Anti-Smuggling System For Trees In Forest

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Abstract- *Illegal tree logging and smuggling are major concerns in many forests around the world. To combat this issue, an anti-smuggling system for trees using IoT technology, specifically Node MCU, vibration sensors, accelerometers, and temperature sensors, is proposed. The system aims to monitor and detect any unauthorized tree cutting and transportation by tracking and analyzing the movements and vibrations of trees in the forest. The vibration and accelerometer sensors will detect any sudden or abnormal movements of the trees, indicating potential cutting or transport activities. The temperature sensor will detect any changes in temperature caused by equipment used for tree cutting or transportation. The data collected by the sensors will be sent to the Node MCU, which will process and analyze the data. Any abnormal readings will trigger an alert, and a notification will be sent to forest officials. The officials can then investigate and take action to prevent further illegal activities. The proposed anti-smuggling system for trees using IoT technology has the potential to significantly reduce the incidence of illegal tree logging and smuggling in forests, thus protecting the natural environment and preserving forests for future generations.*

Keywords- Flex sensor, Zigbee module, , Illegal Logging, Illegal Transportation, Monitoring, Detection, Data Analysis, Alert Notification, Environmental Protection.

I. INTRODUCTION

We are developing such a system which can be used to restrict this smuggling. Every tree will be equipped with one small electronics unit which consists of Micro Controller, Flex Sensor and Zigbee module. Tree cutting will be detected by flex sensors. At server unit cutting trees will be shown in VB front end. Communication between the trees and server will be done by Zigbee modules A SMART automated unit has been thus devised to tackle these issues. The Combination of Latest Wireless communication systems and Embedded solutions offer us such modules. The Module is intended to operate in a particular area and this Module will consist of two Units:

1. Tree Unit
2. Main Server Unit (basestation).

Each Tree should have one little Embedded System-Unit with: Renesas Microcontroller, Sensors, GPRS and Solar power.

II. LITERATURE SURVEY

1. Anti-smuggling System for Trees in Forest using Flex Sensor with GSM &Zigbee Network

From many years we are getting news about smuggling of the trees such as sandal, Sagwan etc. These trees are very expensive and less obtainable in the market. To avoid such type of smuggling and to save the forests around the globe some preventive systems need to be developed. We are forming a system which can be used to restrict this smuggling. The suggested system will consist of two modules which are described below, 1) Tree Unit 2) Main Server Unit (base station).]Every tree having one small electronics division which consists of ARM 7, 3 Sensors and Zigbee module. There will be one area selected. The data of different tree units can be collected by this units. The each tree unit will give the information to base station using GSM module. At main server GUI using one authorized person whom received the message and he will taking action to provide security. This data can be used by concern forest authorities to take preventive action.

2. The Global Positioning System

Currently, most electronic toll collection (ETC) systems around the world are implemented by DSRC (dedicated short range communication) technology. However global positioning system technique is applied to ETC to replace DSRC technique in recent years. It is an innovative technology for Expressway Network electronic toll collection solution, which is totally different scheme comparing to traditional DSRC-based technology. In this paper, the frame composing and working flow of the system are described, the design of GPS-based ETC system are discussed detailedly, and the advantages and disadvantages of the system are discussed at last.

3. GSM/GPRS Network

Differential Resistive Sensor Interface is industrially significant for GSM/GPRS transmission to a mobile phone in order to enhance communication technique. The Sensor output needs to be made digital, hence the need for a microcontroller and the signal is displayed in a PC as output voltage, sensed parameter, x. A frequency and voltage output are obtained, showing how a small change in differential value of the resistor can bring galloping effect on the signal path. This transducer comprises diodes, resistors, capacitor and 555 Timer, that would produce an analog output, which is then converted to digital by the use of a microcontroller. Thus, at this stage, the output signal would then be interfaced with a GSM/GPRS modem called KLS-RUP-200-Pms3-300 module to be received by cellular mobile phone. The errors and the non-linear path of the transducer response curve are compensated for at the output stage. At various stages, different codes are written for the interfacing process. Analysis of the resulting signal is done using various engineering software such as Matlab, OrcadPspice, GUI etc. The device also finds applications in areas of liquid level characterization, sensing the bent in a bimetallic strip also detects the expansion and contraction of the muscles. PIC16F877 is used which has the capability of monitoring up to 8 analog channels (from the Sensor/Transducer) simultaneously. All measured data would be serially transferred to a PC via RS232 before sending through the GSM modem. Through experiments, frequency and duty cycle responses are obtained to show that the proposed telecommunication system is robust and reliable.

