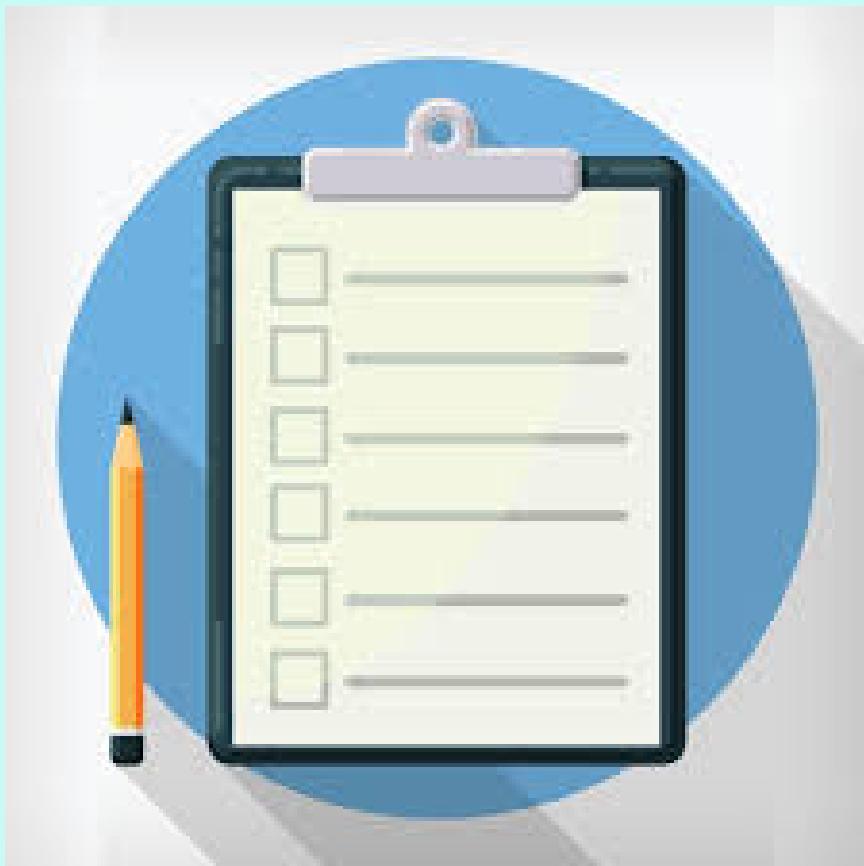
A vertical column of hand-drawn product sketches on the left side of the page. It includes various views of a cylindrical device with a textured surface, a small vertical component, and a hand holding the device. Labels in pink and blue ink point to specific parts: 'KEY TOOLS PORT' at the top, 'SCREEN' and 'PORTS' on the left, 'POWER BUTTON' on the right, 'PINCH AND HOLD TO ACTIVATE DEVICE BUTTON' on the bottom right, and 'QUICK SWIPE TO USE IN BURST MODE' at the bottom. A large horizontal line separates the sketches from the title.

PRODUCT PROTOTYPE

Prepared by: Bhadra D Nair
Roshni Chaudhuri

Date: 20/5/2025

AGENDA



- ↗ **Overview**

- ↗ **Working and Design**

- ↗ **Key Features**

- ↗ **Components**

Our Smart Animal Deterrence System combines AI-powered detection with multi-sensor fusion to identify and deter animals—all while minimizing false alarms.

Unlike traditional systems, ours uses Edge AI to intelligently distinguish between pets, strays, and wild animals, ensuring targeted and ethical deterrence.

It's portable, solar-powered, and works seamlessly in all environments, using customizable outputs . Whether it's a rooftop garden in the city or a farm, our system adapts—making it a cost-effective and smart solution to human-animal conflict.



OVERVIEW

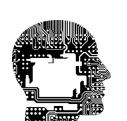
Working of the system



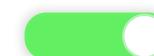
DETECTION
The detection module in the System accurately identifies approaching animals using advanced sensors to trigger timely deterrent actions.



AI powered recognition
Once an animal is detected, the system uses AI-based algorithms to analyze its size, movement patterns, and heat signature for precise identification and response.



Real time decision making
The system performs real-time decision-making for species-specific responses by integrating AI analysis with environmental factors like weather and time of day for accurate and effective deterrence.



