

# ECOVAL: Human-Wildlife Conflict Evaluation System

Project Portfolio | Benhein Michael Ruben L

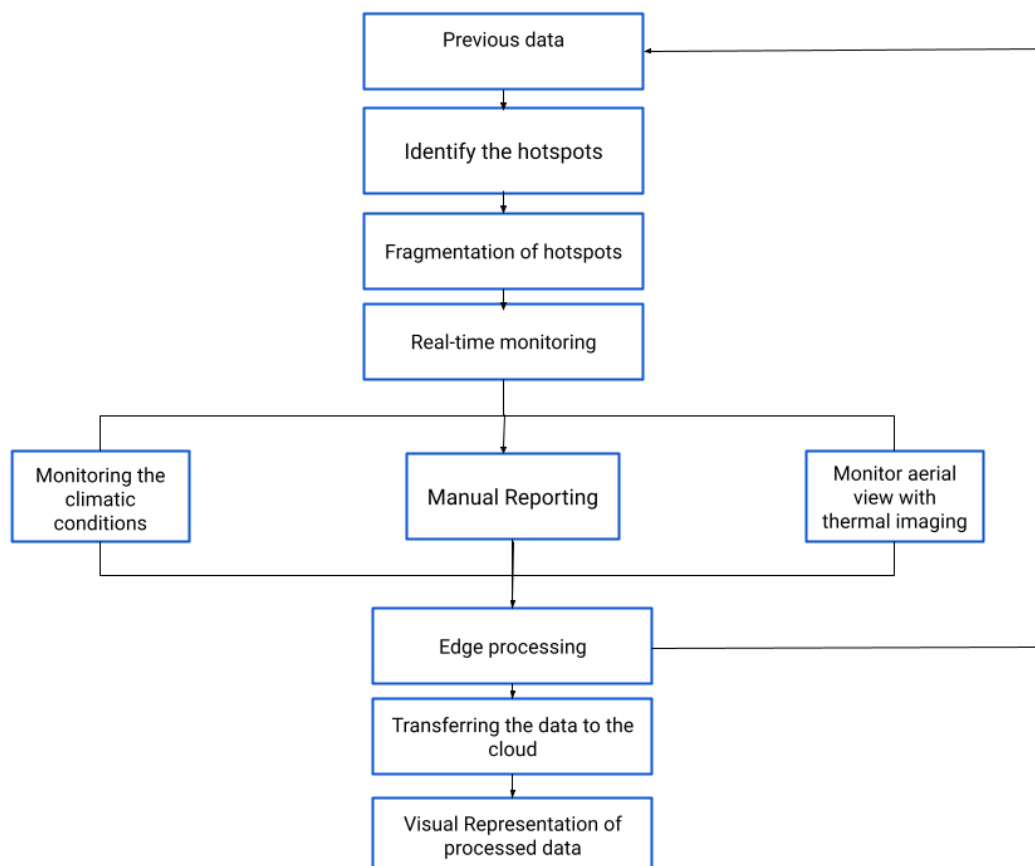
## 1. Project Abstract

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.

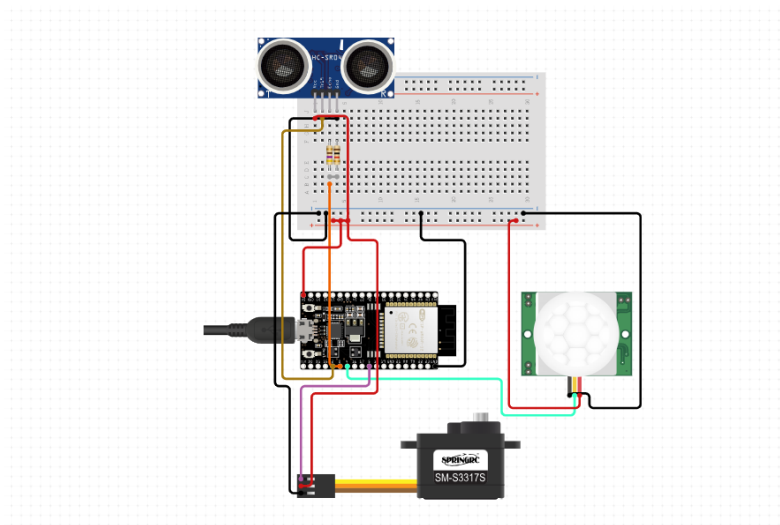


Flowchart

### 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.

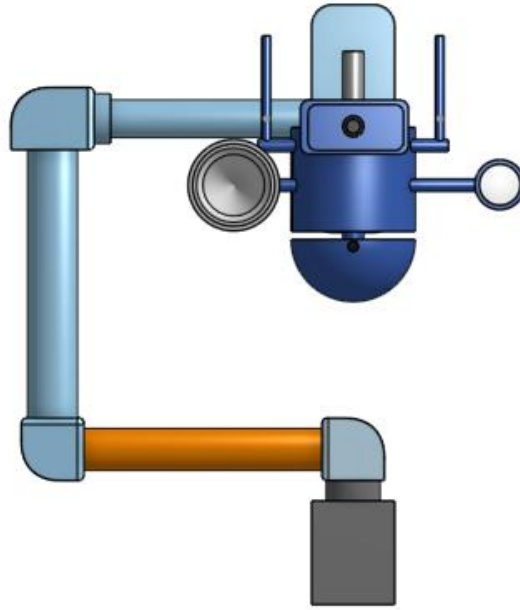


**Circuit Diagram**

### 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.