4. ZigBee Network Protocols and Application

Remote control network is a research focus in the application domain of wireless communication technology. Zigbee technology makes up for the vacancy of wireless communication market in the low-cost and low-power equipment domain. This paper presents the design and application of wirless sensor network web server based on S3C2410 and Zigbee protocol. This server can realize real-time motoring and control for the remote object. With B/S structures and modular design method, hardware and software design is introduced, and key implementation techniques are described. It has been proved that the server runs stability and has good scalability, which can be widely used in smart home, monitoring systems, industrial control, and other fields

5. Zigbee wireless communication technology

In neuroscience, it is widely believed that learning and memory are primarily based on synaptic plasticity which is a neural mechanism that modifies the strength of connections between neurons. As a counterpart in machine learning, the modification of connection strength (weight) endows artificial neural networks with a powerful learning capability to solve various problems. Independent of modification for synaptic strength, recent experimental results have revealed that a single neuron also has the ability to change its intrinsic excitability to fit the synaptic input. This mechanism is referred to as neuronal intrinsic plasticity (IP) in the literature. Computational learning rules for IP have been developed based on the hypothesis of information maximization with a stable response level. With the discovery of this novel plasticity mechanism, a series of studies has focused on how IP plays a role in biological neural systems and how they benefit the learning performance of artificial neural networks. In this review, corresponding research on synergies between IP and synaptic plasticity mechanisms is presented in both the computational modeling of biological neural systems and the applications of artificial neural networks, and this combination in artificial learning systems is defined as synergistic learning.

III. PROPOSED SYSTEM

The proposed anti-smuggling system for trees in the forest using IoT involves the following components:

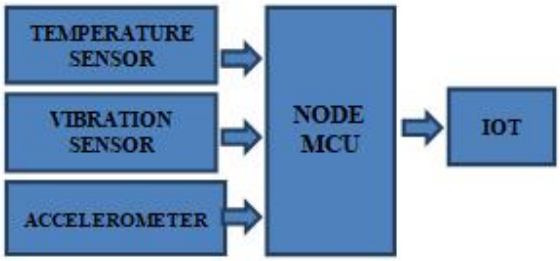
- **NodeMCU:** The NodeMCU is a Wi-Fi enabled microcontroller that serves as the brain of the system. It is responsible for collecting data from the various sensors and sending it to the cloud for analysis.
- **Vibration sensor:** The vibration sensor detects any movement or vibration in the trees, which could indicate illegal activities such as cutting or felling.
- **Accelerometer:** The accelerometer measures the acceleration of the trees and can detect any sudden movements or changes in position.
- **Temperature sensor:** The temperature sensor measures the temperature of the surrounding environment and can detect any abnormal temperature changes, such as those caused by fire or heating equipment used in illegal activities.
- **Cloud platform:** The cloud platform receives the data from the NodeMCU and runs analysis to detect any suspicious activity.
- **Alert system:** The alert system sends notifications to forest officials or law enforcement agencies when any suspicious activity is detected.

The proposed system works by placing the sensors on trees in the forest. The sensors detect any movement, acceleration, or temperature changes in the trees, and send this data to the NodeMCU. The NodeMCU then sends the data to the cloud platform, where analysis is carried out using

machine learning algorithms to detect any suspicious activity. When suspicious activity is detected, an alert is sent to forest officials or law enforcement agencies, who can then take appropriate action.

The proposed system can help prevent illegal activities such as logging, poaching, and other activities that harm the environment. It can also help protect the biodiversity of forests and preserve their natural resources for future generations.