Activation
Species specific deterrence mechanism is activated such as for
*Elephants/Boars- Loud disorienting, Irregular noise
*Stray dogs- High frequency sounds, Strobe lights, Mist sprayers
*Monkeys- Loud noise, Water splash



Data logging
The system records details about animal detections, deterrence, activations and effectiveness of system over time in an app

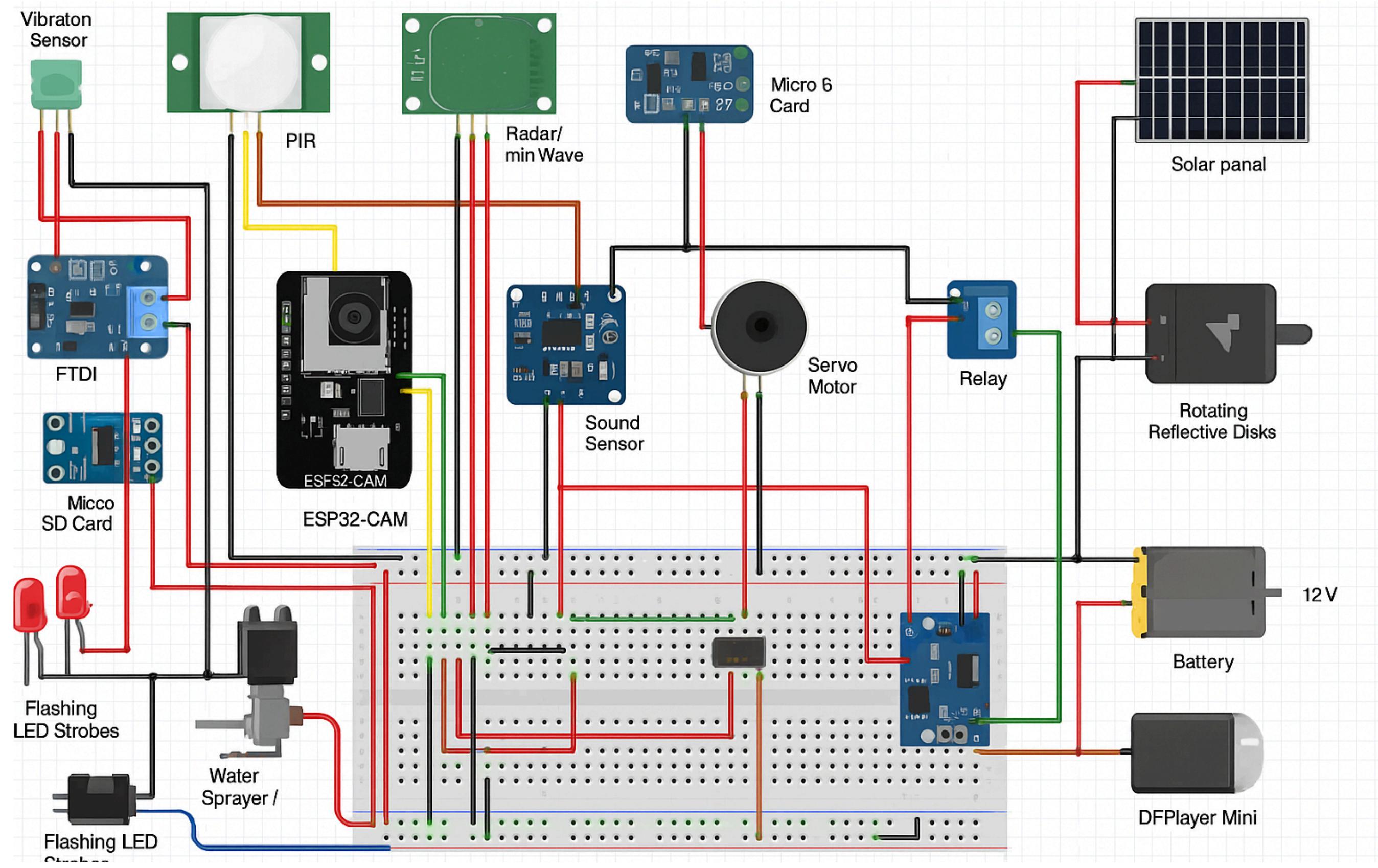
- Energy efficient sensors and components
- Buttons to control and adjust

