PROJECT ABSTRACT

IoT Campus Traffic Counter with Dashboard

An ESP32-based people/vehicle counter for campus gates: dual IR break-beam lanes that distinguish entries from exits, with live occupancy and a web dashboard.

Project type: Hardware + Software (Hybrid)

Availability: Built to order

Suitable branches: IoT & Embedded, Electronics / E&TC

Technologies: ESP32, IR break-beam sensors, 16x2 LCD, debouncing logic, web dashboard

Price: Request a quotation

Prepared by Projectech · projectech.in — for academic project reference.

1. Introduction / Background

Campuses need to know how many people are on site at any moment - for safety drills, canteen planning, parking management and event crowd control. Manual headcounts and turnstile logs are either labour-intensive or absent entirely at open gates.

This project builds a low-cost bidirectional counter: each gate lane has two IR break-beam sensors 30 cm apart, and the order in which the beams break tells entries from exits. An ESP32 per gate debounces the signals, flags tailgating, shows live counts on an LCD, and streams everything to the GateCount dashboard with hourly in/out charts, per-gate status and a live campus occupancy figure.

2. Problem Statement

Open campus gates have no practical way to count entries and exits separately. Single-sensor counters cannot tell direction, and manual counts do not scale across multiple gates or produce any historical record.

This project provides bidirectional counting with direction detection from dual-beam sequencing, per-gate online/degraded status, tailgating estimation, and a dashboard that turns raw crossings into occupancy, peak-hour and gate-health analytics.

3. Objectives

- Detect direction of passage using two IR break-beam sensors per lane (beam A-then-B = entry, B-then-A = exit).
- Debounce beam signals (400 ms) and flag tailgating events under 1.2 s as estimates.
- Maintain live per-gate in/out counts with a local LCD display.
- Publish counts over Wi-Fi to a central dashboard with hourly charts and gate status.
- Compute campus-wide live occupancy with peak detection and daily rollover archiving.

4. Proposed Methodology

- Mount paired IR break-beam modules on posts 30 cm apart per lane at each gate; wire to the ESP32 with pull-up inputs.
- Implement the direction state machine in firmware with 400 ms debounce and a 1.2 s tailgating window; increment entry/exit counters and a signed occupancy value.
- Show running totals on the gate LCD; publish counter updates over Wi-Fi at fixed intervals.
- Render the dashboard: KPI cards (entries, exits, current occupancy, busiest hour), the hourly in/out bar chart, per-gate status cards and the event log.
- Validate by walking a known number of passes through the gate in both directions and comparing against the counters.

5. System Architecture / Working

The edge layer is one ESP32 per gate with its dual IR beam pairs and a 16x2 LCD showing live count, entries and exits. The firmware runs the direction-detection state machine, debouncing and tailgating logic locally.

The application layer is the GateCount dashboard aggregating all gates: hourly crossing charts with peak labelling, per-gate cards with in/out totals and lane health, live occupancy with daily rollover, and an event log recording sensor degradation and count corrections.

6. Hardware / Software Requirements

- Hardware: ESP32 development board per gate, 2x IR break-beam sensor modules per lane, cardboard/3D-printed posts for the demo gate, 16x2 LCD with I2C backpack, 5 V power supply, breadboard and jumper wires.
- Software: Arduino IDE, Wi-Fi network, web dashboard (single-file HTML/JS app included).

7. Expected Outcomes

- Bidirectional counting with direction accuracy verified by controlled walk-through tests.
- Live per-gate and campus-wide occupancy on the dashboard.
- Hourly in/out analytics with peak-hour detection.

- Sensor-health monitoring: weak-beam lanes flagged as degraded with counts marked estimated.
- A documented build: wiring diagram, firmware, dashboard and calibration procedure.

8. Applications

- College and school campus entry/exit monitoring.
- Library and laboratory footfall analytics.
- Event and auditorium crowd counting.
- Canteen and mess queue planning from occupancy data.
- Parking entry/exit logging for small lots.

9. Future Scope

- ANPR or RFID integration to identify vehicles as well as count them.
- LoRa backhaul for gates far from Wi-Fi coverage.
- People-density heatmaps from multiple counting points.
- Integration with emergency mustering systems.
- Battery + solar power for standalone gate posts.