IV. BLOCK DIAGRAM



BLOCK DIAGRAM EXPLANATION

NODE MCU ESP8266

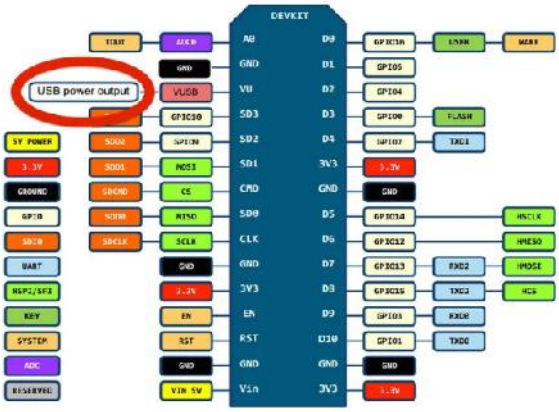
The ESP8266 itself is a self-contained WiFi networking solution offering as a bridge from existing micro controller to WiFi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect NodeMCUdevkit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

Specification:

- Voltage:3.3V.
- Wi-Fi Direct (P2P), soft-AP.
- Current consumption: 10uA~170mA.
- Flash memory attachable: 16MB max (512K normal).
- Integrated TCP/IP protocol stack.
- Processor: Tensilica L106 32-bit.
- Processor speed: 80~160MHz.
- RAM: 32K + 80K.
- GPIOs: 17 (multiplexed with other functions).
- Analog to Digital: 1 input with 1024 step resolution.
- +19.5dBm output power in 802.11b mode
- 802.11 support: b/g/n.
- Maximum concurrent TCP connections: 5.
- GPIO pin re-mapped, use the index to access gpio, i2c, pwm.
- Both Integer version(less memory usage) and Float version(Default) firmware provided

New Wireless module with CH340 USB-UART, NodeMcu is WIFI IoT (Internet of Things) development board based on ESP8266.

NodeMcu is a tiny board, based on ESP8266, integates GPIO, PWM, IIC, 1-Wire and ADC all in one board. It's a Lua based firmware for WiFi-SOC (Systems-On-Chop) ESP8266WiFi module.



- NodeMCU V3 is an open-source firmware and development kit that plays a vital role in designing your own IoT product using a few Lua script lines.
- Multiple GPIO pins on the board allow you to connect the board with other peripherals and are capable of generating PWM, I2C, SPI, and UART serial communications.
- The interface of the module is mainly divided into two parts including both Firmware and Hardware where former runs on the ESP8266 Wi-Fi SoC and later is based on the ESP-12 module.
- The firmware is based on Lua – A scripting language that is easy to learn, giving a simple programming environment layered with a fast scripting language that connects you with a well-known developer community.

- And open source firmware gives you the flexibility to edit, modify and rebuilt the existing module and keep changing the entire interface until you succeed in optimizing the module as per your requirements.
- USB to UART converter is added on the module that helps in converting USB data to UART data which mainly understands the language of serial communication.
- Instead of the regular USB port, MicroUSB port is included in the module that connects it with the computer for dual purposes: programming and powering up the board.
- The board incorporates status LED that blinks and turns off immediately, giving you the current status of the module if it is running properly when connected with the computer.
- The ability of module to establish a flawless WiFi connection between two channels makes it an ideal choice for incorporating it with other embedded devices like Raspberry Pi.

Features:

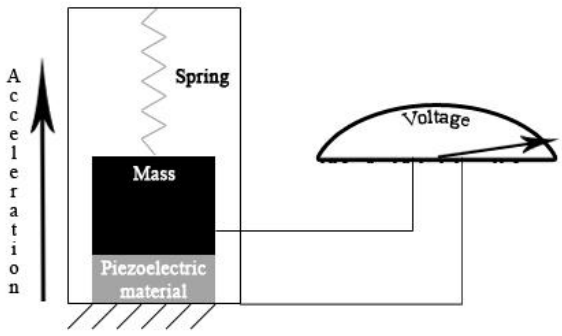
- Open-source
- Arduino-like hardware
- Status LED
- MicroUSB port
- Reset/Flash buttons
- Interactive and Programmable
- Low cost
- ESP8266 with inbuilt wifi
- USB to UART converter
- GPIO pins

As mentioned above, a cable supporting micro USB port is used to connect the board. As you connect the board with a computer, LED will flash. You may need some drivers to be installed on your computer if it fails to detect the NodeMCU board.

ACCELEROMETER

- Accelerometers are devices that measure acceleration, which is the rate of change of the velocity of an object. They measure in meters per second squared (m/s2) or in G-forces (g).
- A single G-force for us here on planet Earth is equivalent to 9.8 m/s2, but this does vary slightly with elevation (and will be a different value on different planets due to variations in gravitational pull). Accelerometers are useful for sensing vibrations in systems or for orientation applications.