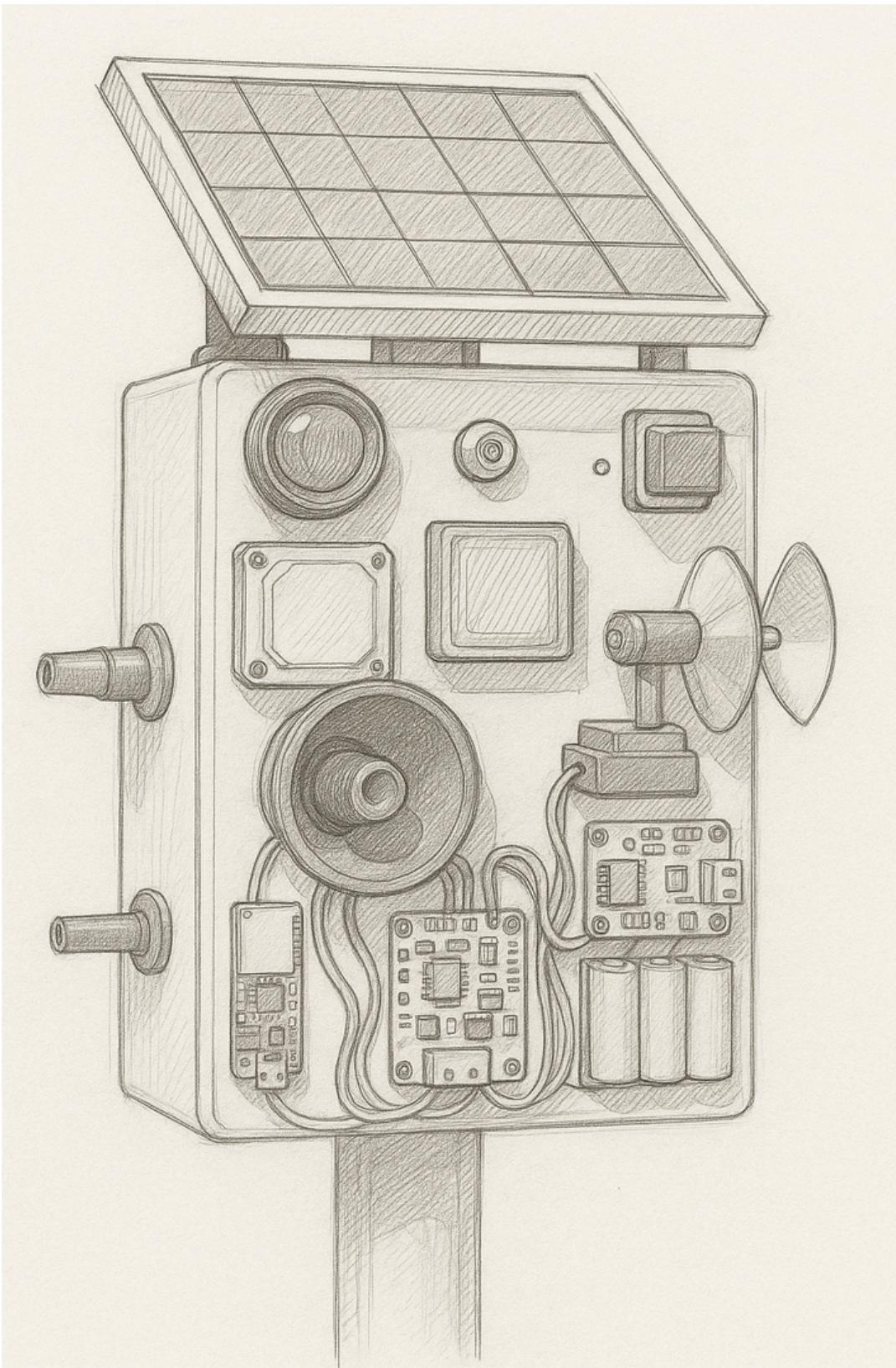
Optimization to operate in a low power mode when no animal is detected. Ramp up power on detection

Usage of RFID Tags to differentiate