

1. INTRODUCTION

- 1.1. This crocodile detection alert system combines computer vision-based detection technology with an IoT control panel to reduce incidents of crocodile attacks on humans. The first part uses the ESP32S3-CAM running YOLOv11 to perform real-time object classification in a specific area. The second part utilises the NodeMCU ESP32, dual LEDs (red and green), an I2C LCD module, and the Blynk IoT software platform for manual confirmation and alarm. The solution is designed to improve human safety, achieve automatic detection, and provide intuitive control for relevant personnel.

2. PROJECT BACKGROUND AND OBJECTIVES

- 2.1. Crocodiles invading human-active areas can pose a significant safety risk. Modern "smart" ecological monitoring projects have demonstrated the effectiveness of embedding wireless sensors and vision systems to monitor crocodile activity and generate actionable alerts. While traditional fence and barrier control systems rely primarily on mechanical sensors to detect anomalies at the boundaries of water areas, our system uses artificial intelligence vision technology to specifically target crocodile activity patterns to ensure safe coexistence between residents and local creatures.

2.2. Objectives

- 2.2.1. Detect objects (especially crocodiles) entering human-active areas in real-time.
- 2.2.2. Classify detected objects to distinguish between crocodiles and harmless objects.
- 2.2.3. When an intrusion is confirmed, officers will activate the station's physical LED (Red colour) and LCD alarms through the dashboard.

3. SYSTEM ARCHITECTURE

The solution comprises two integrated subsystems:

3.1. Real-Time Monitoring & Detection

3.1.1. Hardware

- ESP32S3-CAM module with OV5640 camera.

3.1.2. Software.

- YOLOv11 running on a local server (Laptop) that pulls JPEG frames from the ESP32S3-CAM over HTTP, applies a pretrained YOLOv11 model for classification, and streams annotated results.

3.1.3. Detect objects and output bounding boxes with labels.

3.2. Control Panel & Alerting

3.2.1. Hardware

- NodeMCU ESP32
- LEDs (Red / Green)
- 150 Ω resistors
- 2C LCD (Liquid Crystal Display)

3.2.2. Software

- Arduino code using BlynkSimpleEsp32 to bind virtual pins V0 and V1 to Red and Green LEDs respectively, and to drive the LCD via LiquidCrystal_I2C.

3.2.3. After checking the camera output, the station officer switches V0 (red) if a person is detected, which turns on the red LED, turns off the green LED, and displays "Crocodile" on the LCD. Next, switch V1 (green), it turns on the green LED, clears the red LED, and displays "No Crocodile" on the LCD.

4. Detailed Component List

Component	Quantity	Purpose
ESP32S3-CAM	1	Frame capture, HTTP JPEG streaming
YOLOv11 Module (Laptop)	1	Runs AI module for classification
NodeMCU ESP32	1	Blynk client, LED/LCD controller
Red LED, Green LED	1 each	Visual alert indicators
150 Ω Resistors	2	LED current limiting
I2C LCD (Liquid Crystal Display)	1	Textual alerts
Jumper wires (Male - Female)	8	Used to interconnect the components of a breadboard
Breadboard	1	Used to prototype electronic circuits.
Blynk IoT Software Platform	1	Remote control panel
USB Cable	2	Used for data transmission, power supply and peripheral connection. It enables embedded devices to exchange data

		<p>with computers or other devices, such as transmitting sensor data, upgrading firmware or debugging systems. At the same time, many embedded devices rely on USB cables to provide stable power. During the development and debugging process, a USB connection is crucial and can be used for code burning (uploading to the controller), serial communication debugging and log reading, greatly improving development efficiency.</p>
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5. Conclusion & Next Steps

By combining low-cost embedded vision technology with an IoT alarm panel, the system addresses the critical safety challenge of crocodiles unauthorised entering human activity areas. Next steps include a pilot deployment in a specific water area, iterative optimisation based on actual ambient lighting and alligator behaviour patterns, and expansion to a hands-free alarm function that includes an automatic audio alarm to promptly alert visitors and residents to stay away from potentially dangerous areas.