- Accelerometers are electromechanical devices that sense either static or dynamic forces of acceleration. Static forces include gravity, while dynamic forces can include vibrations and Accelerometers can measure acceleration on one, two, or three axes. 3-axis units are becoming more common as the cost of development for them decreases.
- Generally, accelerometers contain capacitive plates internally. Some of these are fixed, while others are attached to minuscule springs that move internally as acceleration forces act upon the sensor. As these plates move in relation to each other, the capacitance between them changes. From these changes in capacitance, the acceleration can be determined.
- Other accelerometers can be centered around piezoelectric materials. These tiny crystal structures output electrical charge when placed under mechanical stress (e.g. acceleration).



- For most accelerometers, the basic connections required for operation are power and the communication lines. As always, read the datasheet to ensure proper connections are made.

COMMUNICATION INTERFACE:

- Accelerometers will communicate over an analog, digital, or pulse-width modulated connection interface.

- Analog - Accelerometers with an analog interface show accelerations through varying voltage levels.

- These values generally fluctuate between ground and the supply voltage level. An ADC on a microcontroller can then be used to read this value. These are generally less expensive than digital accelerometers.

- Digital - Accelerometers with a digital interface can either communicate over SPI or I2C communication protocols. These tend to have more functionality and be less susceptible to noise than analog accelerometers.

- Pulse-Width Modulation (PWM) - Accelerometers that output data over pulse-width modulation (PWM) output square waves with a known period, but a duty cycle that varies with changes in acceleration.

POWER

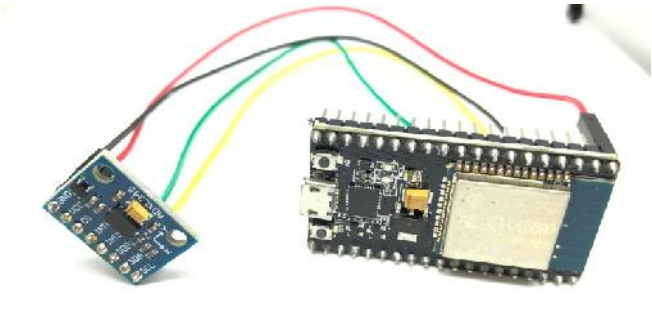
- Accelerometers are generally low-power devices. The required current typically falls in the micro (µ) or milli-amp range, with a supply voltage of 5V or less.
- The current consumption can vary depending on the settings (e.g., power saving mode versus standard operating mode). These different modes can make accelerometers well suited for battery powered applications.
- Make sure that proper logic levels are matched, especially with the digitl interfaces.

RANGE

- Most accelerometers will have a selectable range of forces they can measure. These ranges can vary from ±1g up to ±250g. Typically, the smaller the range, the more sensitive the readings will be from the accelerometer.
- For example, to measure small vibrations on a tabletop, using a small-range accelerometer will provide more detailed data than using a 250g range (which is more suited for rockets).

ADDITIONAL FEATURES:

- Some accelerometers include features such as tap detection (useful for low-power applications), free-fall detection (used for Active Hard Drive Protection), temperature compensation (to increase accuracy in dead reckoning situations) and 0-g range sensing, which are other features to take into consideration when purchasing an accelerometer.
- The need for these types of features on the accelerometer will be determined by the application in which the accelerometer is incorporated.
- There are also IMUs (Inertial Measurement Units) available, which can include accelerometers, gyroscopes and even, occasionally, magnetometers into a single IC package or board. Some examples of this include the MPU6050 and MPU9150.
- These are commonly used in motion tracking applications and UAV guidance systems, where location and orientation of an object is important.



The Accelerometer module has 5 pins i.e.,

- VCC - To be connected to NodeMCU +3.3v.
- X - To be connected to Analog Pin A0 of the NodeMCU.
- Y - NIL
- Z - NIL
- GND - To be connected to Ground Pin (GND) of the NodeMCU.