between pets and strays

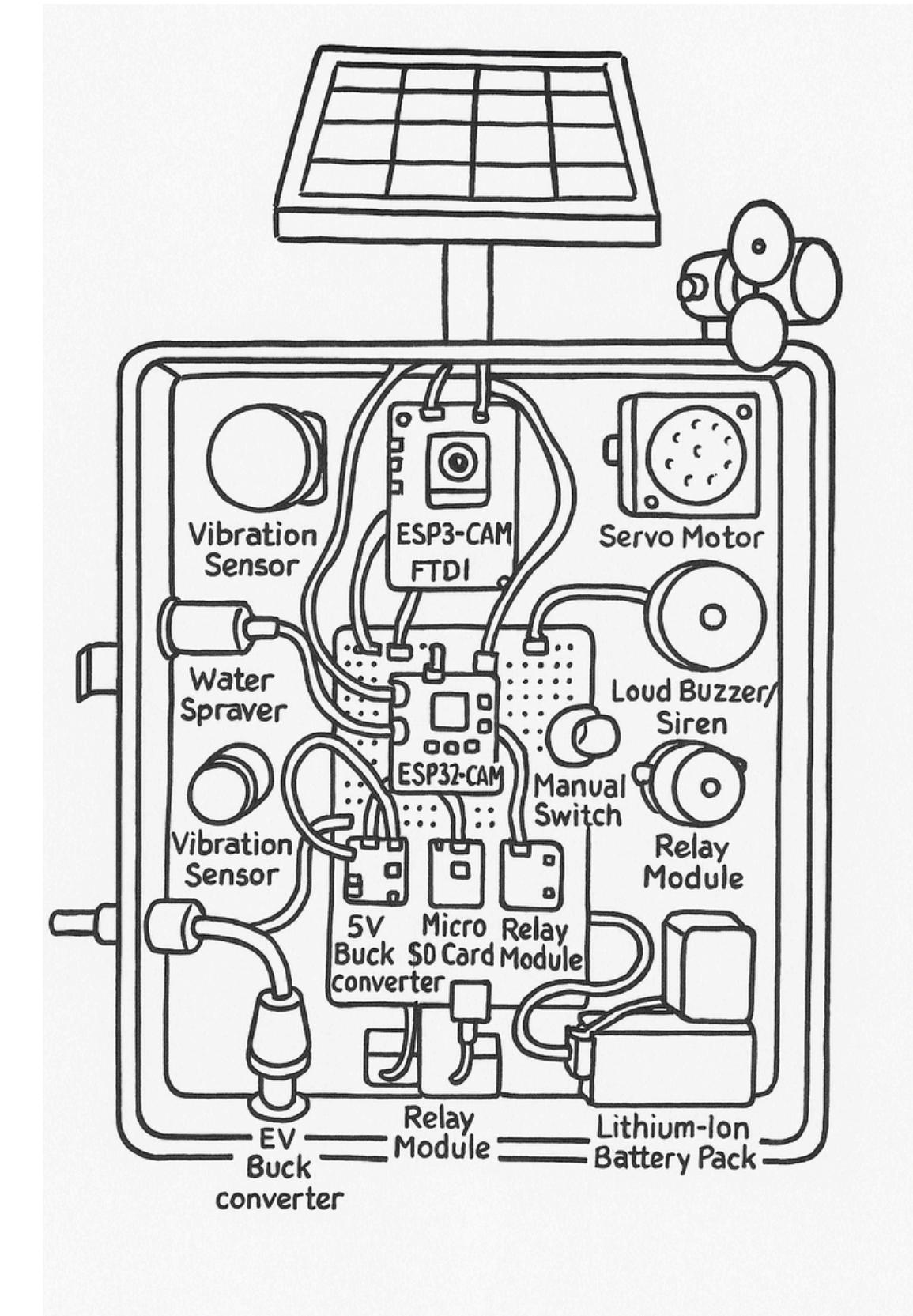
- *Compact and modular design.
- *Usage of lightweight /durable materials
- *Play and Plug design

