PROJECT ABSTRACT

Lightning Storm Detector and Alert System using AS3935 and ESP32

An ESP32-based lightning storm detector using the AS3935 sensor — strike detection with statistical distance estimation, three LED alert bands, buzzer and a live LCD storm display — built-to-order with prototype, tuning guide, firmware, report, PPT and viva kit.

01. Title

Lightning Storm Detector and Alert System using AS3935 and ESP32

02. Introduction / Background

The most useful lightning warning is simply knowing a storm is approaching while it is still kilometres away. The AS3935 is a dedicated lightning-detector chip — the same family used in consumer weather stations — that listens for the electromagnetic signature of strikes, rejects man-made noise, and estimates the distance to the storm front. This project builds a student prototype around it: an ESP32 reads strike events over SPI and turns them into a three-band LED alert (distant/approaching/near), a buzzer for close strikes, and a 20x4 LCD announcing the storm distance. The report treats the physics honestly: the distance is a statistical estimate, and the system is an educational alert aid, not a certified warning system.

03. Problem Statement

Students rarely work with RF sensing: most projects read slow analog sensors, while real-world detection — pulses, signatures, statistical estimation — stays theoretical. Lightning detection is an ideal vehicle: a single specialised chip, a tuned antenna, SPI interfacing, and an estimation algorithm whose limits make for excellent viva discussion.

04. Objectives

- Detect lightning strikes with an AS3935 sensor and tuned coil antenna on an ESP32.
- Estimate storm-front distance with the sensor's statistical algorithm and display it live.
- Drive three LED distance bands and a buzzer alert for close strikes.
- Announce storm distance and alert state on a 20x4 LCD.
- Configure disturber rejection and document antenna tuning and placement.
- Provide a self-test/simulated-strike mode for storm-free demonstrations.
- Deliver the complete student kit: prototype, firmware, tuning guide, report, PPT and viva Q&A.;

05. Proposed Methodology

The build proceeds in four stages. (1) RF front end: the AS3935 module with tuned coil antenna and whip antenna, placed per the guide for maximum reception and minimum indoor noise. (2) Digital interface: SPI communication with the ESP32, verified by reading chip registers. (3) Alert logic: firmware maps distance estimates to LED bands and buzzer thresholds, with disturber-rejection registers configured. (4) Demonstration: the self-test mode

and simulated-strike procedure make the full chain demonstrable without waiting for weather.

06. System Architecture / Working

AS3935 + coil/whip antennas → SPI → ESP32 (strike validation, distance banding, alert logic) → 3 LEDs + buzzer + 20x4 LCD. The working flow is: assemble per the wiring diagram → tune and place the antenna → verify SPI register reads → run the self-test → demonstrate with simulated strikes, or capture a real storm when one passes.

07. Hardware / Software Requirements

- ESP32 DevKit v1 board
- AS3935 lightning detector module (SPI)
- Tuned coil antenna + whip antenna
- 5 V buzzer module
- Red/yellow/green LEDs
- 20x4 character LCD
- 5 V DC supply
- Arduino IDE (C/C++ firmware)

08. Expected Outcomes

- A working detector that registers strikes with distance estimates on the LCD.
- A demonstrable three-band LED + buzzer alert chain via self-test and simulated strikes.
- A tuned antenna installation documented with the placement procedure.
- A complete report, PPT and viva Q&A; on RF sensing, SPI and statistical estimation.

09. Applications

- Teaching RF sensing and SPI interfacing.
- Weather-instrumentation and environmental-sensing demonstrations.
- Outdoor event and farm lightning awareness (as an aid, not a certified system).

10. Future Scope

- Strike logging with timestamps for storm-track analysis.
- Wi-Fi push alerts to a phone on close strikes.
- Multi-node triangulation experiments.
- Integration with a home weather station.