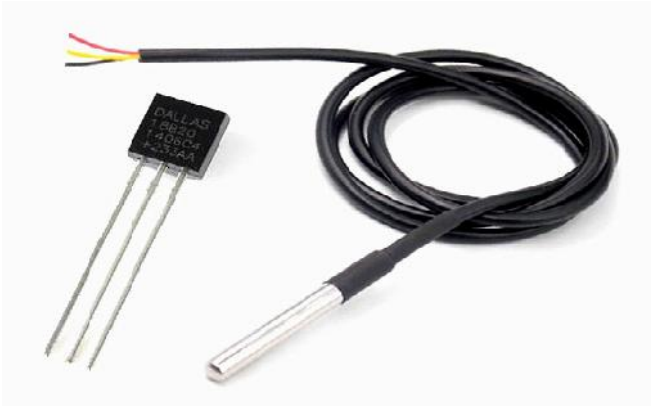
DS18B20 TEMPERATURE SENSOR

Pin Configuration

No:	Pin Name	Description
1	Ground	Connect to the ground of the circuit
2	Vcc	Powers the Sensor, can be 3.3V or 5V
3	Data	This pin gives output the temperature value which can be read using 1-wire method

DS18B20 SENSOR SPECIFICATIONS

- Programmable Digital Temperature Sensor
- Communicates using 1-Wire method
- Operating voltage: 3V to 5V
- Temperature Range: -55°C to +125°C
- Accuracy: ±0.5°C
- Output Resolution: 9-bit to 12-bit (programmable)
- Unique 64-bit address enables multiplexing
- Conversion time: 750ms at 12-bit
- Programmable alarm options
- Available as To-92, SOP and even as a waterproof sensor

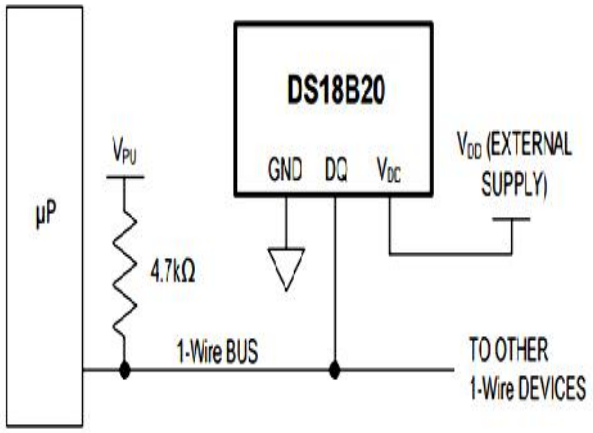


DS18B20 Sensor

The **DS18B20** is a 1-wire programmable Temperature sensor from maxim integrated. It is widely used to measure temperature in hard environments like in chemical solutions, mines or soil etc. The constriction of the sensor is rugged and also can be purchased with a waterproof option making the mounting process easy. It can measure a wide range of temperature from **-55°C to +125°** with a decent accuracy of **±5°C**. Each sensor has a unique address and requires only one pin of the MCU to transfer data so it a very good choice for measuring temperature at multiple points without compromising much of your digital pins on the microcontroller.

How to use the DS18B20 Sensor

The sensor works with the method of 1-Wire communication. It requires only the data pin connected to the microcontroller with a pull up resistor and the other two pins are used for power as shown below.

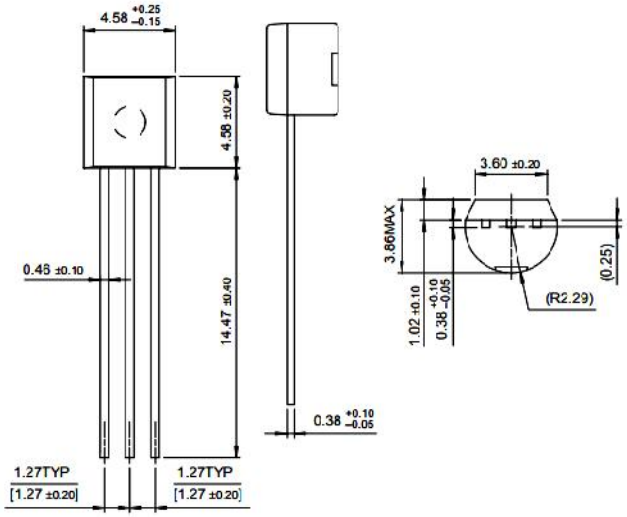


The pull-up resistor is used to keep the line in high state when the bus is not in use. The temperature value measured by the sensor will be stored in a 2-byte register inside the sensor. This data can be read by the using the 1-wire method by sending in a sequence of data. There are two types of commands that are to be sent to read the values, one is a ROM command and the other is function command. The address value of each ROM memory along with the sequence is given in the datasheet below. You have to read through it to understand how to communicate with the sensor.