CIRCUIT DIAGRAM



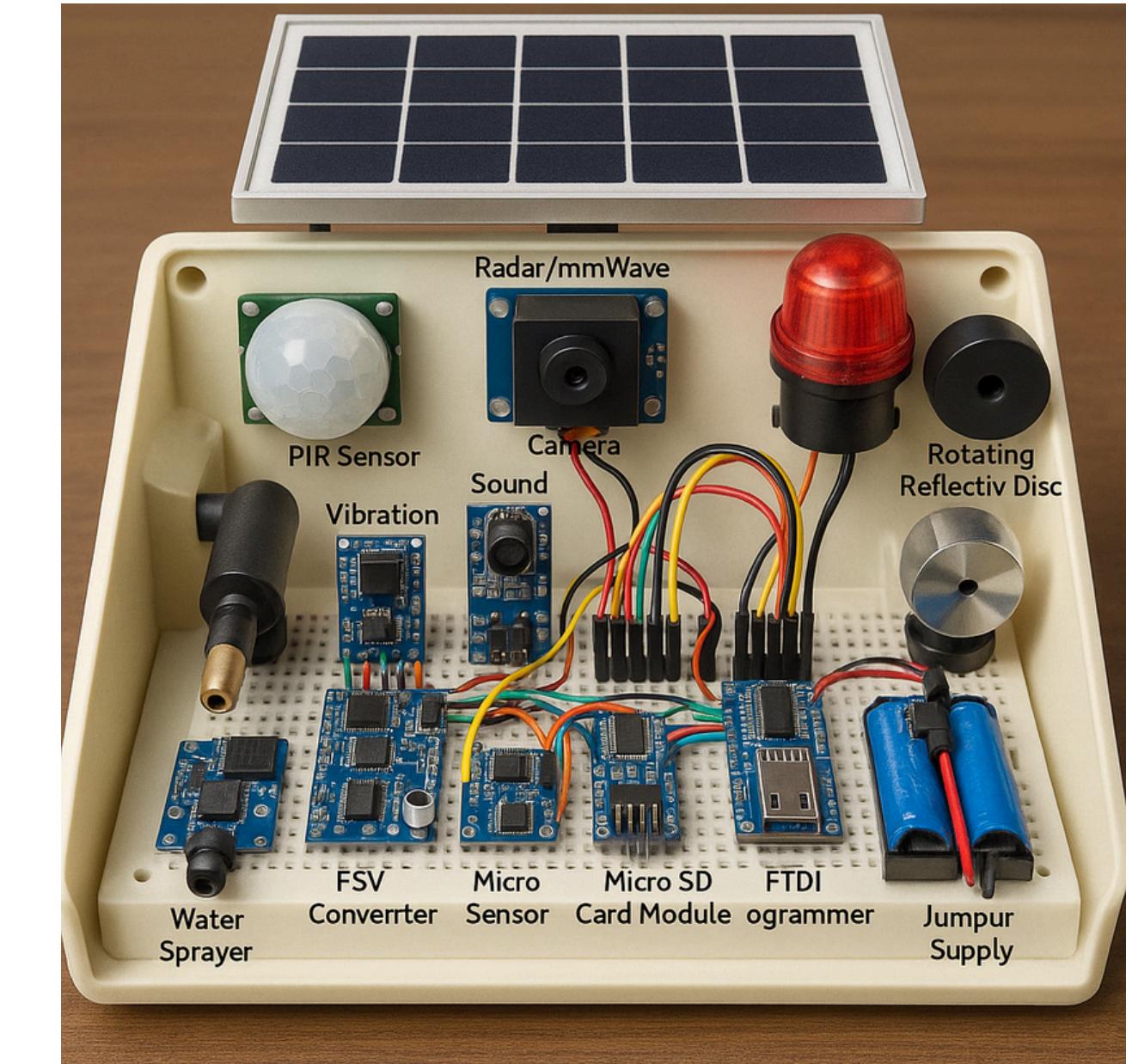
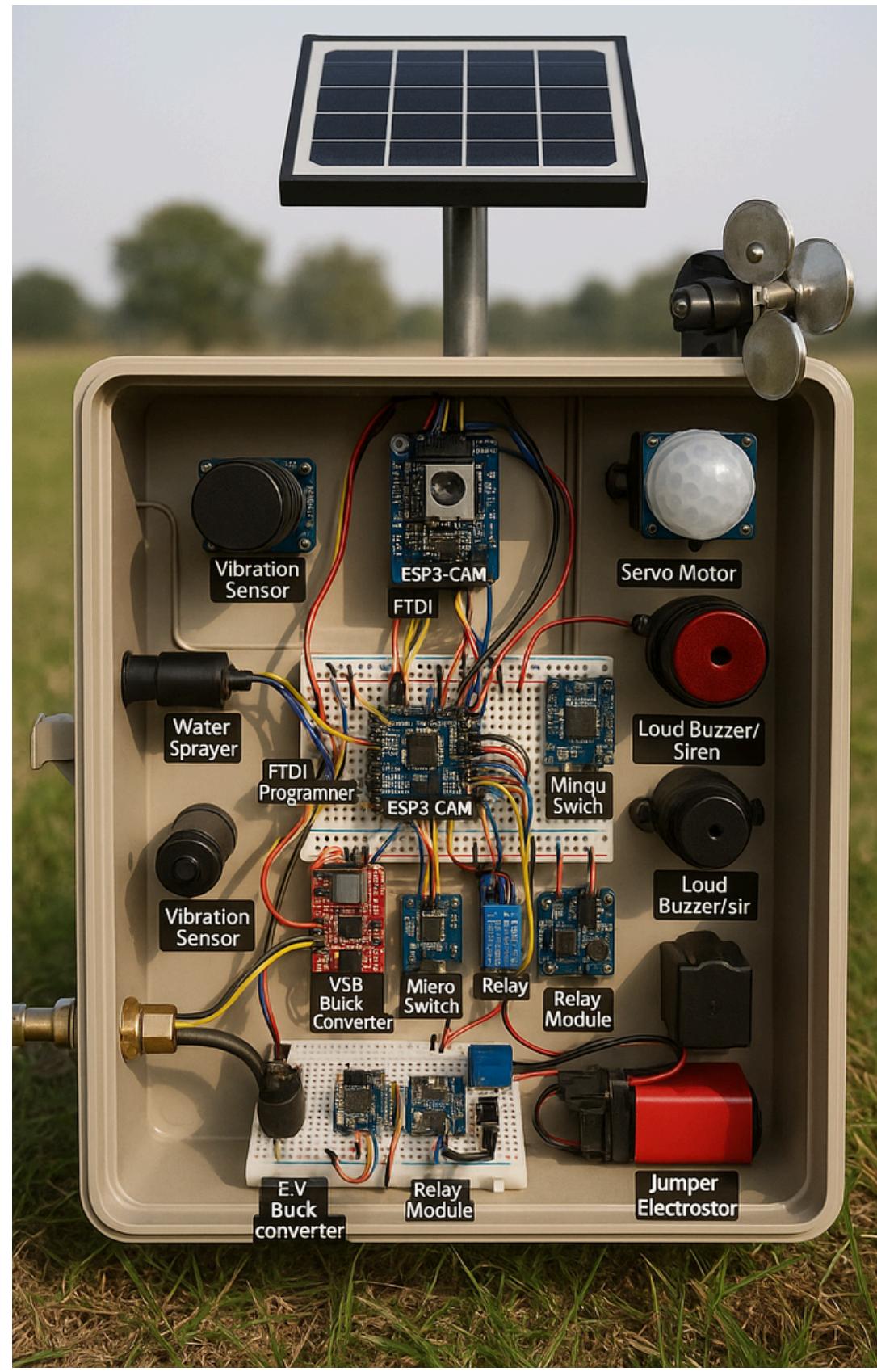


Hardware Design



Cutaway

Expected design_(Designed using AI).





