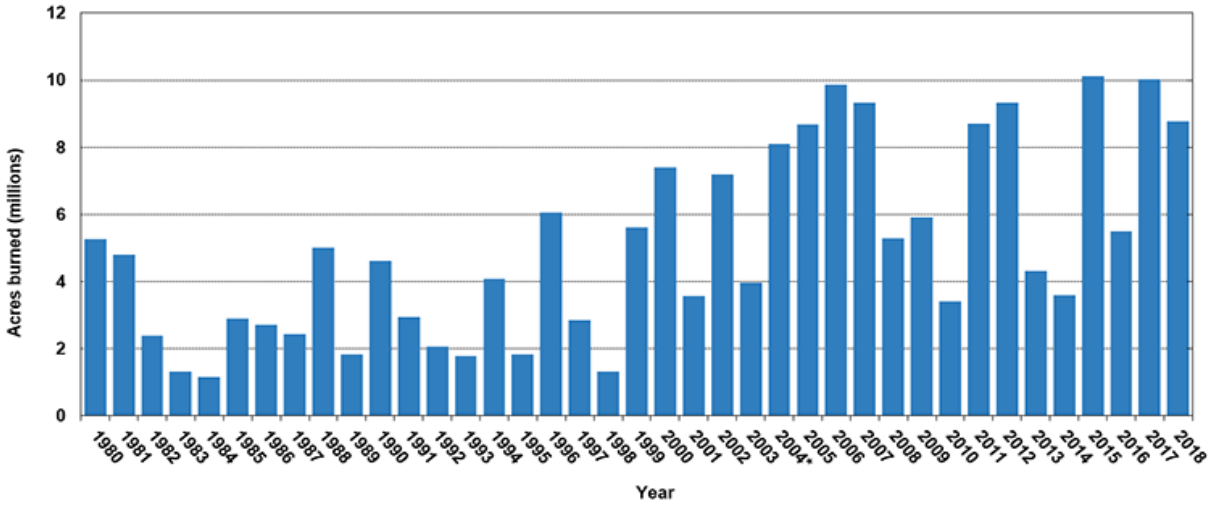

Figure1. Forest fire statistics and acres burned around world

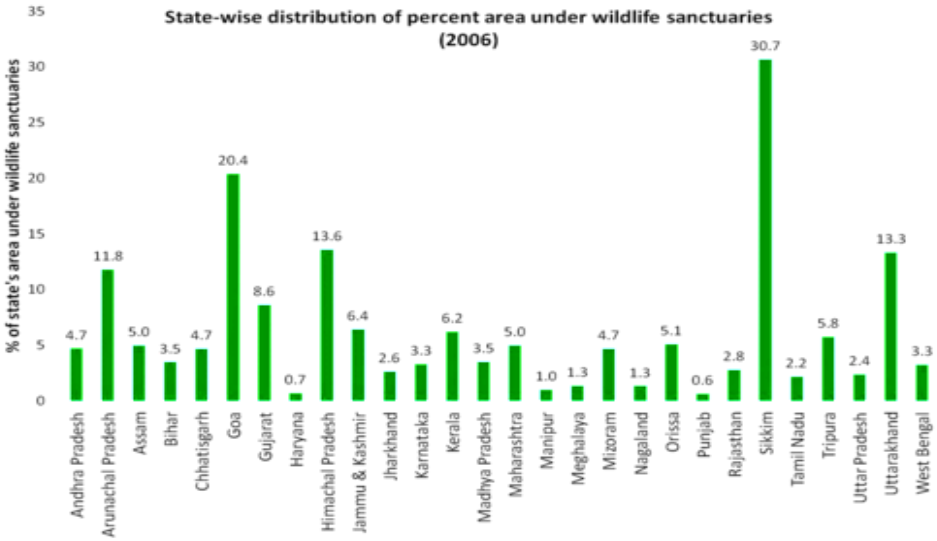

Figure 2. State-wise distribution of percent area under wildlife sanctuaries

The below figure shows the architecture of the proposed system which does all the operations of forest fire detection, communication, and tree logging avoidance. This is a small device that is nailed on trees of forest and microcontroller is placed for a group of devices. Whenever a cutting of the tree is sensed by the device then changes in the sensor data received by it have been transferred to the controller where then the data has been transferred over the network. Then the microcontroller tracks the location of the device and its ID has been transferred to the corresponding department over the web to government.

