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Design of IOT based Anti - Smuggling System for Forest Trees

Sinchana S Babu[1], S Gayathri[2], Shreya G[3], Varsha G Raj[4], Ambika S[5]
[1, 2, 3, 4]*Dept. of Information Science and Engineering, Visvesvaraya Technological University Sapthagiri College of Engineering Bangalore, India*
[5]*Assistant professor, Dept. of Information Science and Engineering Visvesvaraya Technological University Sapthagiri College of Engineering Bangalore, India*

***Abstract:** In the past few years, trespassing into protected forest areas to smuggle assets of the forests like wood, meat which garner a high value in the market has become a very common site. To secure and monitor acres and acres of widely spread forest area is indeed a herculean task. Therefore, implementing the concept of "Internet of things", a system is proposed that could combat this issue where the environmental crisis is at peak. "Internet of things" is a system that interacts through the Internet of computing devices embedded in everyday items, allowing them to receive and send data. The system proposed here is to build a framework which can be utilized to limit smuggling. The structure framework utilizes four sensors that are- PIR sensor, temperature sensor, sound sensor and vibration sensor. In addition to the sensors, a PI camera is proposed to the system to monitor actions around the device's perimeter and they are all mounted on Raspberry pi. Information created from these sensors are constantly sent over the network to the officials using a Wi-Fi module over the cloud.*
***Keywords:** Raspberry pi, PIR sensor, temperature sensor, sound sensor, Wi-Fi module, Anti-smuggling, Internet of Things*

I. INTRODUCTION

Forest is a magnanimous area dominated by various species that include trees, wildlife etc. and is considered as the fundamental ecosystem of earth that is distributed around the globe. Forests cover 31% of the world's land surface and are responsible for accommodating basic needs such as shelter, medicines, subsistence etc. for all species of earth. Lately, deforestation of trees has become one of the major issues due to rapid emergence of industries that demand large spaces and produces a lot of waste that disrupts the biosphere and affects.

Also, deforestation is majorly caused due to human's selfish needs that require gratification and their ignorance towards it. Smuggling of valuable trees like teak, sandalwood has become a day to day news as these timbers would fetch a huge bounty at the markets which is the root cause of illegal poaching.

Recently, the Amazon Rainforest referred to as the 'Lungs of the Earth' which produces a massive amount of the world's oxygen was seen burning at a rate that the scientists have never seen before. This led to a whooping increase in the generation of toxic gases that contributed to the increase of earth's temperature.

All of this tree poaching can lead to serious damage to our environment which will eventually lead to the imbalance of our ecological system. To counter this issue, a system is proposed that will detect any sort of potential threats in the forest by using different types of sensors like temperature sensors, sound sensors, and PIR sensors which are used which identify the temperature change, sound and human movement and respectively. Also, PI camera is used to provide the forest officials snapshots and live stream of the activities. All of which is mounted upon a series of small single-board computers (Raspberry Pi). The data collected via the sensors are sent over the cloud as email to the forest officials for them to monitor the areas that the system covers. The major advantage of using the Raspberry Pi system is that it can perform most of the activities performed by a normal computer but on a smaller scale. The fundamental goal of this system is to protect forest.

II. LITERATURE SURVEY

Ghousia Sultana B et al. [1] The main objective of this project is to develop a system which can be used to restrict smuggling of sandalwood trees. This system consists of two modules: one involving sensor and second: controller which is placed on a tree and the other one is an Android phone. The Blynk application continuously receives sensor data and the sensor data is continuously uploaded to cloud (Blynk server) over a Wi-Fi module. In case of tilt sensor, the buzzer rings when the tree bends and as for the temperature sensor, the water pump is turned on in case of forest fire through the relay switch.

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1) Demerits

a) The data generated by all the sensors should be continuously transmitted to the cloud, if it is not inspected properly the data is lost.

b) Battery should always be charged; else the sensors stop working.

Sridevi Malipatil et al. [2] The objective of this paper is to design a system to reduce poaching. A module will be mounted upon the trunk of each tree that is capable of detecting theft and also, automatically initiates alarm signals if any of the central base station detects any malicious activities. The author and their team have shown use of FFT for signal processing. The system developed is a low power design, therefore will have a longer life.