KEY FEATURES

FEATURE 1

AI-Powered Animal Detection

Uses onboard Edge AI with ESP32-CAM to identify and classify animals —reducing false alarms and ensuring smart responses

FEATURE 2

Multi-Sensor Fusion Accuracy

Combines inputs from PIR, radar, vibration, and sound sensors to reduce false positives and improve reliability across different animal types and environments.

FEATURE 3

Multi-Modal Deterrence System and Prevention of animal habituation by frequency modulation, randomized frequency patterns and random usage of deterrence



KEY FEATURES

FEATURE 4

Smart Differentiation Between Pets & Strays
Incorporates sensor fusion and optional RFID tagging to avoid triggering deterrents on known pets, ensuring only real threats are targeted.

FEATURE 2

Adaptive Sound-Based Triggering
Uses sound and vibration sensing to detect stealthy animals or movement even when not in visual range—ideal for dense vegetation or night-time use.

FEATURE 3

Solar-Powered & Portable
Completely wire-free and portable, with solar panel + battery backup, making it ideal for remote farms, rooftops, and forest-edge villages.



In addition to the above mentioned features, we're planning to include the following features too to our smart animal deterrence system using an app

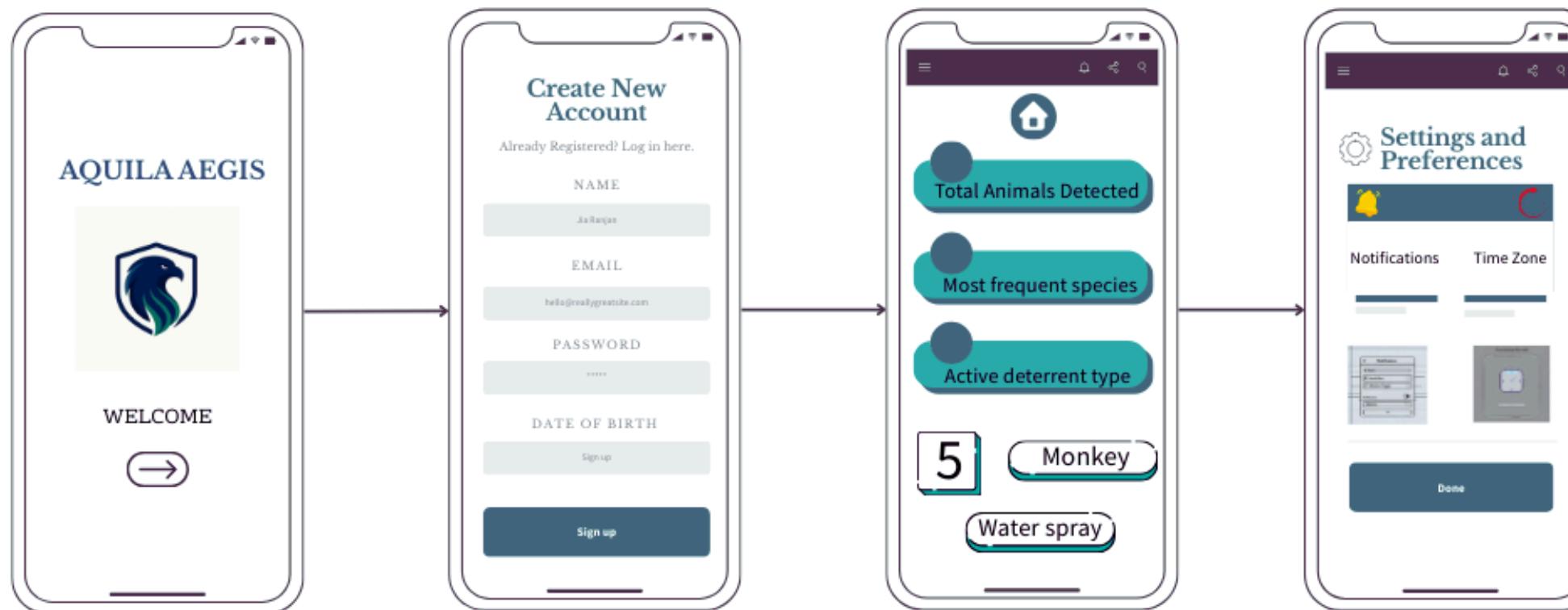
- *Satellite based GPS Tracking for usage in expansive regions
- *Wireless operations for remote monitoring
- *AR Integration to visualize threat zones
- *Using geofencing technology
- *Instead of using a fixed frequency, the system could tune response based on the biorhythms or circadian rhythms of animals
 - Community based feature to share data ,collaborate and monitor the same area. Incorporating open source data platform, the system could benefit from community feedback
 - *Exploring the effects of deterrents in animals

ADDITIONAL FEATURES

Wireframe Review

Mobile

Our application's interface.



