

# **BEEWAY ELEPHANT DETECTION AND FOREST SURVEILLANCE**



# TEAM MEMBERS

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## **PROBLEM:**

- Human-elephant conflict is a pressing issue, especially in regions where forest boundaries overlap with human settlements(Places like Anaikatti, Coimbatore).
- As elephants venture into these areas, they often come into contact with people and property, leading to safety concerns, crop damage, and sometimes harm to both humans and wildlife.
- This conflict has escalated over time, with both communities and elephants suffering the consequences

# INSPIRATION:

- The BeeWay project draws inspiration from the "Elephants and Bees Project" conducted in Kenya by Save the Elephants.
- The Kenyan project demonstrated that elephants naturally avoid bees and can be deterred using bee sounds.
- By constructing beehive fences, researchers effectively created a barrier to prevent elephants from entering farms and damaging crops.
- <https://elephantsandbees.com/>





## OUR SOLUTION:

- Our BeeWay project builds on this concept with a digital approach. Instead of physical beehives, we utilize technology for early detection and deterrence.
- With ESP32-CAM modules, PIR sensors, and a custom Light Weight AI model, our system detects elephants and plays artificial bee sounds to scare them away, providing a scalable, cost-effective, and humane solution for human-elephant conflict management.

# LITERATURE SURVEY

Author(s) / Year	Study Title	Key Findings	Relevance to Our Project
Lee et al. (2019)	"Deep Learning for Animal Detection"	Deep learning models effectively detect large animals like elephants in real-time camera feeds.	Supports the use of AI for accurate, real-time detection in elephant zones.
Chen et al. (2020)	"Challenges in Animal Detection"	Models must adapt to environmental conditions (lighting, weather, etc.) for reliable detection in natural settings.	Highlights the need for robust AI models in varied conditions for BeeWay.
O'Connor and Singh (2021)	"Natural Sound Deterrents for Wildlife"	Elephants show an aversion to bee sounds, offering a non-lethal deterrent solution.	Validates BeeWay's use of bee sounds as a humane deterrent mechanism.
Reddy et al. (2022)	"Data for Wildlife Detection Accuracy"	Diverse datasets improve the accuracy of wildlife detection models.	Supports the need for diverse image data in BeeWay's elephant detection AI.
Patel and Deshmukh (2023)	"Real-Time IoT Alerts for Wildlife Monitoring"	Low-cost, wireless IoT systems can effectively notify communities of wildlife presence in real-time.	Reinforces the idea of using Telegram for instant alerts in BeeWay.
Chen et al. (2023)	"Scalable Wildlife Conservation Technology"	Emphasizes accessible, community-centered solutions for wildlife conservation.	Aligns with BeeWay's goal to engage communities in conservation efforts.

## **METHODOLOGY:**

The BeeWay project employs a multi-layered approach for real-time elephant detection and deterrence in forested areas to minimize human-elephant conflict.

The layers for the BeeWay project are:

- i. Detection Layer
- ii. Notification Layer
- iii. Data Processing and Storage Layer
- iv. User Interface Layer