2) Demerits

a) Designs a portable wireless sensor node which will be a part of a wireless sensor network that automatically initiates an alarm signal where the system has to be mounted on each and every tree.

b) But the node on every tree does not involve sound sensors which is of paramount importance

Pushpalatha R et al. [3] suggests a portable wireless sensor node which will be a part of a wireless sensor network that automatically initiates an alarm signal. It also includes temperature, flex, accelerometer-ADXL335-To sensors that resemble an organ assembly unit for a tree that anticipate and suggests the current condition about the trees.

3) Demerits

a) The node has to be placed on every tree in the forest. This could be a tiring task.

b) On notification of any break-in in the forest the node creates an alarming sound. This could be a nuisance to the animals around.

Jamal Firmat Banzi et al. [4] This research paper presents the use of animals as MBS, that can detect danger faced by the animals and surrounding environment at any given instance. However, the system does not replace the current anti-poaching initiatives but rather combines the effort in order to get rid of poaching instances. This system could prevent potential poaching activities that occur in these forests.

4) Demerits

a) Uses animals as MAB which could cause serious radiation problems and can affect animal's health.

b) This system is complicated and expensive to implement.

c) This system covers a very less area circumference hence requires a greater number of sensors.

III. PROPOSED METHODOLOGY

Implementing the concept of "Internet of Things", a system is proposed that could combat the issue of poaching of trees at this hour when the environmental crisis is at peak. The system proposes to build a framework which can be utilized to limit smuggling. The structure framework utilizes four sensors: PIR sensor, smoke detector, temperature sensor, and vibration sensor. In addition to the sensors, a PI camera is proposed to the system to monitor actions around the device's perimeter, and they are all mounted upon Raspberry pi.

A. Block Diagram

The epistemology of the current work has been conferred in a block diagram as seen in Figure 1. The block diagram implies the basic structure of the proposed system. It shows the various connectivity of the sensor and therefore implying the structure this system is based upon. There exists a relay device that prevents the heat sensor from ruining the raspberry pi. When connected directly, due to the voltage differences, chances of heat sensor consuming the power of the raspberry pi and can end up damaging it forever.

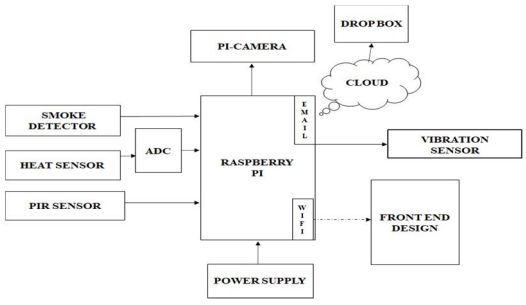


Figure 1: Block diagram of proposed system

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The heat, smoke and PIR sensors are present on a separate pole that is at nominal distance from the trees and are connected to the single-board computer (raspberry pi) through the GPIO pins. The vibration sensor and PI camera are mounted on raspberry pi. Apart from raspberry pi's own generation of power supply, we have included an additional power supply that is Lithium ion battery. All these components are connected to a third-party application and are updated time to time via cloud.

