International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

ILLEGAL LOGGING DETECTION BASED ON ACOUSTICS

Vinaya Raj[1], Ann Rose K Jose[2], Arun George[3] , Athul K[4]

[1]*Student(B.Tech.), Electrical Department, Mar Athanasius College of Engineering, Kothamangalam, India*
[2]*Student(B.Tech.), Electrical Department, Mar Athanasius College of Engineering, Kothamangalam, India*

Abstract - *An acoustic experiment based on the discovery of illegal logging in the forest. A framework for the automatic detection of a number of forest activities including illegal logging, poaching and any other illegal activities using audio surveillance is presented. It incorporates audio recording surveillance channels using a microphone and receives audio samples that are then processed and classified into machine learning into incoming and outgoing sounds. The sound of various functions such as tree falling, chainsaw sound, human voice and natural sounds of wind, animals and birds are also recorded in the system and unwanted sounds from this are eliminated using ML technology. This method is modular, easy to produce and energy efficient as it relies on audio evidence and uses powerful ML algorithms. The system can be adapted to different forest features and can be used equally during the day and night.*

Key Words: Machine Learning, Acoustics, Logging, Audio evidence, Forest.

1. INTRODUCTION

Forests are a natural resource that has many important benefits for biodiversity. There are many factors that affect the existence and sustainability of forests. The biggest threat is illegal logging that can lead to uncontrolled and irreversible deforestation. In addition, illegal logging is considered a major threat to biodiversity, as forests support about 90 percent of the world's biodiversity. Over the decades, advances in remote sensing technology, as well as advances in information and communication technology (ICT) have led to the use of automated or automated surveillance solutions in a wide range of areas such as like forests. A method based on acoustic experiments to find deforestation in the forest introduces. The method presented is modular and as it depends on sound evidence, it can be adapted to suit forest features and can be used equally during the day and night.

2. SOFTWARE SIMULATION

1.1 Creating Dataset

The raw data set is taken and divided into three main labels such as "wood cutting sound", natural sounds "and" animal sounds "to hear each sound separately. The main goal is to detect the sound of wood cutting. The simultaneous audio recording varies depending on the device memory. The ST B-L475E-IOT01A developer board has enough memory to capture 60 seconds of audio at a time, and the Arduino Nano 33 BLE Sense has enough memory for 16 seconds.

Training is done using edge impulse software. After the collection of raw data processing and reading can be done using Mel-Frequency Energy to separate the data. A second sound sample will suffice to determine whether the wood cutting sound, natural sound or animal noise, so you should make sure the window size is set to 1000 ms. Each green sample is cut into multiple windows, as well as a window Upgrade field controls the removal of each subsequent window from the first. For example, an increase in Window value of 1000 ms can cause each window to start 1 second after the start.

1.2 Model Training

The Artificial Neural Network (ANN) is an algorithm used for machine learning of sound segregation, in which each database is cut into chunks and transferred to a processing block. The result of the MFE block is a spectrogram, which is also given a reading block. The study block contains a neural network component similar to a biological neuron. The model will learn individual sound samples that are similar to the individual.

3. DEPLOYMENT OF MODEL

3.1 CONTINUOUS INTERFACING

When audio classification is performed to detect sounds in real time it is necessary to ensure that the entire piece of information is recorded and analyzed, in order to avoid missing events. The device needs to capture audio samples and analyze them at the same time.

Through continuous defrosting, small sample baths or fragments are used and transferred to the determination process. In the process of determining the baths are set in chronological order in FIFO (First In First Out) corresponding to the size of the model. After each repetition, the oldest piece is removed from the end of the bath and a new piece is inserted at the beginning. In each piece, the concept is used several times depending on the number of pieces used in the model. So much so that considering a model with a 1000ms model window and the pieces of each model set to 4 results in a piece size of 250ms.

4. HARDWARE IMPLEMENTATION

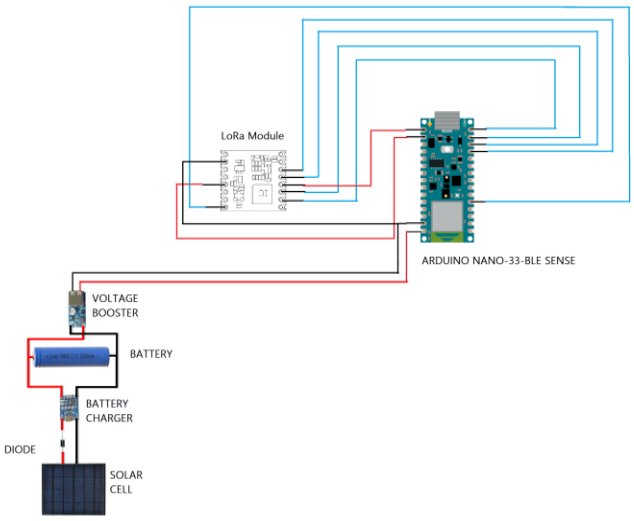
In order to use the system a hardware is built with both transmission and reception side. The transmission side mainly contains Arduino nano BLE sense 33 to record sounds with Lora transmitter for RF signal transmission. It is also powered by a solar cell. The receiving side consists of the Lora receiver RF signal receiver, arduino UNO to process the received signal and the output is displayed on the LCD display.