APPLICATIONS:

- Measuring temperature at hard environments
- Liquid temperature measurement
- Applications where temperature has to be measured at multiple points

2D-Model



Vibration sensor

What is a Vibration Sensor?

The vibration sensor is also called a piezoelectric sensor. These sensors are flexible devices which are used for measuring various processes. This sensor uses the piezoelectric effects while measuring the changes within acceleration, pressure, temperature, force otherwise strain by changing to an electrical charge. This sensor is also used for deciding fragrances within the air by immediately measuring capacitance as well as quality.

In a standard application (50g **range**), the sensitivity of a typical **vibration sensor** is 100mV/g, while in low **vibration** applications (10g) the sensitivity is 500mV/G. **Vibration** frequency – Knowing the frequency span you need to measure is as important as knowing the **vibration range**

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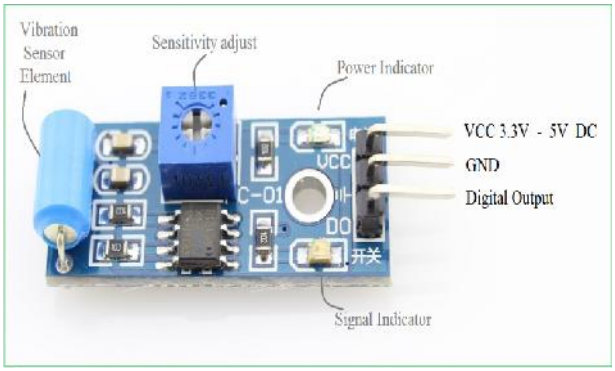
Vibration Sensor Working Principle

The working principle of vibration sensor is a sensor which operates based on different optical otherwise mechanical principles for detecting observed system vibrations.

The sensitivity of these sensors normally ranges from 10 mV/g to 100 mV/g, and there are lower and higher sensitivities are also accessible. The sensitivity of the sensor can be selected based on the application. So it is essential to know the levels of vibration amplitude range to which the sensor will be exposed through out mesurements



IOT

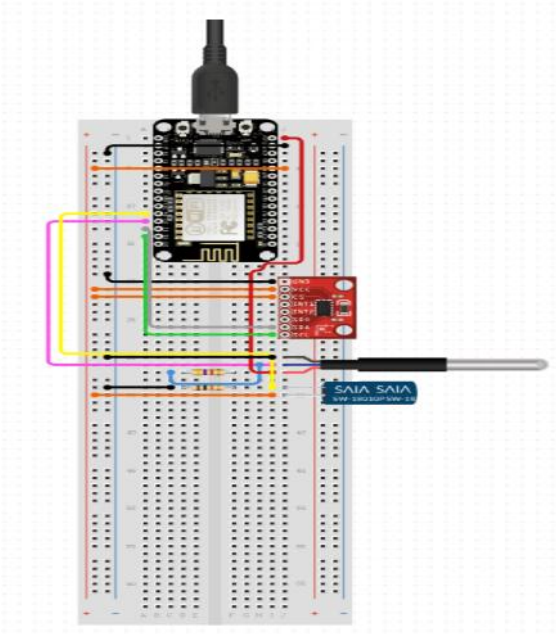
The internet of things, or IoT, is asystem of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

A thing in the internet of things can be a person with a heart monitor implant, a farm animal with a biochip transponder, an automobile that has built-in sensors to alert the driver when tire pressure is low or any other natural or man-made object that can be assigned an Internet Protocol (IP) address and is able to transfer data over a network.

V. CONCLUSION

In conclusion, the proposed anti-smuggling system for trees in the forest using IoT technology, specifically Node MCU, vibration sensors, accelerometers, and temperature sensors, has the potential to address the issue of illegal tree logging and smuggling in forests. The system can effectively monitor and detect any unauthorized tree cutting and transportation, providing real-time alerts to forest officials, who can then take prompt action to prevent further illegal activities. Implementing this system can significantly reduce the incidence of illegal tree logging and smuggling, thereby protecting the natural environment and preserving forests for future generations. Additionally, it can promote sustainability and responsible forest management, contributing to the achievement of global climate change and sustainable development goals. The use of IoT technology in forest management presents promising opportunities for protecting our planet's forests, and the proposed anti-smuggling system for trees in the forest is a step in the right direction towards achieving this goal.

CIRCUIT DIAGRAM



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