ECOVAL: Human-Wildlife Conflict Evaluation System

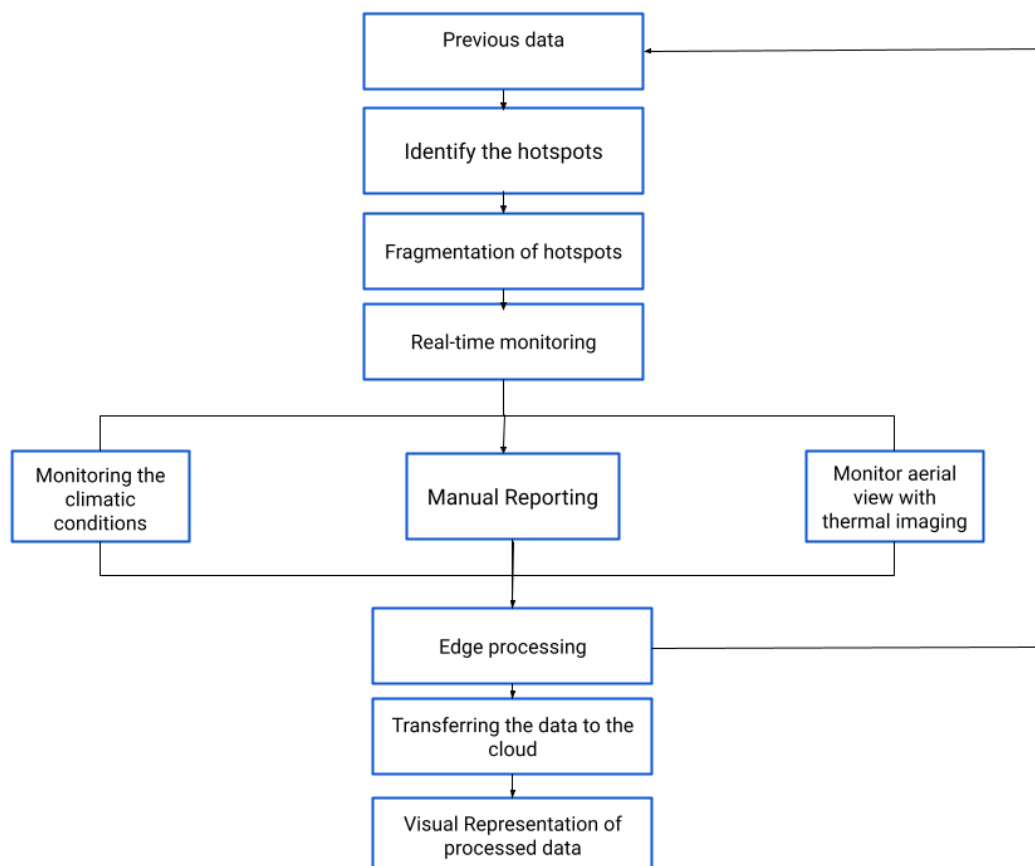**Project Portfolio | Benhein Michael Ruben L**

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:** Immediate triggering of a servo-motor deterrent when a specific proximity threshold is breached.
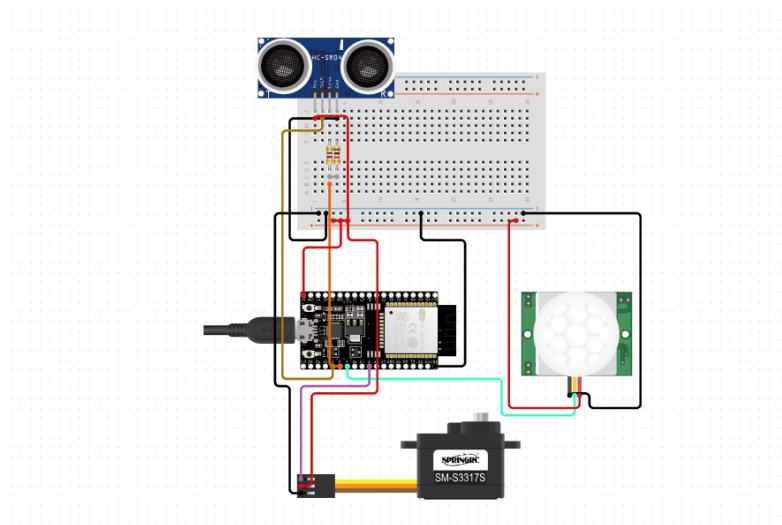

Flowchart

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.
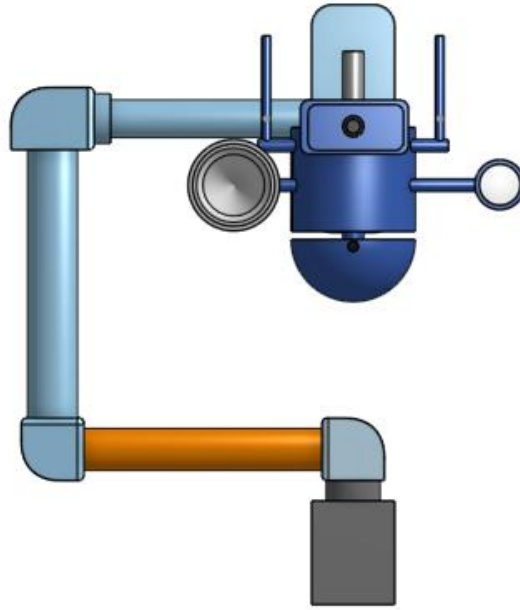

Circuit Diagram

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.

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.