Wireframe

https://www.canva.com/design/DAGoMLlhjC4/8oNYtbSHUTSKrTQseNXTTw/edit?utm_content=DAGoMLlhjC4&utm_campaign=designshare&utm_medium=link2&utm_source=sharebutton



ESP32-CAM + EDGE IMPULSE



COMPONENTS

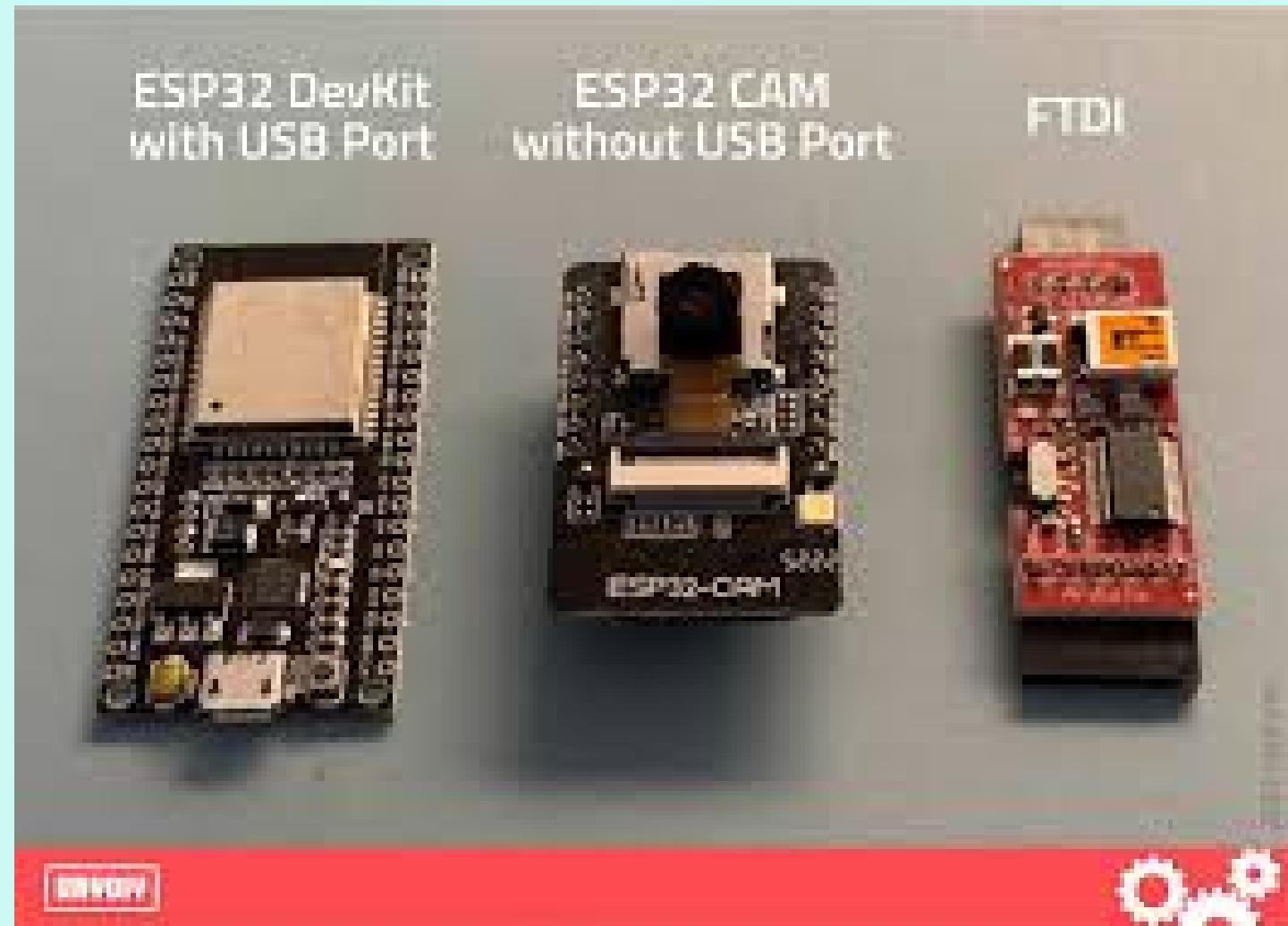
The ESP32-CAM is a compact microcontroller equipped with an integrated camera and Wi-Fi connectivity, making it the central processing unit of the system.

It captures real-time images and uses a machine learning model (deployed via Edge Impulse) to detect and identify specific animals based on visual input.

This component operates continuously, either always on or triggered by motion detected from sensors, processing incoming data to decide the system's response.

It is essential for smart, automated recognition and classification of animals, enabling targeted deterrence rather than random activation. This core module acts as the brain of the entire system, processing all inputs and controlling outputs accordingly.

FTDI PROGRAMMER (USB TO UART)



The FTDI programmer is a USB-to-serial interface used for flashing or programming the ESP32 microcontroller during system setup.

It is only used temporarily when loading the machine learning model and control code onto the ESP32 board before deployment. This tool is crucial for development and debugging phases, allowing easy communication between a computer and the ESP32 to upload new firmware or update existing software.

