

ECOVAL: Human-Wildlife Conflict Evaluation System

Project Portfolio | Benhein Michael Ruben L

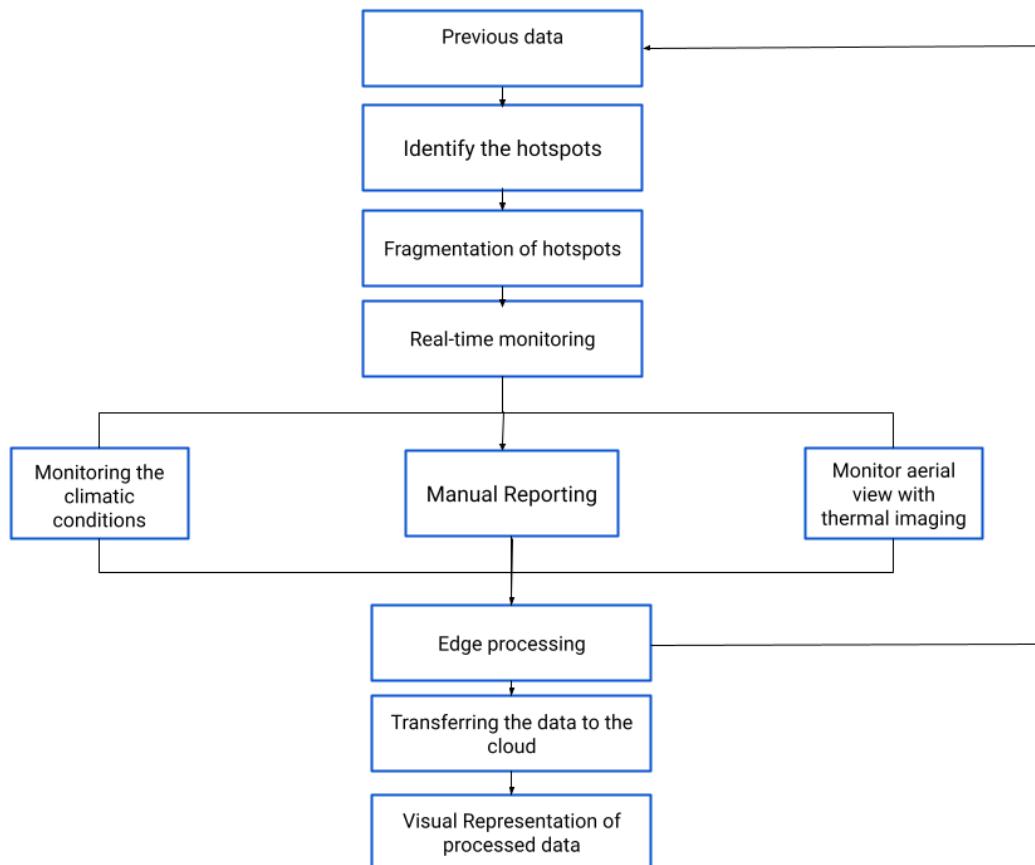
1. Project Abstract

ECOVAL is an IoT-based Minimum Viable Product (MVP) designed to address the critical issue of human-wildlife conflict in forest buffer zones. The system identifies conflict hotspots by analyzing real-time animal behavior and environmental factors, providing automated deterrents at the edge and data-driven insights in the cloud.

2. System Architecture & Flow

The system operates on a feedback loop of **Sensing → Local Action → Cloud Analytics**.

- **Data Acquisition:** Integration of PIR (Motion), Ultrasonic (Distance), and DHT11 (Environment) sensors.
- **Geospatial Intelligence:** Real-time location tagging using the **Neo-6M GPS** module to map specific conflict coordinates.
- **Edge Logic:** Interrupt-Driven Edge Logic: The continuous 180° servo sweep is halted upon PIR motion detection to stabilize the platform for precision Ultrasonic distance measurement.