4.1 TRANSMISSION SIDE

There are a number of communication technologies available for communication between IoT devices today, and the most popular are Wi-Fi and Bluetooth. But it has limitations like high power consumption, limited width, limited access points etc. The ESP8266 module is the most popular Wi-Fi module used on IoT devices. LoRa and Arduino Lora Communication technology was introduced as it is capable of transmitting very long distances using low power.

In the transfer phase we can send audio signals from one Arduino to another using the LoRa SX1278 module. Arduino nano 33 BLE will hear unusual sounds like chopping wood, human voice in the woods etc. After processing, it will detect the actual sound. On the transmitter side is the Lora module, which contains a rod. The output signal is sent to the Lora module. A high-gain antenna will gain a longer distance and better signal quality in the Lora module, but it should be directed directly at the receiving antenna side. It will modify the data wants to send to radio waves, which the transmitter will send out. The BLE sensor is connected to the Arduino transmission side. The LoRa module contains 16 pins, of these six pins are GPIO pins, and four are Ground pin. This LoRa module operates in 3.3V, so the 3.3V pin on LoRa is connected to the 3.3v pin on the Arduino UNO board.

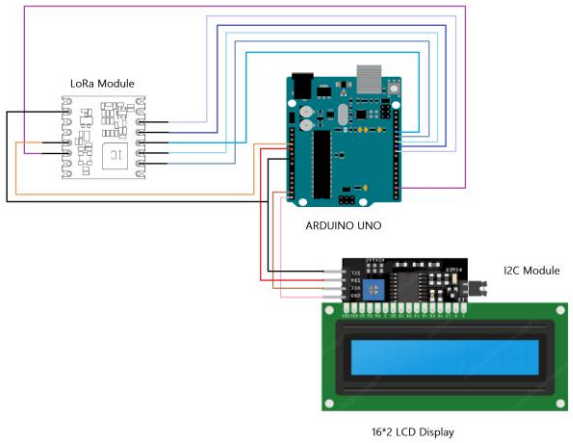
Circuit diagram -1: Transmission side



4.2 RECEIVING SIDE

On the Reception side, we will use Arduino Uno with a LoRa module and a 16 × 2 LCD module. for arduino you have and the LCD display unit. The arduino uno provides the interface for the Lora module and the LCD display. Then the LCD display shows the input signal that arduino nano 33 BLE found. A diagram of the circuit to connect Arduino via LoRa and the LCD module is shown below.

Circuit diagram -2 : Receiving side



5. FUTURE WORKS

Our approach focuses on audio features, which can be easily altered in many domains such as environmental safety. Our future activities can be set to multimodal ie. Both audio and visual analysis. As a future project, we can use the automated classification process to categorize our project. And we can include the system entered the drone aircraft for surveillance purposes. In the future, we may be able to perform large-scale experiments with large data sets to increase the accuracy of detection using a deep neural network. A system that uses a combination of audio sensor and vibrating sensor can be used. The sound sensor works to identify the chainsaw while vibrating the sensor uses to detect the fall of trees. API technology can be used as a protocol for storing all sensed data collected. Local noise processing is another problem from here. The new method is therefore developed based on the principles of Acoustic Multilateration that will measure the sound source. Using the Internet for Natural forest technology, we can integrate sound detection networks and acoustic signal analyzes to improve the robustness of a ground-based tracking system. The Arduino nano BLE 33 sensor also has heat and humidity sensors that can be installed in our system to detect forest fires.

3. CONCLUSION

A new forest surveillance facility to detect illegal logging used for noise detection on a wireless sensor network is

being developed here. The use of sound sensors generates the ability to handle illegal logging. We initially trained our Machine Learning model using edge impulse software that appears to be 85.7% accuracy. We trained the model using three key data set under the animal voice label, natural sounds and wood cutting sound. After a successful training session, a model was introduced. Arduino Nano BLE sense 33 featuring built-in microphone for recording real-time sounds. After shipment the device was tested in an open area where it successfully detected and analyzed wood cutting, natural sound and animal voices and returned output values. The field test confirmed that our Arduino nano BLE sense 33 device can capture log cutting sound. Analysis of the recorded data shows that the Mel-frequency cepstral coefficients can differentiate the chain signal signals separately from the surrounding environment. With this conceptual evidence, we have tools for collecting large acoustic data and how to remove discriminatory features. Both are needed in training in deep learning networks.

REFERENCES

[1] D. Gilman, "Unmanned aerial vehicles in humanitarian response,"United Nations Office for the Coordination of Humanitarian Affairs, 2018

[2] K. J. Piczak, "Environmental sound classification with convolutional neural networks, in Machine Learning for Signal Processing (MLSP)", 2015 IEEE 25th International Workshop on. IEEE, 2015, pp. 1–6.

[3] L. Hema, D. Murugan, and R. M. Priya, "Wireless sensor network based conservation of illegal logging of forest trees," in Emerging Trends In New and Renewable Energy Sources And Energy Management (NCET NRES EM),IEEE National Conference, 2014.

[4] S. F. Ahmad and D. Singh, "Automatic detection of tree cutting in forests using acoustic properties,"Journal of King Saud University Computer and Information Sciences, Feb 2019.