SafeTusk: AI-Powered Elephant Protection Network

This working prototype demonstrates a scaled-down, low-cost version of the Migratory Corridor Emergency Response System. The prototype uses **motion detection**, a deployable **miniature bridge panel**, and **sound playback** to simulate a real-world elephant-safe crossing deployment.

Working Principle:

1. **Detection Phase**:
- A Passive Infrared (PIR) motion sensor continuously monitors the surrounding area for movement. In the hackathon demo, a person or object is used to simulate an approaching elephant.

2. **Trigger Decision**:
- Once motion is detected, the ESP32 microcontroller processes the input signal and initiates the deployment sequence.

3. **Deployment Phase**:
- The ESP32 sends control signals to a micro servo (SG90), which rotates and physically unfolds a lightweight demo panel, representing the deployable bridge in real life.

4. **Audio Playback Phase**:
- Simultaneously, the ESP32 communicates with the DFPlayer Mini MP3 module over UART to play a preloaded sound file. For elephants, this could be an infrasound rumble or a bee-swarm deterrent sound. The sound is output through an 8Ω 3W speaker.

5. **Active State Indication**:
- An LED indicator is turned on during the deployment to represent a 'Crossing Active' signal in real-world scenarios.

6. **Retraction Phase**:
- After a short delay (e.g., 5–10 seconds), the ESP32 commands the servo to retract the demo panel and turns off the LED. The system then returns to the idle monitoring state.

Functional Schema:

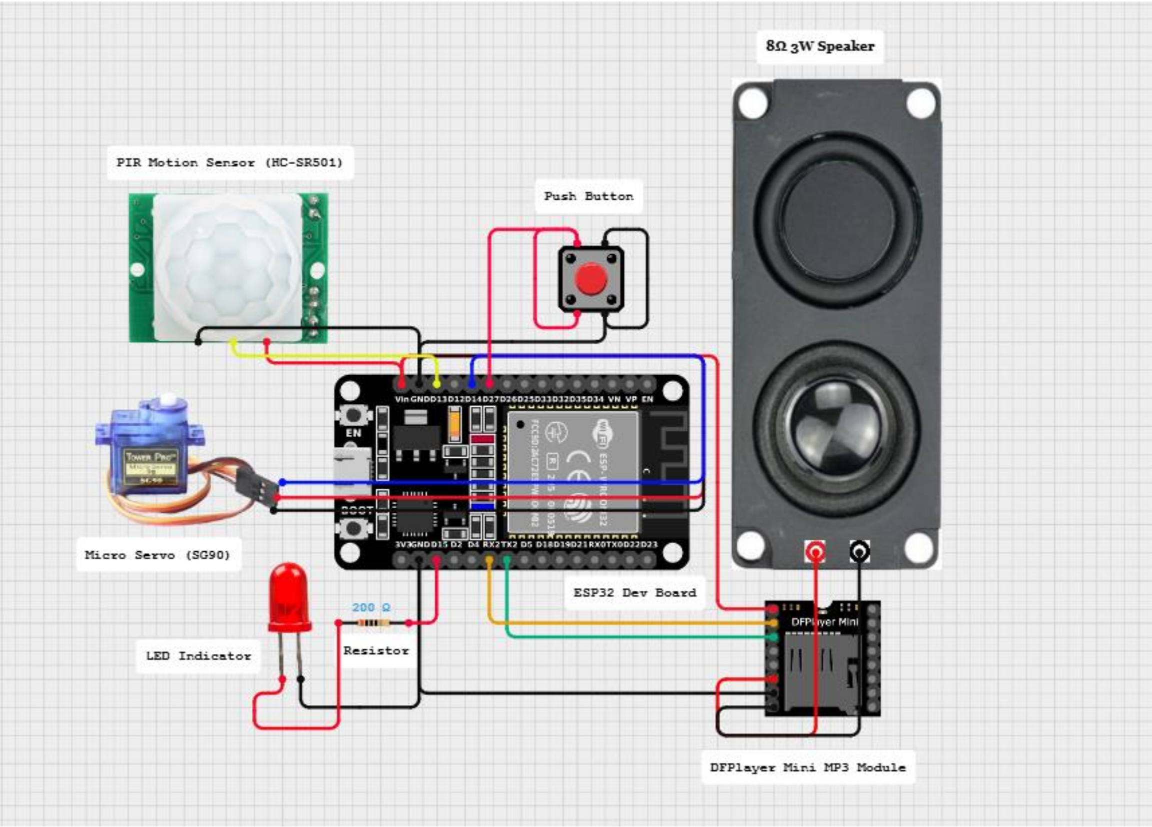
The prototype's workflow can be described as the following sequence:

PIR Motion Detection → ESP32 Processing → Servo Activation (Deploy Panel) + DFPlayer Audio Playback → LED Active Indicator → Delay → Servo Retraction → LED Off → Return to Idle

Hardware Schema:

- PIR Sensor → Digital input pin on ESP32
- Micro Servo → PWM output pin on ESP32
- DFPlayer Mini MP3 Module → UART (TX/RX) pins on ESP32
- Speaker → Connected to DFPlayer Mini audio output
- LED Indicator → Digital output pin on ESP32
- Pushbutton (optional) → Manual override input to ESP32
- Power Source → 5V power bank supplying ESP32, DFPlayer Mini, and servo

CIRCUIT DIAGRAM:


8Ω 3W Speaker
PIR Motion Sensor (HC-SR501)
Push Button
Vin GNDD13D12D14D27D26D25D33D32D35D34 VN VP EN
EN
BOOT
3V3GNDD15 D2 D4 RX2TX2 D5 D18D19D21RX0TX0D22D23
Micro Servo (SG90)
ESP32 Dev Board
200 Ω
Resistor
LED Indicator
DFPlayer Mini
DFPlayer Mini MP3 Module