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Anti-Poaching Alarm System for Valuable Trees

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Abstract: ***The concept of an anti-poaching alarm system for forest trees would likely summarize the system's purpose, design, and functionality. It could touch upon the integration of sensors to detect human activity, the use of communication technology to alert authorities, and its potential impact on reducing illegal activities. This helps in the protection of endangered species by acting as a deterrent against poaching activities. The system monitors when the tree logging occurs, the vibration generated due to axing the tree is sensed by the vibration sensor. Also, if there is forest fire it is sensed by flame sensor. This paper is an IoT(Internet of Things) based framework structure for identification of fire and wood cutting for preventing forest fires and deforestation, the proposed project makes use of things like sensors, GPS module, dashboard and SMS gate way , Blynk Apps. All these things are inter connected over a network; they exchange the information to implement the proposed project***

Keywords: IOT, GPS Module, Blynk Apps

1. Introduction

Forests constitute approximately 30 % of the global land area. They provide habitat for both humans and some species that share the valuable ecosystem's goods. Managing a forest has become an extremely hard task. Illegal logging represents one of the biggest challenges of forests sustainability. According to the UN Framework Convention on Climate Change (UNFCCC), there is more carbon stored in the forests than there is in the Earth's atmosphere–some 638 billion metric tons as of 2005. In addition, it is estimated that deforestation accounts between 1/6 and 1/4 of global carbon emissions. These percentages and figures are definitely reflecting how serious the phenomena of deforestation is, it also urges people around the world that have some knowledge and understanding of the consequences to think about solutions or ways to prevent illegal logging. Forestry departments in many countries such as Brazil and Malaysia thought of digitizing trees and hence transforming forest management to a hightech process using RFID tags. RFID (radio frequency identification) systems usually consist of a microchip, antenna, and it can store up to 2 kilobytes of data. There are 3 types of RFID tags. They are active, semi active and passive. Active and semi active RFID tags are power sources by an internal battery to power their circuit. An active tag use the internal battery to broadcast the signal to reader, the broadcasted frequency in this case can reach 950 Hz and be read 30 meters away. If more batteries are added into the tag, the broadcasting will be boosted and the distance could reach 100 meters in the case of a semi active RFID tag, broadcasting relies on the reader, which means that the reader supplies its power for broadcasting. The other type is passive tags.

Today there is a high demand for internet application development, so IoT emerges as a major technology as it produces various internet applications. Internet of things is the internet connectivity to devices and consists of electronics and other forms of hardware and the interaction with them is taken over internet. IoT is an autonomous control feature by which any device can be control without human interaction. Things in IoT refer to the combination of hardware, software data and services. This project shows an IoT based framework structure for identification of fire and wood cutting for preventing forest fires and for discovery of sound and plot for forestalling the cutting of trees as right on time as possible. In the proposed framework ESP32 is interfaced with couple of sensors, GPS module and Relay. In case any disastrous occasions emerge, the framework consequently alerts the concerned authorities by sending an alert sms containing location info which is fetched using GPS module. This project is an IoT based framework structure for identification of fire and wood cutting for preventing forest fires and deforestation, the proposed project makes use of things like sensors, GPS module, dashboard and SMS gate way. All these things are inter connected over a network; they exchange the information to implement the project.

1.1 IoT system compromises of four different components

(i) Sensors/devices
Sensors is a device that detects and collects data to respond for some input from environment. The input can be any of the form like heat, light, pressure, temperature. The output is in the signal form which can be readable by humans at sensor location or it can be transmitted electronically over network

(ii) Connectivity
The data obtained is sent to cloud and sensors can be connected to cloud using cellular satellite, wi-fi, Bluetooth or directly through internet.

(iii) Data Processing
Programming plays out some sort of handling like once information jumps on cloud, for example, checking the temperature perusing is inside the worthy range.

(iv) User interface
The data got will be made valuable to the clients by alarming them through email, content, notice. A client can have interface to beware of framework.