## METHODOLOGY:

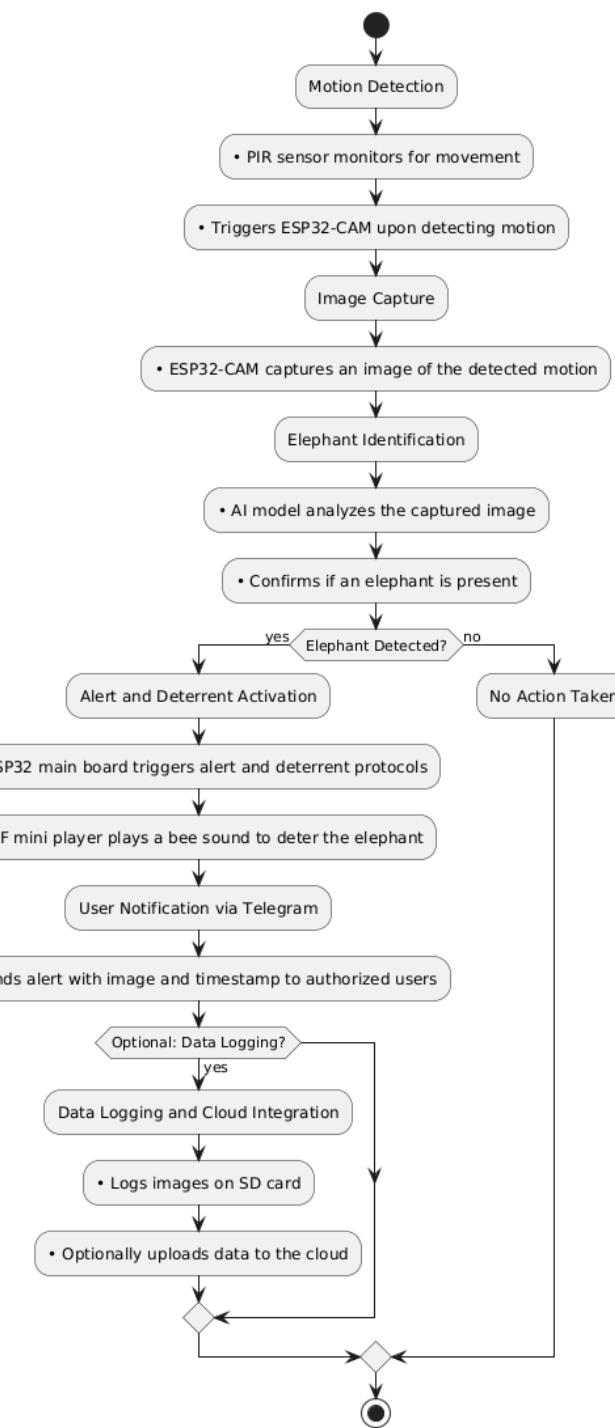
- **Detection Layer:** The ESP32-CAM module, paired with a PIR motion sensor, captures images upon motion detection. These images are processed locally by an AI model trained via Edge Impulse to identify elephants accurately.
- **Notification Layer:** When an elephant is detected, the ESP32-CAM sends the image to the ESP32 main board, which transmits it to designated users via Telegram for immediate alerts. This layer also activates the DF mini player to play bee sounds, a natural deterrent for elephants.

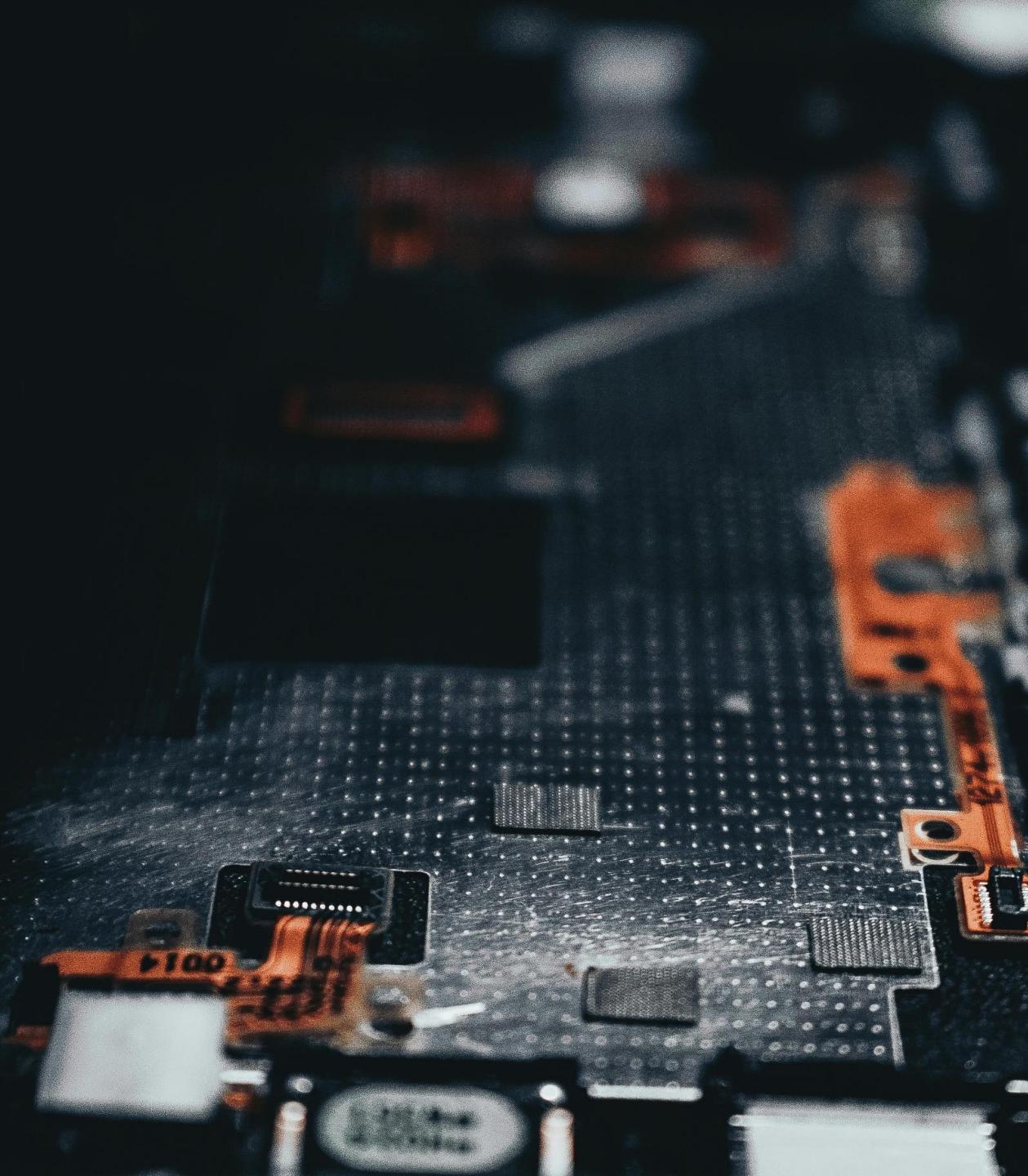
## METHODOLOGY:

