ACOUSTIC-BASED DRONE DETECTION

IDENTIFYING UAVS THROUGH SOUND SIGNATURES

THAPAR INSTITUTE OF ENGINEERING & TECHNOLOGY (Deemed to be University)

Mentor:

Dr. Sharad Saxena *(Associate Professor)*

CPG-179 Department of Computer Science & Engineering (CSED)

Submitted By:
Miet Pamecha (102203012)
Gautam (102203061)
Iipsita Devgan (102203408)
Tamanna Bajaj (102203413)
Devansh Dhir (102203449)

PROBLEM & NEED

- **Blind & Costly:** Cameras fail at night, while Radar is too expensive and misses small targets.
- **RF Limits:** Radio scanners cannot detect autonomous drones flying in "radio silence."
- **The Solution:** A low-cost acoustic system to track unhideable motor noise 24/7.

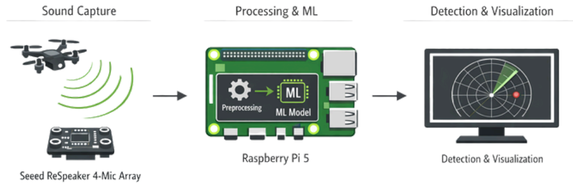
OBJECTIVE

- **Edge Detection:** Real-time, standalone acoustic tracking on Raspberry Pi.
- **AI Classification:** Machine learning identifies drone signatures vs. noise.
- **Localization:** Pinpoints drone angle using Direction of Arrival (DOA).
- **Distance Est.:** Approximates proximity via signal strength analysis.
- **Field Testing:** Validates robustness across diverse real-world environments.

TECH STACK

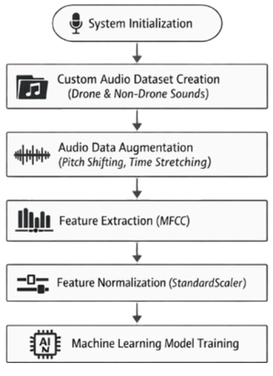
- **Hardware:** Raspberry Pi 5 + ReSpeaker 4-Mic Array
- **Language:** Python 3
- **Libraries:** Scikit-Learn, Librosa, NumPy, Matplotlib.

SYSTEM ARCHITECTURE



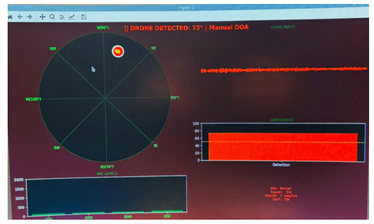
Drone sound is captured by a microphone array, processed on Raspberry Pi 5 using a machine learning model, and visualized on a real-time detection dashboard.

METHODOLOGY & ALGORITHM

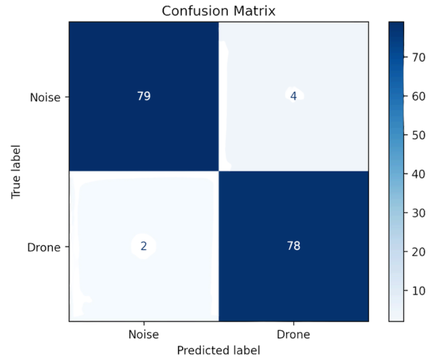


A custom acoustic dataset of drone and non-drone sounds is augmented and processed using MFCC-based normalized features. A supervised classifier is trained with stratified splitting and cross-validation. In real time, audio is continuously monitored and an alert is generated upon drone detection while monitoring continues.

RESULTS



Dashboard



Confusion Matrix

96.32% classification accuracy with reliable real-time drone detection and alert generation.

KEY OUTCOMES

- Achieved 96.32% classification accuracy on test data
- Reliable distinction between drone and non-drone acoustic signals
- Real-time continuous monitoring with alert generation
- Effective performance with minimal false alarms

CONCLUSION & FUTURE WORK

The proposed acoustic-based drone detection system reliably identifies drone sounds in real time and generates alerts during continuous monitoring. The system demonstrates strong classification performance using acoustic features and machine learning, with future work focusing on improved noise robustness, multi-drone detection, deep learning integration.