2. System Requirements Specification

2.1 Software Requirements

2.1.1 Arduino IDE

In this project this IDE is used to write, test and deploy C code to hardware circuit, program written using this IDE are called as sketch, each sketch is written in C or C++, this ide allows to communicate with the circuit boards connected to USB port of the development computer.

2.1.2 Introduction to Arduino language

In this project we have Arduino programming language to communicate with the hardware as it finds handy for this task. The language has fallowing characteristics

- High-level language
- Structured
- Modular approach
- Best suited for communication with hardware.

In c each program includes one more functions hence it is called procedural programming language.
Basic datatypes used in the C are

1) int
2) float
3) double
4) char

All whole numbers irrespective of sign are known as integers, fractional numbers irrespective of sign with 6 digits decimal points are known as floats, fractional numbers irrespective of sign with 16 digits decimal points are known as doubles.

In Arduino we have 2 user defined functions called setup() and loop(), setup() function gets called only once we code is launched to device and loop() function gets called continuously.

2.1.4 Blynk IoT Platform

Blynk is a comprehensive software suite that enables the prototyping, deployment, and remote management of connected electronic devices at any scale.

Whether it's personal IoT projects or commercial connected products in the millions, Blynk empowers users to connect their hardware to the cloud and create iOS, Android, and web applications, analyse real-time and historical data from devices, remotely control them from anywhere, receive important notifications, and much more.

2.1.5 Blynk Apps

Blynk.Apps is a versatile native iOS and Android mobile application that serves these major functions:

- Remote monitoring and control of connected devices that work with Blynk platform.
- Configuration of mobile UI during prototyping and production stages.
- Automation of connected device operations.

Applications made with Blynk are ready for the end-users. Whether they are family members, employees, or product purchasers, they can easily download the app, connect their devices, and start using them.

Blynk also offers a white-label solution as part of the Business Plan, allowing you to customize the app with your company logo, app icon, theme, colors, and publish it on App Store and Google Play under your company's name. These customized apps will work seamlessly with your devices.

2.2 Hardware Requirements:

2.2.1 Pin configuration of ESP32

ESP32 is one of the microcontrollers 802.11b/g/n integrated with 802.11b/g/n Wi-Fi and dual mode Bluetooth its means it supports both Bluetooth 4.0 (BLE) and Bluetooth Classic (BT). It is a low-cost, low-power system so it has more advantages to implement the projects. ESP Ressif Systems and Shanghai-based Chinese company created/invented and developed this ESP32 microcontroller and it is manufactured by TSMC with the help of their 40 nm process. Sometimes it connects the network of its own. It provides power supply is of about 5V through USB. The ESP32 is good option for peer-to-peer connection without the need of an access point supports wi-fi Direct as well.

Figure 2.1: ESP32 microcontroller

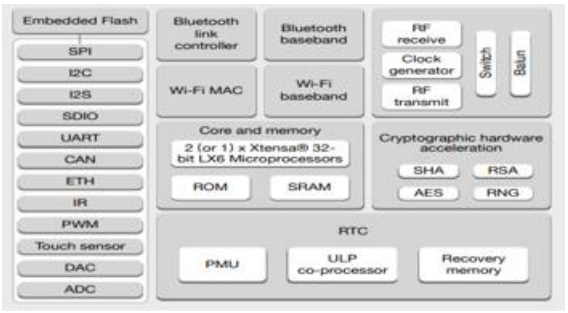

Figure 2: Block diagram of ESP32

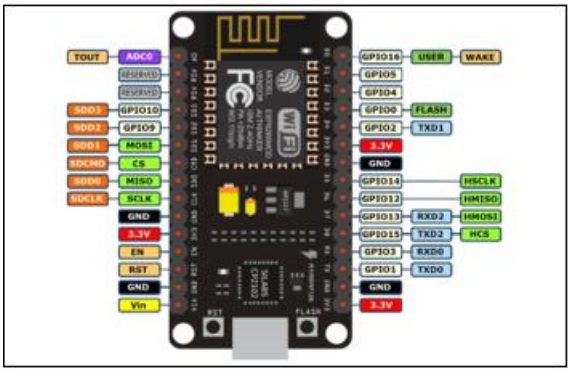

Figure 3: Pin description of ESP32

2.2.2 Flame sensor

This tiny Flame sensor infrared receiver module ignition source detection module is Arduino compatible can use to detect flame or wavelength of the light source within 760nm~1100nm also useful for Lighter flame detect at the distance 80cm.