- **Data Processing and Storage:** The AI model on the ESP32-CAM conducts image analysis on-device, minimizing the need for cloud computing. Data can also be optionally uploaded to cloud storage for further analysis and model improvement.
- **User Interface:** A Telegram bot interface provides accessible, user-friendly controls for receiving alerts, managing notifications, and configuring system settings.



# WORKFLOW DIAGRAM





# WORKFLOW:

1. Motion Detection
  - o PIR sensor monitors for movement.
  - o Triggers ESP32-CAM upon detecting motion.
2. Image Capture
  - o ESP32-CAM captures an image of the detected motion.
3. Elephant Identification
  - o AI model analyzes the captured image.
  - o Confirms if an elephant is present.
4. Alert and Deterrent Activation
  - o ESP32 main board triggers the alert and deterrent protocols.
  - o DF mini player plays a bee sound to deter the elephant.
5. User Notification via Telegram
  - o Sends alert with image and timestamp to authorized users.
6. Data Logging and Cloud Integration (Optional)
  - o Logs images on SD card.
  - o Optionally uploads data to the cloud for further analysis.

# SCREENSHOTS

**EON™ Compiler**  
Same accuracy, 10% less RAM, 10% less ROM.

**Quantized (int8)**

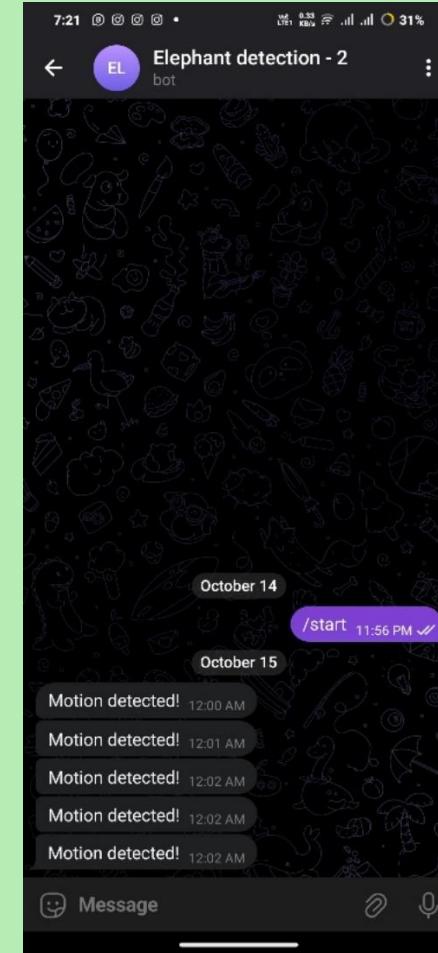
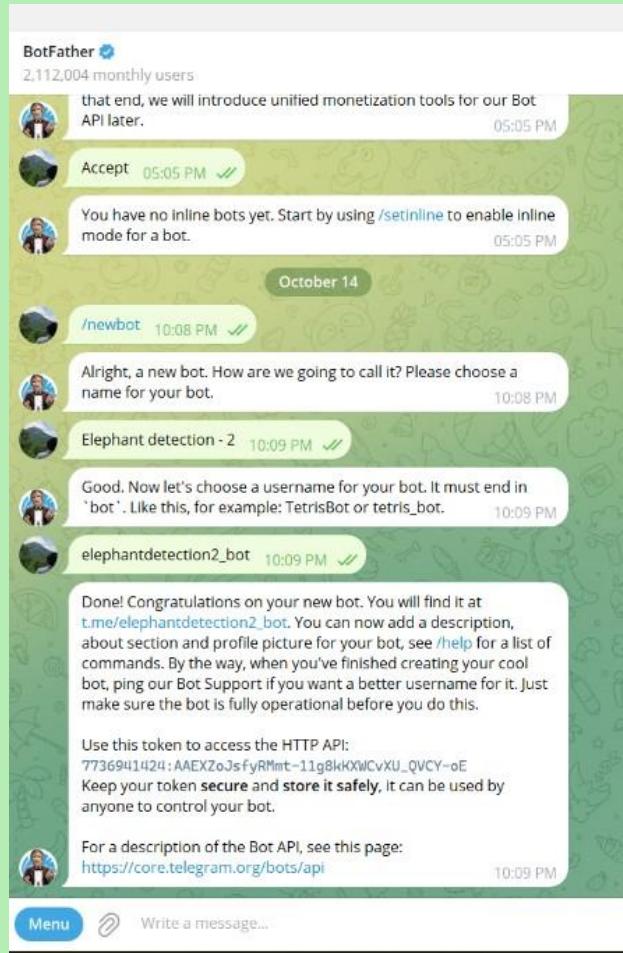
	IMAGE	TRANSFER LEAR...	TOTAL
LATENCY	4 ms.	152 ms.	<b>156 ms.</b>
RAM	4.0K	756.7K	<b>756.7K</b>
FLASH	-	1.0M	-
ACCURACY			-

**Unoptimized (float32)**

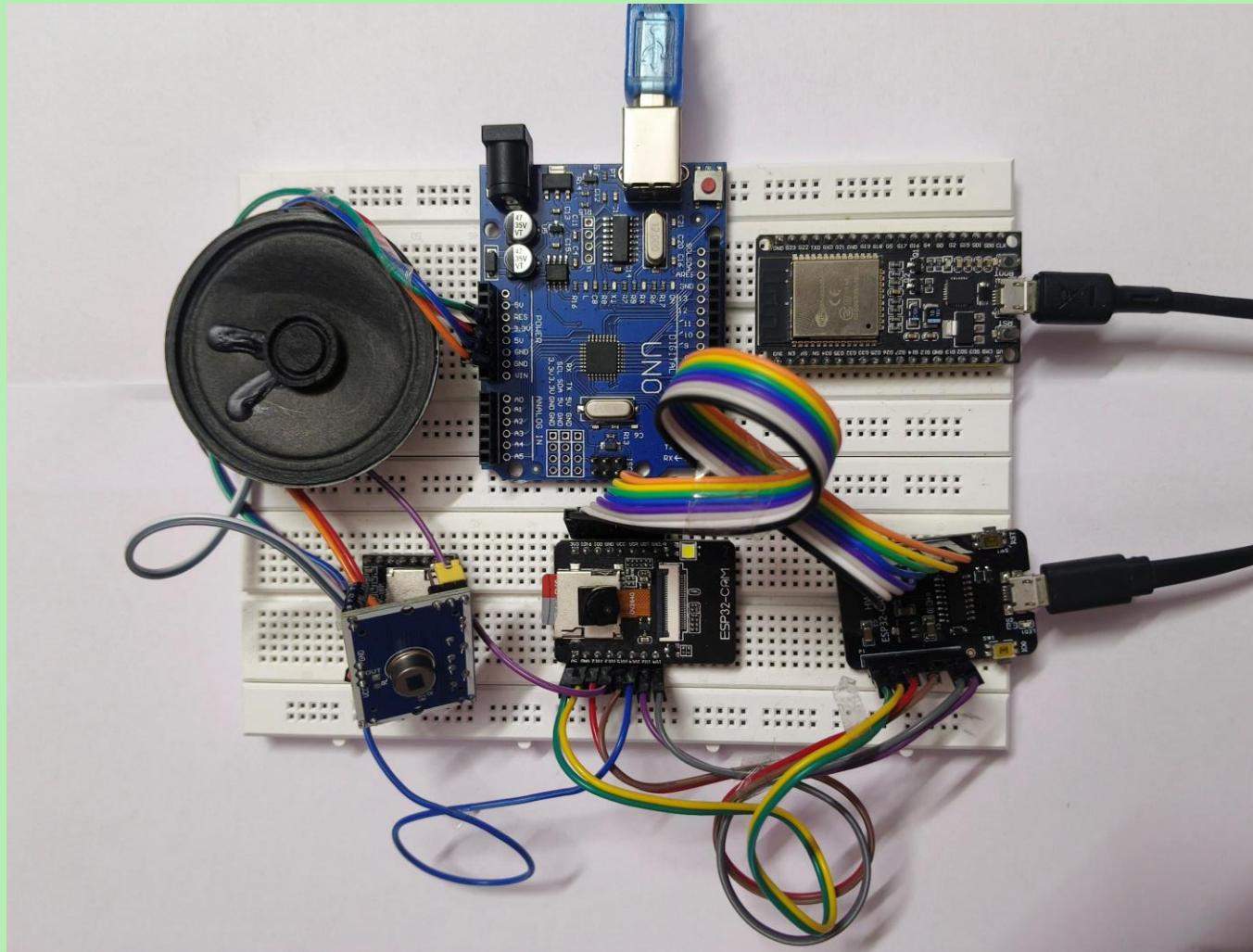
	IMAGE	TRANSFER LEAR...	TOTAL
LATENCY	4 ms.	438 ms.	<b>442 ms.</b>
RAM	4.0K	2.4M	<b>2.4M</b>
FLASH	-	3.2M	-
ACCURACY			-