It connects directly to the ESP32 board and is not part of the permanent system installation.

MOTION AND VIBRATION DETECTION SENSORS

The system employs a Passive Infrared (PIR) sensor and a vibration sensor to detect animal presence effectively. The PIR sensor identifies movement by sensing changes in infrared heat emitted by living beings within its field of view. Acting as a low-power motion detector, it serves as a first-alert trigger, activating the ESP32-CAM and other components only when motion is detected. PIR sensor is ideal for detecting warm-bodied intruders like monkeys, dogs, or humans.

Complementing this, the vibration sensor detects ground tremors caused by large animals such as elephants or wild boars. Using mechanical or piezoelectric elements, it senses vibrations transmitted through the earth and activates the system when significant ground movement is detected. This is particularly useful in forest-border areas where large wildlife may bypass visual motion detection, making vibration sensing an essential early-warning layer.



RADAR/MILLIMETER-WAVE SENSOR AND SOUND SENSOR MODULE

The radar or millimeter-wave sensor uses electromagnetic waves to detect motion, enabling accurate sensing even in low-visibility conditions such as dense foliage, darkness, or fog. It operates continuously or alongside other sensors, offering precise long-range detection, making it ideal for outdoor areas where PIR sensors may be ineffective. Positioned in zones requiring enhanced accuracy, it ensures reliable monitoring of animal movement.

The sound sensor module, typically an analog microphone-based device, detects animal-related noises like barking, rustling leaves, or subtle movements. It is especially effective during nighttime or quiet periods when motion sensors might miss silent animals. By recognizing presence without requiring physical movement, it adds a crucial layer of detection, improving the system's overall reliability.



WATER PUMP + SOLENOID VALVE



This hardware combination forms the water spraying mechanism used as a non-lethal deterrent to scare away animals.

The solenoid valve controls the flow of water, while the pump provides the necessary pressure. These components activate only when the ESP32 sends a signal based on animal detection, spraying water bursts aimed at deterring animals without harming them.

This approach is environmentally friendly and safe for both animals and property. The pump and valve are connected via a relay and is mounted

Flashing LED Strobes



The system uses bright LED strobes and a loud buzzer or siren as two distinct sensory deterrents to discourage animals from approaching.

Upon animal detection, either the LED strobes or the buzzer/siren activates—not both together—depending on the specific deterrent mode chosen.

The LED strobes create intense, flashing lights that startle and visually distract animals, while the buzzer or siren emits a loud, alarming noise to scare them away audibly. Activating only during confirmed detection events, these deterrents operate separately to provide flexible, situation-specific responses. Both visual and audio signals can also alert nearby humans of animal presence, enhancing safety.

LOUD BUZZER / SIREN

CONTROL & POWER SYSTEMS

Relay Module

An electrically controlled switch that lets the ESP32 safely turn high-power devices like water pumps and buzzers on or off. Triggered by GPIO pins, it's placed between the ESP32 and external outputs.

Servo Motor + Reflective Discs

Rotates reflective discs to create movement-based visual deterrence. Activated upon detection to distract or scare away animals. Installed near fences or known entry paths.

Lithium-Ion Battery + Solar Panel

The solar panel charges the battery during the day, providing power at all times. Ensures eco-friendly, continuous system operation. Mounted on or near the device enclosure.

Manual Switch

Used for manually toggling the system on or off. Helpful for testing or emergency control. Installed externally for easy access.

5V Power Supply / Buck Converter

Regulates and steps down voltage to provide a stable 5V supply to sensors and other components. Connects between battery and all modules.

MicroSD Card Module

Stores images and event data locally when an animal is detected. Useful for monitoring activity and maintaining logs. Connected to the ESP32 board.

Estimated Cost

Main Processing & Intelligence

ESP32-CAM ₹625

FTDI Programmer ₹175

Micro SD Card Module ₹129

Detection Sensors

PIR Motion Sensor ₹113

Vibration Sensor ₹125

Sound Sensor Module ₹125

Radar/mmWave Sensor ₹650

Deterrence Actuators

Component Approx. Cost (INR)

Servo Motor ₹149

Water Sprayer (Solenoid + Pump) ₹399

Flashing LED Strobes ₹335

Loud Buzzer/Siren ₹19

Power & Control

5V Buck Converter ₹80

Lithium-Ion Battery Pack ₹220

Solar Panel Module ₹1,199

Relay Module ₹150

Manual Switch ₹30

Basic Hardware & Assembly

Jumper Wires / Dupont Cables ₹194

Breadboard ₹84

Soldering Iron + Heat Shrink Tubing ₹395 + ₹59 = ₹454

Weatherproof Enclosure Box ₹250 (approx.)

Mounting Poles/Stands ₹200 (approx.)

TOTAL ESTIMATED COST - Prototype Cost Estimate: ₹5,804

THANK YOU!

THANK YOU