Greater the flame, farther the test distance. It has the Detect angle of 60 and very sensitive to flame spectrum.

It produces the one channel output signal at the D0 terminal for further processing like an alarm system or any switching system. The sensitivity is adjustable with the help of blue potentiometer given on the board.

2.2.3 Vibration Sensor

Normally open vibration sensor module is for a variety of vibration trigger function, reported theft alarm, smart car, electronic building blocks and so on. normally open vibration sensor module in the induction of a small vibration when the trigger time is very short, not enough to drive the relay, some of the information display can be directly connected to the relay module, the actual use of ineffective.
When the product does not shake, the vibration switch is held in off state, the output is high and the green light does not shine and when the product vibrates, the vibration switch goes in momentary conduction mode, the output end of the output goes low and the green indicator light-up.

Output can be directly connected to the microcontroller through the microcontroller to detect high and low levels, thus to detect whether there is a vibration of the environment, play an alarming role.

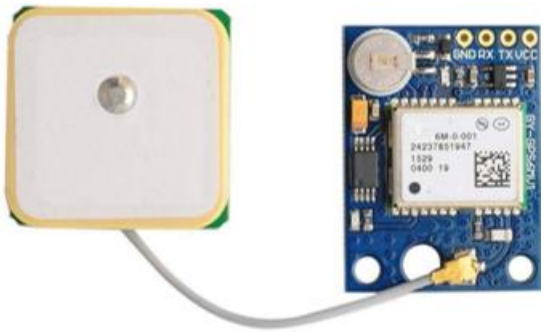

Figure: NEO-6M GPS Module

This is a complete GPS module that is based on the NEO-6M. This unit uses the latest technology to give the best possible positioning information and includes a larger built-in 25 x 25mm active GPS antenna with a UART TTL socket. A battery is also included so that you can obtain a GPS lock faster. This is an updated GPS module that can be used with ardupilot mega v2. This GPS module gives the best possible position information, allowing for better performance with your Ardupilot or other Multirotor control platform.

The NEO-6M GPS engine on this board is a quite good one, with the high precision binary output. It has also high sensitivity for indoor applications. NEO-6M GPS Module has a battery for power backup and EEPROM for storing configuration settings. The antenna is connected to the module through a ufl cable which allows for flexibility in mounting the GPS such that the antenna will always see the sky for best performance. This makes it powerful to use with cars and other mobile applications.

The GPS module has serial TTL output, it has four pins: TX, RX, VCC, and GND. You can download the u-center software for configuring the GPS and changing the settings and much more.

2.2.4 8 Bread board

The SYB-170 Mini Solder less Breadboard is named for its 170 tie points. It has 17 columns of 10 holes, which are separated into two pairs by a central notch, and labelled 1 to 17. Each column is also labelled, with a letter from A to J to that they can be easily referenced in instructions (like the squares on a chess board).It has a peel and sticks adhesive backing as well as two mounting holes for M2 screws so you can anchor it down. This solder less, re-usable breadboard is made from sturdy ABS plastic housing. Great for prototyping, testing and creating add-on modules or new circuits. Its standard nickel-plated spring clips ensure longevity and firm grip. As a single unit, the PTBB-170W provides one large (170) tie-point IC circuit terminal strip.
If you run out of space, the PTBB-400W can be pair with additional breadboards (below) to accommodate larger projects. Works with LEDs, transistors, diodes, capacitors, and resistors.