To compare model accuracy, run model testing for all available optimizations.

**Run model testing**



# PROTOTYPE





**COMPARISION WITH  
OTHER EXISTING  
SYSTEM**

**MADUKKARAI AI  
CAMERA SYSTEM**

Feature	BeeWay Project	Madukkarai AI Camera System
Primary Objective	Detecting and deterring elephants to prevent human-elephant conflicts in rural and forest-adjacent areas.	Monitoring elephant movements along railway tracks to prevent elephant-train collisions.
Key Technology Used	ESP32-CAM with Edge Impulse AI model, PIR sensor, DF mini player for sound deterrence.	High-definition AI cameras placed along railway tracks, integrated with software to detect elephant intrusions.
Detection Method	Uses PIR sensor for motion detection, AI model for elephant identification, and bee sound deterrent.	Detects elephants visually via AI cameras trained to recognize elephant presence on railway tracks.
Alert and Notification System	Sends real-time alerts via Telegram to authorized users with captured images.	Sends alert notifications to railway authorities to allow time to stop or slow down trains, preventing accidents.
Response Mechanism	Plays bee sounds to naturally deter elephants from entering human spaces; not reliant on human intervention.	Focused on alerting train operators; relies on human intervention to avoid collisions.
Data Logging and Analysis	Optionally stores images on SD cards or uploads to the cloud for further analysis and AI model improvements.	Analyzes patterns to optimize camera placement and improve railway safety strategies.
Scope of Coverage	Applicable in varied locations like villages, forest borders, and small farmland areas near elephant habitats.	Specifically positioned along railway tracks to monitor and address train-related elephant intrusion risks.
Cost and Scalability	Uses low-cost hardware like ESP32-CAM, making it scalable and accessible for remote areas.	Likely involves more expensive equipment high-definition cameras and custom software
Conservation Impact	Supports conservation by deterring elephants humanely, promoting coexistence.	Helps conserve elephants by preventing fatal train accidents along railway corridors.

# FUTURE WORKS:

- **Improving Detection Accuracy**(Currently 85%)
- **Expanding Deterrent Methods**
- **Increased Range and Coverage**
- **Enhanced Real-Time Communication**(SMS)
- **Data Privacy and Security**
- **Integration with Local Authorities and Conservation Networks**
- **Battery Optimization and Renewable Power Sources**
- **Enhanced Community Training and Involvement**
- **Scalability for Detection of Other Wildlife**



Subhash Raveendran <subhashraveendran1@gmail.com>

## Request for Discussion on Elephant Detection System for Anaikatti

forsec <forsec@tn.gov.in>

To: Subhash Raveendran <subhashraveendran1@gmail.com>

Cc: Fielddirectoratr <fielddirectoratr@gmail.com>

14 October 2024 at 14:16

Sir,

As instructed by Principal Secretary, you may contact & meet Thiru.Ramasubramanian, Field Director & Conservator of Forests, Coimbatore & Anaimalai Tiger Reserve.

