

PROJECT ABSTRACT

6-Zone Home Intrusion Alarm Panel with Keypad and Web Dashboard

An ESP32 alarm panel wiring six zones — door/window reed switches, PIR motion sensors and a 24-hour smoke zone — with 4x4 keypad arming, siren output and a web dashboard showing zone states and an event log. Delivered built-to-order with working hardware prototype, companion dashboard web app, firmware, wiring documentation, report, PPT and viva Q&A.

01. Title

6-Zone Home Intrusion Alarm Panel with Keypad and Web Dashboard

02. Introduction / Background

Homes are protected by single-sensor gadgets that cry wolf or by commercial alarm panels whose wiring logic is a black box. A real intruder panel is a zone machine: every door, window and room is a zone with a sensor, an end-of-line supervision resistor, an arm state and an entry/exit delay — and understanding that machine is exactly the embedded systems lesson. This project builds a 6-zone panel on an ESP32: reed switches on doors and windows with 2.2 k Ω end-of-line supervision, HC-SR501 PIRs in living spaces, an MQ-2 smoke sensor as a 24-hour always-active zone, a 4x4 keypad for PIN arming with AWAY / STAY / NIGHT modes, a relay-driven siren, battery backup, and a web dashboard showing zone states and a timestamped event log. The system is an educational prototype, not a certified security product.

03. Problem Statement

Students learn digital inputs and relays in isolation and never see a real zone-supervised alarm architecture: EOL resistor supervision, entry/exit delays, arming modes, 24-hour zones and event logging working together. The project addresses this with a demonstrable panel where six zones are wired with supervision, armed by keypad PIN in three modes, and every arm, trip, delay and alarm is recorded in an event log on a web dashboard — with all timing and range values presented as design figures, never measured claims.

04. Objectives

- Wire six zones: reed switches (doors/windows), HC-SR501 PIRs (rooms), MQ-2 (24h smoke).
- Supervise wired zones with 2.2 k Ω end-of-line resistors to detect tamper and open loops.
- Implement keypad PIN arming with AWAY, STAY and NIGHT modes plus entry (30 s) and exit (45 s) delays.
- Drive a relay siren on any armed-zone trip, with the smoke zone always active.
- Run on battery backup and report panel health (mains, battery, RSSI) on the dashboard.
- Log every arm, disarm, trip and self-test with timestamps on the web dashboard.

05. Proposed Methodology

The system is built in four stages. (1) Zone wiring: each wired zone is a normally-closed loop with a 2.2 kΩ end-of-line resistor; the ESP32 ADC/digital inputs read SECURE / TRIPPED / TAMPER states. (2) Panel logic: firmware implements the keypad PIN entry, the three arming modes, entry and exit delay timers, and the siren relay driver. (3) Power: a mains supply with rechargeable battery backup keeps the panel alive through outages, with voltage reported to the dashboard. (4) Dashboard: zone states, arming mode, panel health and the timestamped event log are served as a web app over Wi-Fi; a daily self-test chirps the siren and checks every zone.

06. System Architecture / Working

Each reed-switch zone is wired as a supervised loop; the PIRs report motion per their onboard timing; the MQ-2 zone is read continuously regardless of arm state. Arming from the 4x4 keypad starts the exit delay — AWAY arms all zones, STAY bypasses interior PIRs, NIGHT arms the perimeter plus selected rooms. During entry delay a returning user disarms with the PIN; otherwise the siren relay fires and the dashboard raises an alarm banner. The event log records arms, disarms, trips, delays and the daily self-test with timestamps, while the panel-health panel shows ESP32 status, Wi-Fi RSSI, backup-battery voltage and siren-driver state.

07. Hardware / Software Requirements

- ESP32 development board (Wi-Fi)
- 4x4 matrix keypad
- HC-SR501 PIR motion sensors (rooms)
- Reed switches with magnets (doors/windows)
- 2.2 kΩ end-of-line resistors
- MQ-2 smoke sensor (24h zone, educational)
- Relay module + 12 V siren (110 dB class)
- Rechargeable battery backup pack
- Demo home rig (door/window/room mock zones)
- Arduino IDE (C/C++ firmware), local web dashboard

08. Expected Outcomes

- A working 6-zone panel with supervised loops and three arming modes.
- Documented entry/exit delay behavior and zone-bypass logic.
- A dashboard event log the student exports for the report.
- A complete report, PPT and viva Q&A on alarm-panel architecture and zone supervision.

09. Applications

- Home-security teaching demonstrations and embedded-systems labs.
- Teaching supervised zone wiring, state machines and event logging.
- Prototyping alarm concepts for small homes and labs.

10. Future Scope

- GSM call/SMS alerts on alarm (optional extension).
- RFID tag arming as an alternative to PIN.
- Wireless zone expanders over 433 MHz.
- Mobile app with push notifications for alarm events.