B. Flow of system

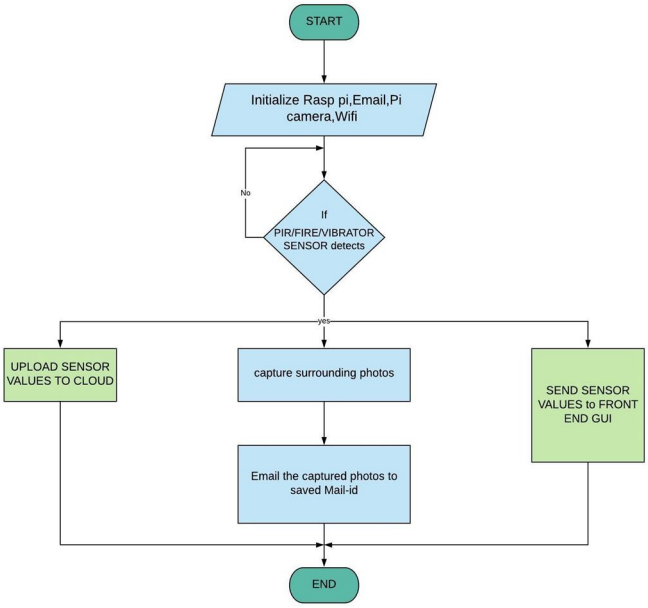


Figure 2: Flow chart

At the beginning, few components like raspberry pi, Email, Pi camera and Wi-Fi are initialized. If the sensor detects any human activities, it updates sensor values, captures the photo and emails the admin. It sends the sensor value to GUI. If no sensors are detected, the initialized elements stay the same and finally ends.

C. Implementation and working

The Vibration sensors are mounted on raspberry pi, which is attached to the tree. Heat and smoke sensors are present at a separate pole which is at nominal distance from the tree and is connected to the raspberry pi. Sensors are connected to GPIO pins of raspberry pi. They are programmed using python in raspbian jessie OS for raspberry pi.

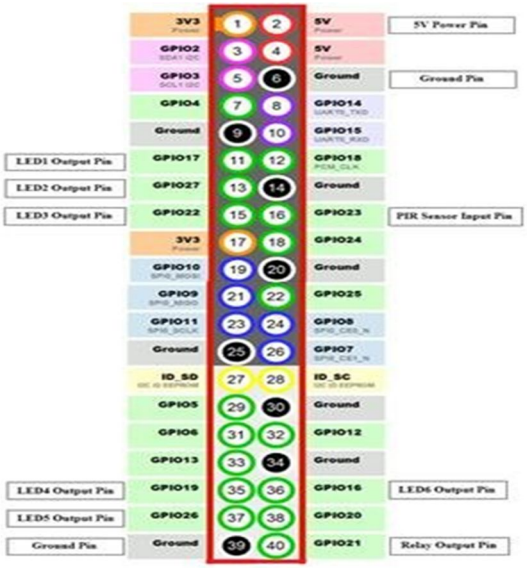


Figure 5: GPIO pin of raspberry pie

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1) *Raspberry Pi:* The Raspberry Pi is a cheap mini-computer that runs Linux, and also, provides a set of GPIO (general purpose input/output) pins that allow to control electronic components for physical computing and explore the Internet of Things (IoT). The Raspberry Pi is a series of small single-board computers
2) *Pi Camera:* The Pi camera module is a portable lightweight camera that is supported by Raspberry Pi which communicates with it using the MIPI camera serial interface protocol which is used in image processing, machine learning or in surveillance projects.
3) *Temperature Sensor:* A 1-Wire Raspberry Pi temperature sensor makes it very easy to read it out and only one GPIO pin is adequate to perform this task efficiently. The temperature sensor DS18B20 is also available as a waterproof version.
4) *Sound Sensor:* It is a device that receives sound waves and converts them into electrical signals in order to detect the sound intensity in an ambient environment like a microphone. Therefore, making the module easier to detect various sounds in different frequencies.
5) *PIR Sensor:* PIR stands for passive infrared. It is a motion sensor that consists of a fresnel lens, an infrared detector, and supporting detection circuitry. Lens on the sensor focuses upon any infrared radiation present around it. Human bodies generate infrared heat, and as a result, this heat is absorbed by the motion sensor. The sensor outputs a 5V signal for a minute as soon as it detects the presence of a Homosapien. It offers a wide range for detection which is about 6–7 meters and is highly sensitive.

D. Hardware Setup

The following is the prototype of the model proposed. It is mounted upon a board and the heat sensors and the smoke detectors are mounted on poles close to the model as a precaution to avoid damage to the sensors and detectors.

For the prototype, we've implemented plants to simulate the forest and the various tests conducted with simulated dangers, the model has been able to detect it and report it with full details successfully to the front end and it also sends data to the cloud.