PS to Principal Secretary

ECCF Dept.

[Quoted text hidden]



**Subhash Raveendran** (He/Him) • You  
Innovator | Flutter Developer| IOT Developer | ...  
3w •

Bee-Way: A Forest Surveillance Solution for Forest Conservation.

We're Excited to introduce Bee-Way, a groundbreaking project aimed at protecting elephants through the innovative use of bee sounds. By harnessing the natural deterrent power of bees, we're developing an electronic device that can safely and effectively deter elephants from encroaching on human settlements.

Our team has been working to understand the complex dynamics of human-elephant conflict and explore the potential of bee-inspired technology to provide a sustainable solution. Through extensive research and experimentation, we've developed a prototype that emits a specific frequency of bee sounds, [...more](#)



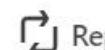
18 comments · 7 reposts



Like



Comment



Repost



Send



2,199 impressions

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Add a comment...



# CODING

The screenshot shows the Arduino IDE 2.3.3 interface. The top menu bar includes File, Edit, Sketch, Tools, Help, and a connection status for an ESP32 Dev Module. The main window has a dark theme. On the left, the Library Manager is open, showing the 'LIBRARY MANAGER' tab. A search bar at the top of the manager lists 'samplewrking\_1aimodel' as the current project. Below the search bar, there are filters for Type (All) and Topic (All). The results list three libraries:

- EspNowNetworkShared** by Johan Böhl...  
Shared code for the EspNowNetwork See  
<https://github.com/Johboh/EspNo...>  
More info  
1.0.0 INSTALL
- Microfire\_HABridge** by Microfire LLC  
Create a Home Assistant sensor from any hardware and send measurements with ESPNow or...  
More info  
1.0.0 INSTALL
- QuickESPNow** by George Papamichail  
An Arduino library for handling ESP-NOW communication. This library provides easy-to-use functions to s...  
More info  
2.0.0 INSTALL

The code editor on the right contains the following C++ code:

```
1 #include <subashraveendran-project-1_inferencing.h> // Edge Impulse Model Header
2 #include <esp_camera.h>
3 #include <WiFi.h>
4 #include "esp_now_send_image.h" // Separate tab for image sending
5
6 #define CAMERA_MODEL_AI_THINKER
7 #include "camera_pins.h"
8
9 // Define missing constants
10 #define EI_CAMERA_RAW_FRAME_BUFFER_COLS 320
11 #define EI_CAMERA_RAW_FRAME_BUFFER_ROWS 240
12 #define EI_CAMERA_FRAME_BYTE_SIZE 3
13
14 static bool debug_nn = false;
15 static bool is_initialised = false;
16 uint8_t *snapshot_buf;
17
18 static camera_config_t camera_config = {
19     .pin_pwdn = PWDN_GPIO_NUM,
20     .pin_reset = RESET_GPIO_NUM,
21     .pin_xclk = XCLK_GPIO_NUM,
```

The Output window at the bottom shows the progress of a file write and a hash verification:

```
Writing at 0x000d3256... (86 %)
Writing at 0x000d854a... (88 %)
Writing at 0x000e276c... (91 %)
Writing at 0x000e7dd0... (94 %)
Writing at 0x000ed6a2... (97 %)
Writing at 0x000f2eb8... (100 %)
Wrote 943184 bytes (583001 compressed) at 0x00010000 in 51.4 seconds (effective 146.7 kbit/s)...
Hash of data verified.
```

At the bottom of the output, it says "Leaving..." and "Hard resetting via RTS pin..."

At the very bottom of the screen, the status bar shows "Ln 221, Col 7 ESP32 Dev Module on COM16 [not connected]".

A large elephant stands in the center of a dense forest. Sunlight filters through the tall trees, creating bright rays and lens flare effects. The elephant is facing slightly to the right, with its trunk hanging down. The forest floor is covered in fallen leaves and branches.

<\TEAM BEEWAY/>>