PROJECT ABSTRACT

IoT Lightning Strike Detector with Storm Alert Dashboard

A solar-powered sensor node that detects lightning electromagnetic pulses, estimates strike distance, and streams events to a web dashboard with a live strike map and configurable SMS/push storm alerts. Delivered built-to-order with the working node, firmware, dashboard, documentation, report, PPT and viva kit.

01. Title

IoT Lightning Strike Detector with Storm Alert Dashboard

02. Background

Lightning kills more people in India each year than most other natural hazards, and outdoor workers, farmers and event organizers often get no warning before a storm cell arrives. Professional lightning-location networks exist, but their data feeds are commercial and far beyond a student or community budget. A low-cost IoT node changes the equation: a lightning EM-pulse sensor detects each discharge, estimates its distance, and a connected dashboard turns raw pulses into a live strike map with alerts when strikes fall inside a chosen radius. This project builds that complete chain — sensing, telemetry, visualization, alerting — as a student-buildable prototype.

03. Problem Statement

Communities, farms, schools and construction sites need timely local warning when lightning activity approaches, but affordable detection hardware with a usable alert interface is hard to find. The project addresses this with a solar-powered ESP32 node carrying a lightning EM-pulse sensor, streaming timestamped strike events (with sensor-estimated distance) to a web dashboard that maps recent strikes and fires SMS/push alerts inside a configurable radius.

04. Objectives

- Detect lightning EM pulses with a dedicated sensor (e.g. AS3935-class) and reject man-made disturbers.
- Estimate strike distance per event using the sensor's distance-estimation output.
- Stream timestamped strike events from the ESP32 node to a cloud/web backend over Wi-Fi.
- Render a live dashboard: strike map with range rings, recent-event log, waveform view and storm status.
- Fire SMS/push alerts when strikes occur inside the user-configured radius.
- Run the node on solar power with battery backup for field deployment; deliver the full student kit.

05. Proposed Methodology

The system is developed in four stages. (1) Sensing: the lightning sensor IC is tuned (noise floor, spike rejection, disturber masking) and interfaced to the ESP32 over SPI/I2C; each validated strike raises an interrupt with distance and energy estimates. (2) Telemetry: the ESP32 timestamps events and publishes them over Wi-Fi (MQTT/HTTP) with store-and-forward for outages. (3) Backend and dashboard: a web service stores events and serves the live map, log and alert-configuration UI. (4) Alerting: a rules engine compares each strike's distance against the configured radius and triggers SMS/push notifications.

06. System Architecture / Working

The sensor node — ESP32, lightning sensor with a tuned antenna, solar panel and Li-ion battery in a weatherproof enclosure — sits at the monitored site. On each detected discharge the ESP32 reads the strike's estimated distance and energy, timestamps it and publishes the event. The backend appends it to the strike log; the dashboard plots it on the range-ring map centred on the node and updates the nearest-strike and storm-status cards. When a strike lands inside the alert radius, the rules engine sends an SMS/push alert; the siren-relay output can drive a local hooter.

07. Hardware / Software Requirements

- ESP32 development board
- Lightning EM-pulse sensor module (AS3935-class) with antenna
- Solar panel + Li-ion battery + charge controller
- Weatherproof enclosure, pole mount
- Backend: Node.js/Python + database; MQTT or HTTP telemetry
- Web dashboard (HTML/CSS/JS); SMS/push gateway account for alerts

08. Expected Outcomes

- A working node that detects emulated lightning pulses and reports distance estimates.
- A live dashboard with strike map, event log, waveform view and alert configuration.
- SMS/push alerts firing for strikes inside the configured radius (gateway-dependent).
- Solar-powered field operation; complete documentation: report, PPT and viva Q&A.;

09. Applications

- Early storm warning for farms, schools, playgrounds and construction sites
- Outdoor event safety monitoring
- Educational demonstration of EM sensing and IoT telemetry
- A base for multi-node triangulation or weather-station integration

10. Future Scope

- Multi-node time-of-arrival triangulation for precise strike location
- Integration with rain/wind sensors for a full storm station
- LoRa long-range variant for off-grid sites
- Mobile app with push alerts and storm tracking

11. Declaration

This is a built-to-order IoT project. Strike-distance figures are the sensor IC's own estimates (approximate by nature); detection range and alert latency are design targets, not certified measurements. The system is an educational early-warning aid, not a substitute for official meteorological warnings.