Figure 6: Hardware set up

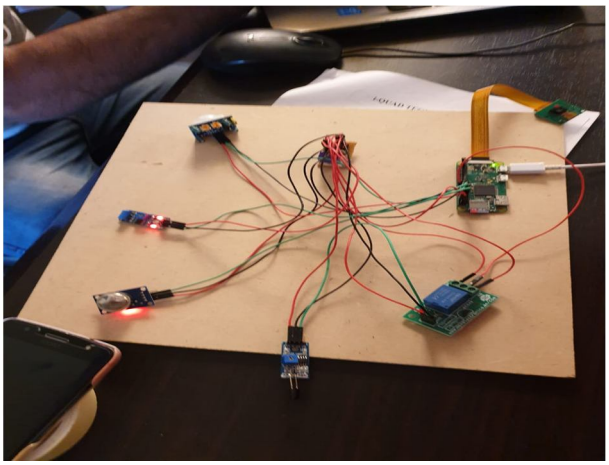


Figure 7: Circuit set up

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The model also successfully sends photos, alerts and uploads them on dropbox, which is on the cloud as shown in figure 8. It also provides on demand live steam as and when requested by the user. This thereby helps in monitoring the situations in the forest in a much efficient way.

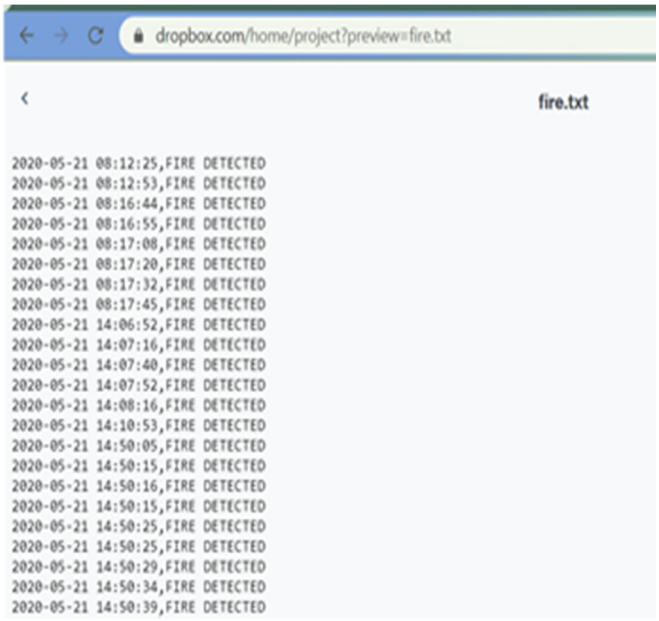


Figure 8: Updation of activities on the cloud

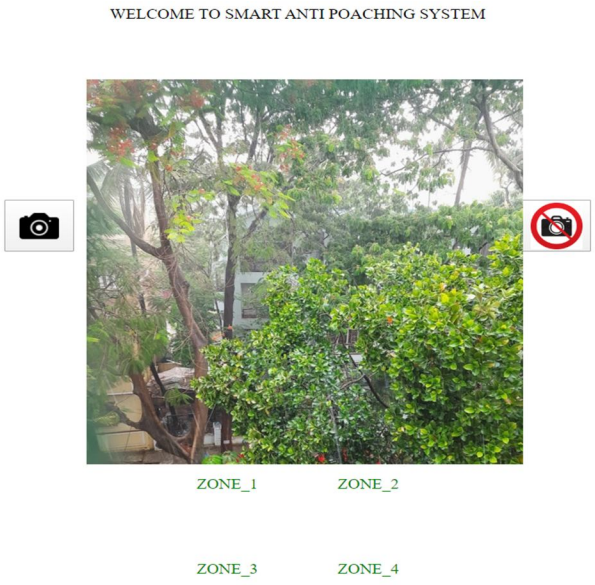


Figure 9: Live relay on demand

IV. CONCLUSION

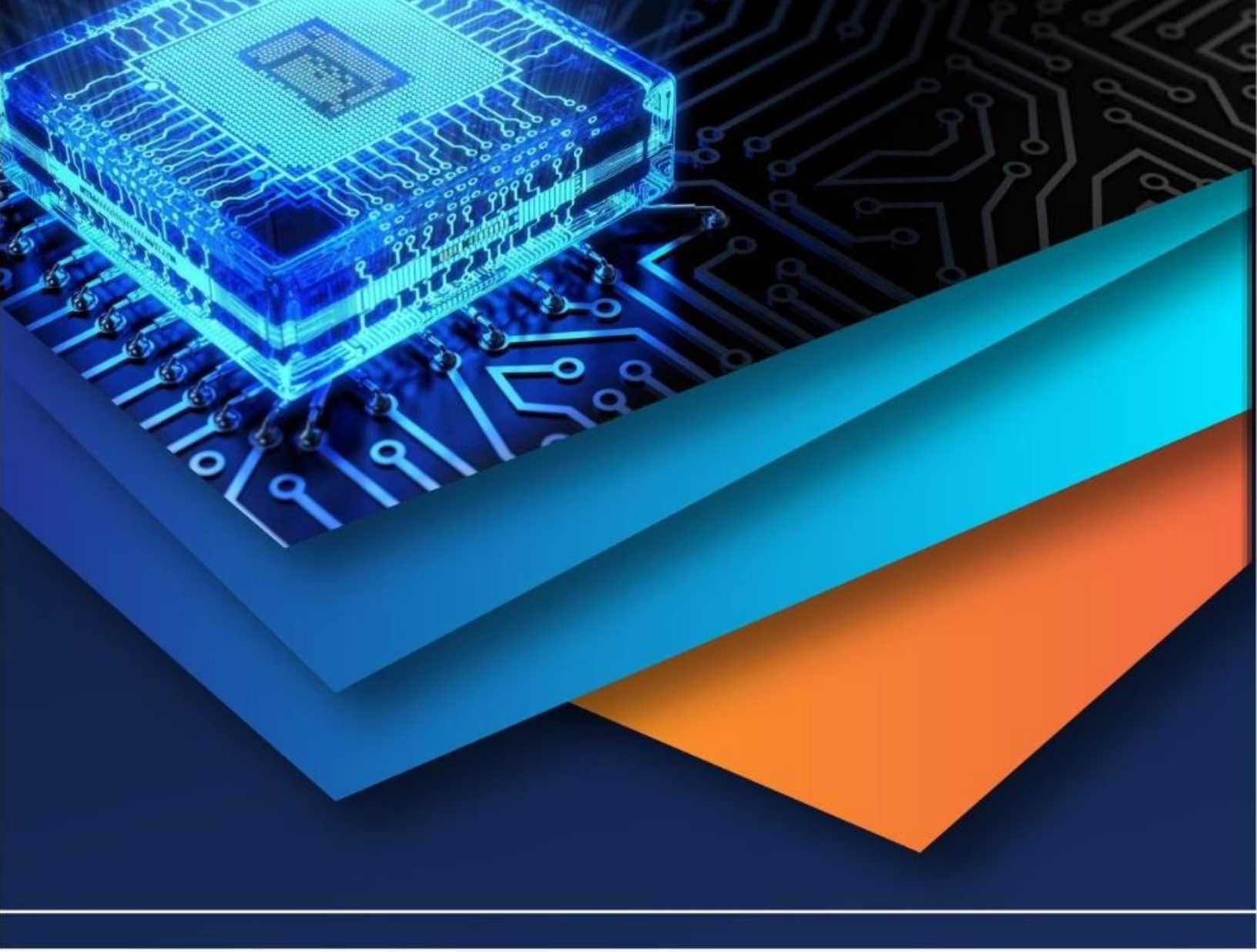
In the proposed framework the Internet of Things (IoT) is utilized. Deforestation can happen quickly until we stop destruction of our trees. We have to increase the security around trees. This system could be implemented with tremendous success and ecological benefits. Cameras are implemented which provides photos of the activities. The use of innovative computer vision technology will improve the system capability to detect the poacher's position in real time. The future extent of work is execution of a Multi-hub system and fuse of mouthpiece, movement identifier sensor and temperature sensor to make frameworks increasingly powerful. Also, solar panels can be used to supply power to the system that could be more efficient and also eco-friendly.

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