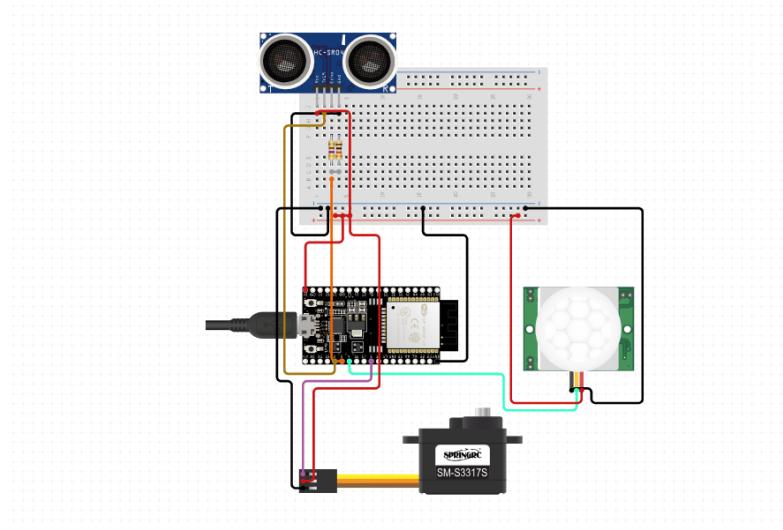


Flowchart

3. Hardware Implementation

The hardware was designed for high reliability in remote forest environments with low power consumption.

- **Controller:** ESP32 (Dual-core, integrated Wi-Fi/Bluetooth).
- **Actuation:** Pulse Width Modulation (PWM) controlled Servo Motor for physical deterrent mechanisms.
- **Circuit Design:** Optimized wiring to handle multiple sensor inputs (PIR, Ultrasonic, GPS) simultaneously.

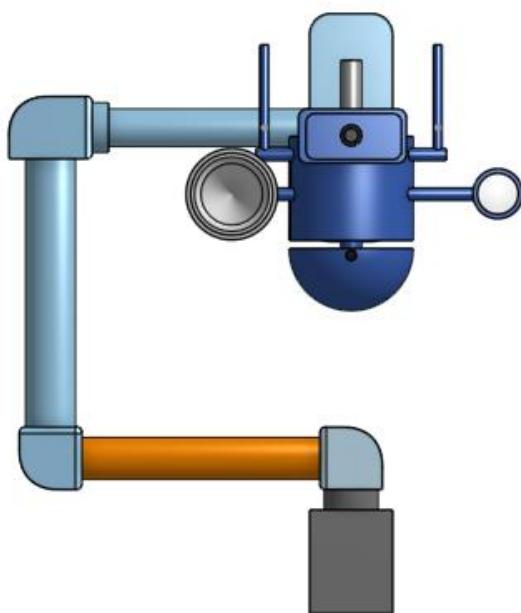


Circuit Diagram

4. Cloud Infrastructure (AWS Stack)

A robust data pipeline ensures that data captured at the forest edge is available for long-term research and government agency monitoring.

- **Protocol:** MQTT for lightweight, low-latency transmission.
- **IoT Gateway:** AWS IoT Core for secure device authentication and message routing.
- **Storage:** Amazon DynamoDB (NoSQL) for high-speed logging of sensor data and GPS coordinates.
- **ETL Process:** Python-based scripts for migrating and cleaning local sensor logs for cloud storage.
- **Serverless Orchestration:** Utilized a dual-AWS Lambda pattern to separate data ingestion (Write) from mobile-app data retrieval (Read) via API Gateway.



CAD of the MVP

5. Key Technical Outcomes

- **Hotspot Analysis:** Enabled precise identification of "conflict hours" and high-risk zones through historical data analysis.
- **Edge Reliability:** Calibrated sensor sensitivity to distinguish between small movement (wind/vegetation) and large animal presence.
- **Scalability:** Designed with a low Bill of Materials (BOM) to allow for wide-scale deployment in rural communities.