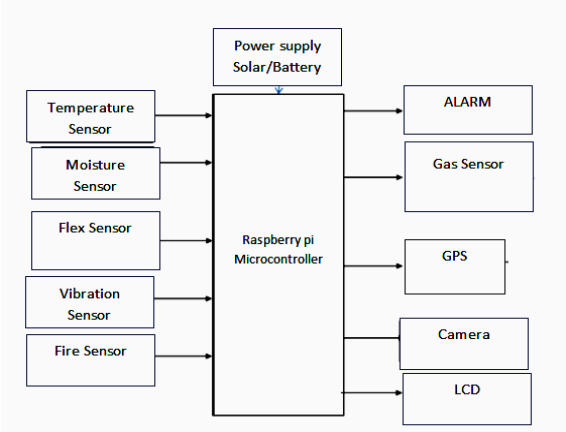

Figure 3. Architecture of the complete system

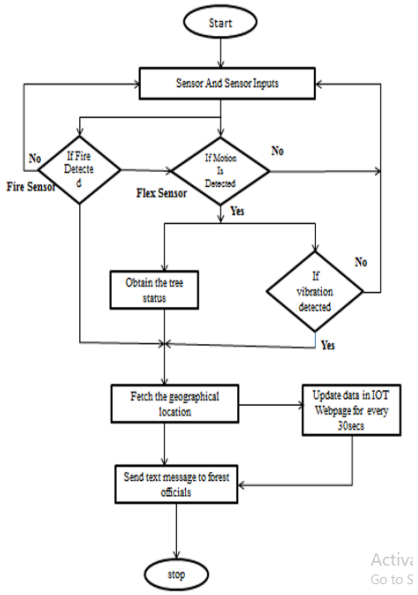

Figure 4. Flow diagram of the above system

The flow of the proposed system is given in the above figure.4 and the sensor used are divided for two different operations one is fire detection and alerting system and another is tree logging prevention system.

1. The process starts – sensors start sensing data around it.
2. Data gathered from all sensors by the microcontroller
3. If the fire has been detected then the location of a particular device is captured through GPS attached to the device and then an alert has been sending to officials and updated over the internet.
4. Else if motion or vibration has been detected on any tree then the exact location has been transferred to the forest department by mobile app and on IOT web page.
5. These data will be updated for every 30 seconds on the IOT web page.

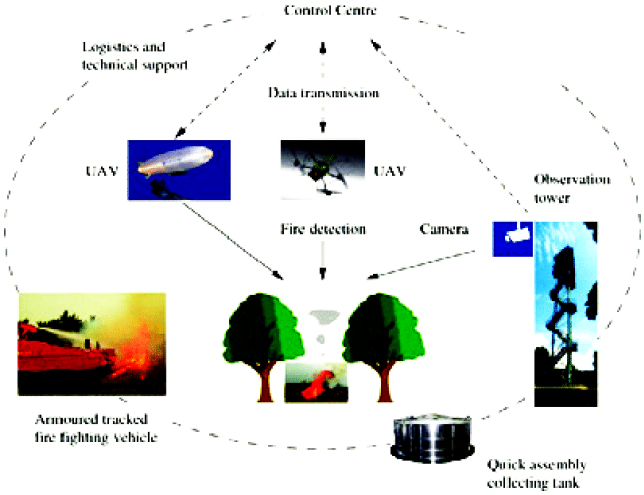

Figure5. Schematic structure of integrated forest fire detection system

The complete working is as follows in figure.5.the sensors record information continuously and sent to Raspberry pi. Sensors included are fire sensor that is the flame sensor which transfers a signal whenever fire flame has been detected indicating a fire in that area, Gas sensor senses smoke caused due to fire, Temperature sensor gives temperature details whenever temperature raises certain level an alert has been given to the corresponding department, humidity sensor gives moisture details even if the moisture level is below extent chances of getting fire becomes high thus indicates low moisture details. And all these sensors involved in fire detection and they are made into a single device and placed at every 100mts in the forest area. Then the flex sensor that detects the titling of tree and vibration sensor gives details on vibration occurring due to the cutting of the tree. And these two sensors involved in tree logging detection. This device has been nailed to a tree. Both the block contains a GPS in it and devices are connected as a group to multiple controllers. Then these controllers receive data and send responses to all the data. The camera gets activated whenever fire has been detected and an alarm has been given to alert animals and details with the image are updated on IOT web page.

III. HARDWARE AND SOFTWARE SUPPORT

Power Supply- power supply required for the above devices are less than10v. thus they are operated with Solar/battery supply. Whenever solar power is available it makes use of solar panel and in the absence of solar energy battery power is used as an alternative source. Even this battery has been charged by a solar panel.

Flex sensor- they detect the measure of the change in a position like bending. Whenever there is flex in the sensor the resistance will be increased across the sensing device. This data will say about the cutting of the tree.

Raspberry pi – here we use raspberry pi 3 which has a size of a credit card that can be used as a replacement for a computer for some applications. The device uses ARM CortexA53 with 1.4 GHz and 64bit quad-core ARMv8 CPU.1GB memory is provided by raspberry pi and additionally SD card can be inserted. There are 4 USB ports where we can connect USB based camera, mouse,

keyboard, and any other devices with USB port, 40 GPIO pins which support connection with many sensors and actuators, HDMI port ready for display.

GPS- GPS receives data from GNSS (Global Navigation Satellite System) which gives geographical information i.e. latitude and longitude details. 30 satellites involved in a network of GNSS.

Fire sensor - Fire sensor senses fire and give a variation in is output for the presence of fire. It has a range of 10m that is it can detect dire even 10m far away.

Moisture sensor – Moisture in the air has been detected by this moisture sensor. The amount of moisture in the air is converted as a value given by the sensor. It can be known as Hygrometer.

CONCLUSION

A system has been designed for forest fire detection and deforestation prevention that overcomes the drawbacks faced previously. Thus catastrophic events caused due to fire can be reduced by this system. Cutting of trees can be stopped and tree trafficking can be regulated. Even this prevents smuggling of precious trees like sandal; teak, red sandal, etc. detection can be made at the time of cutting a single tree where we get an immediate alert on cutting trees and can be stopped by quick action. Similarly, fire can be monitored through multiple sensors and detected early without before a large disaster through sensor data and images. Thus the system avoids humans involved in monitoring forests and makes fast alerts on fire to make any preventive activities.

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