3. Methodology

3.1 Circuit Diagram

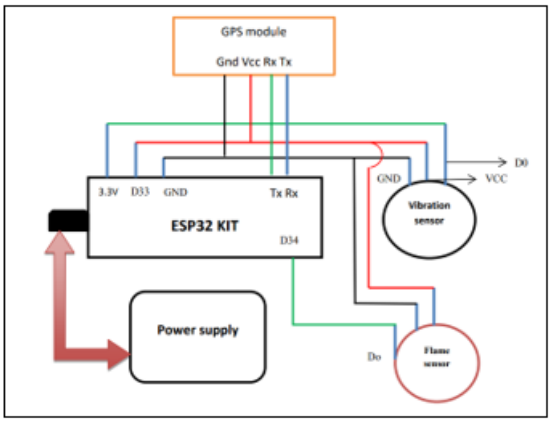

Figure 3.1: Circuit Diagram of Project Model

The system monitors when the tree logging occurs, the vibration generated due to axing the tree is sensed by the vibration sensors. Sensors includes Flame sensor, Vibration Sensor. This will be mounted on trunk of each tree, capable of detecting theft as well as automatically initiate send alarm signals. Then this generated data is sent to the forest officer if any event occurs so that appropriate action can be taken.

The anti-poaching alarm system circuit using an ESP32 microcontroller, vibration sensor, flame sensor and GPS module. The ESP32 and sensors require a stable voltage source. This can be a battery or a solar panel with a voltage regulator. Connect the vibration sensor to a digital pin of the ESP32. Similarly, connect the flame sensor to another ESP32 pin. The GPS module typically uses a serial

communication protocol (UART) to send location data. Connect the module's Tx and Rx pins to designated ESP32 pins for serial communication. The ESP32 is the brain of the system. It reads data from all sensors continuously. The program checks the sensor signal. Vibration or flame sensor indicating potential poaching activity, the ESP32 triggers the alarm.

The main advantages of Proposed system are distributed hence supports distributed access. Continuous monitoring with the help of sensors helps to ensure forest safety. GPS helps to get accurate current location where events are detected. The centralized database hosts the information such as location where wood cutting activity detected, which helps authorities to take proper action

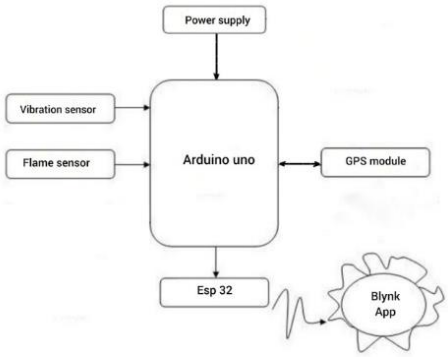

Figure 3.2: Block diagram of Project Model

The brains and brawn of the anti-poaching system come together in this section of the block diagram. The ESP32, a low-power microcontroller, acts as the central processing unit. It receives signals from three key sensor blocks Power Supply Block. This block ensures the system has enough juice to function. It could be a battery or a solar panel with a voltage regulator, depending on the availability of sunlight.

- **Vibration Sensor Block:** Here, a vibration sensor picks up tremors caused by sawing or chopping at the tree. These vibrations are translated into electrical signals that the ESP32 can understand.
- **Flame Sensor Block:** This combined block tackles two threats. The flame sensor detects unusual heat spikes, potentially caused by someone trying to burn the tree.
- **GPS Module Block:** The GPS module, on the other hand, provides the system's location if tampering is detected. This crucial data helps rangers or authorities pinpoint the exact location of the crime for a swift response.

The ESP32 analyzes the data from all these sensors. If vibrations, heat, or both exceed pre-programmed danger zones, the ESP32 triggers the alarm system and, if applicable, sends an alert with GPS coordinates through the communication module (explained in another block). This coordinated effort by the power supply, sensors, and ESP32 forms the heart of the anti-poaching defense system for valuable trees.

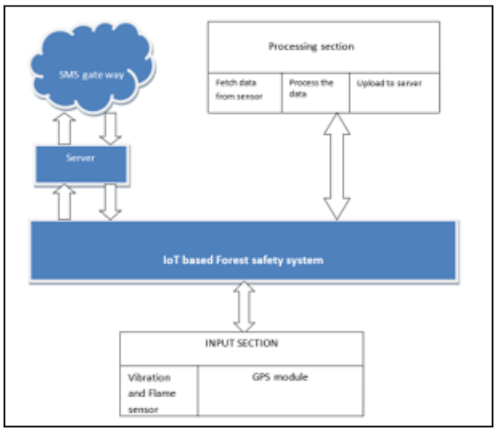

Figure 3.3: Architecture diagram

Above diagram shows various functional units being used in the project, it has sections like input, processing and server, input makes use of sensor, processing is done programmatically and information is saved in centralized server.

This is an IoT based framework structure for identification of fire and wood cutting for preventing forest fires and for discovery of vibration and plot for forestalling the cutting of trees as right on time as possible. In the proposed framework ESP32 is interfaced with couple of sensors, GPS module.

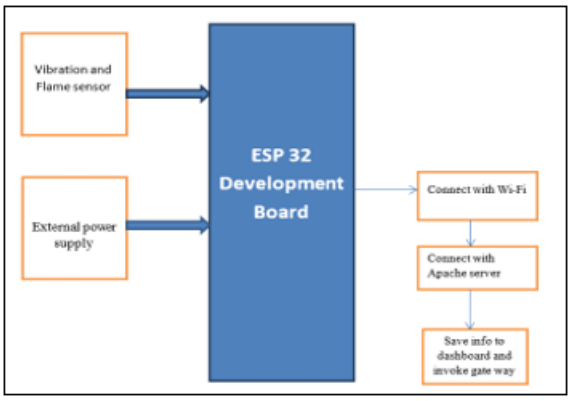

Figure 3.3: Context Diagram

4. Result and Discussion

The procedure of executing system with the target of finding error is outlined as testing. It can also be defined as the process that defines, isolates, subjects to rectification of defects, and so that the customer satisfaction is reached at last with the assurance of the system is free from defects.

Software testing is a very important element of the quality assurance and it represents the SRS, designing, coding and implementation of the system proposed.

4.1 Algorithm and coding used in the project

4.1.1 Algorithm for ESP32 Code

Step1: Configuring the tilt sensor for reading values
sensor will have 3 pins, VCC, GND and OUT, connect VCC to 3.5V, GND to ground and OUT pin to IO pin of ESP32. And turn on the kit, following steps should be followed to read the values.

```
Function ReadInfo( )
Begin
Value=ReadValues( pin number )
SendToTransamitter(value)
IntroduceDelay()
End of function
```

A function needs to be defined for reading values of voltage sensor with an average delay of 1 or 2 seconds. The read value must be sent to transmitter of base station for further transmission.

4.2 Algorithm for coding using IDE

Step 1:
Launch Arduino IDE
Step2:
Include all necessary header files
Step 3:
Define constants
Step 4:
Within setup () method initialize pin configurations
Step 5:
Read sensor data from GPIOS, define this task in loop method as this method gets called repeatedly.
Step 6:
Using digital write methods control the devices
Step 7:
Close connection.
4.3.3 Pseudo code to read data from sensor

```
Function  readData()
{
        pinMode(33,INPUT)
        value=analogRead(33)
        writeToBlynk(V0,value)
}
```

Pseudo code to connect to wifi

```
Function connectToWifi()
{
        SSID=”yourSSID”
        Password=”YOURpassword”
while(Wifi(ssid,password) not Connected ) )
        {
                Delay(500)
        }
}
```

5. Conclusion

A system has been proposed for forest fire detection and tree cutting detection which overcomes the constraints of the existing technologies. This system is helpful in preventing the after effects by detecting the forest fires as early as possible over a wide area. Currently there is no system to detect illegal logging and cutting of trees. This proposed system will be helping forest officials in detecting and alerting so that proper actions could be taken. The proposed system will monitor when the tree logging occurs
The system monitors when the tree logging occurs, the vibration generated due to axing the tree is sensed by the vibration sensor. Also, if in case forest fires, when the temperature of the surroundings increases its sensed by the flame sensor. Then this generated data is sent to the forest officer if any event occurs so that appropriate action can be taken.

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