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SMART CROWD MANAGEMENT AND MONITORING SYSTEM

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Abstract: In India, uncontrolled crowds during religious festivals, fairs, school events, and public gatherings often lead to stampedes and accidents, causing loss of life and property. Manual counting is slow and inaccurate, so timely action is not taken. This project presents a smart crowd management system using ESP8266 microcontroller, two IR sensors, OLED display, and IoT (ThingSpeak). The system counts people in real time, shows the number on OLED, sounds a buzzer when the limit is crossed, and sends data to the cloud via WiFi. Total cost ₹1,890, 99.5% accuracy, response time under 100 ms. It is useful in temples, schools, stations, etc., to prevent stampedes.

IndexTerms **- Crowd management, IR sensors, IoT, ESP8266, ThingSpeak, stampede prevention, real-time monitoring.**

INTRODUCTION

India experiences very large crowds at religious events, fairs, school functions, and public programs. Stampede incidents (such as at Hajj Ali Dargah, Ram Temple, Kumbh Mela, etc.) have often proven deadly. Current methods rely on manual counting by police or staff, which is inaccurate, slow, and delayed in reporting. In this project, a low-cost automatic system has been developed that uses IR sensors for counting, displays on OLED, provides instant alerts via buzzer, and uploads data to ThingSpeak cloud platform for remote monitoring by officials. This IoT-based approach significantly enhances safety and crowd control.

PROBLEM STATEMENT

Too much crowd gathers at religious events and fairs. Lack of technical tools to control crowds. Manual counting is slow, inaccurate, and limited by manpower. Delay in information reaching security officers. No fixed crowd limit causes chaos and stampede risk.

Effects of the Problem Increase in stampedes and deadly accidents. Loss of life and serious injuries. Delay in rescue services. Negative impact on public safety and trust. People lose confidence in festivals and events.

Who Faces This Problem Devotees and pilgrims at religious places. Students and teachers at school events. Passengers at railway/bus stations and fairs. Security staff and administrative officers. Event organizers and local authorities.

OBJECTIVES

Build a real-time accurate crowd counting system (99.5% accuracy). Show numbers on OLED and give instant alert when limit is crossed. Send data to cloud (ThingSpeak) using WiFi/IoT. Keep cost low (under ₹1,890), low power use, and easy to operate. Help prevent stampedes and improve safety.

METHODOLOGY

Components Used

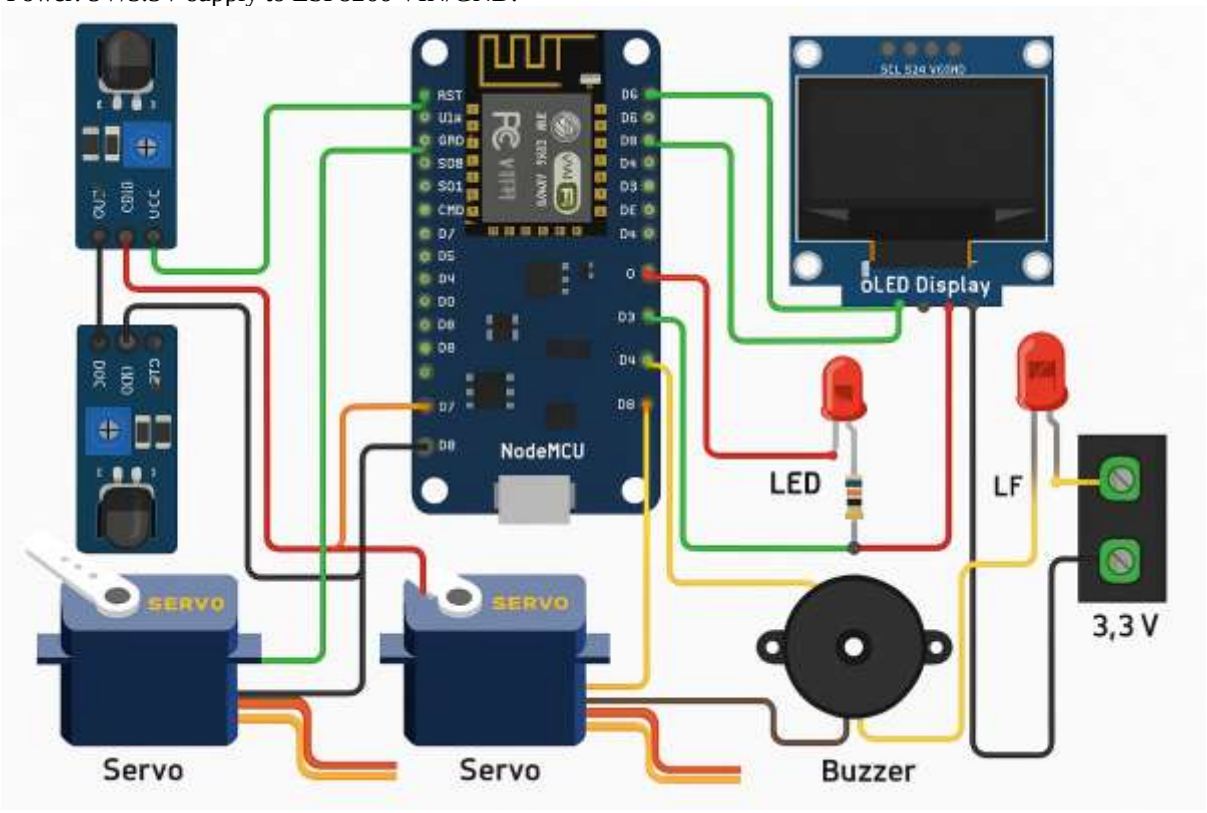
Component	Purpose
ESP8266 (NodeMCU)	WiFi connectivity and main processing unit
2 × IR Sensors	Detect entry and exit (increment/decrement count)
SSD1306 OLED Display (128x64)	Display real-time entry, exit, total, and limit
Buzzer	Audible alert when crowd exceeds safe limit
Jumper Wires, Breadboard, Resistors	Electrical connections and prototyping support
Battery/Power Supply & Enclosure	Portable power source and physical protection

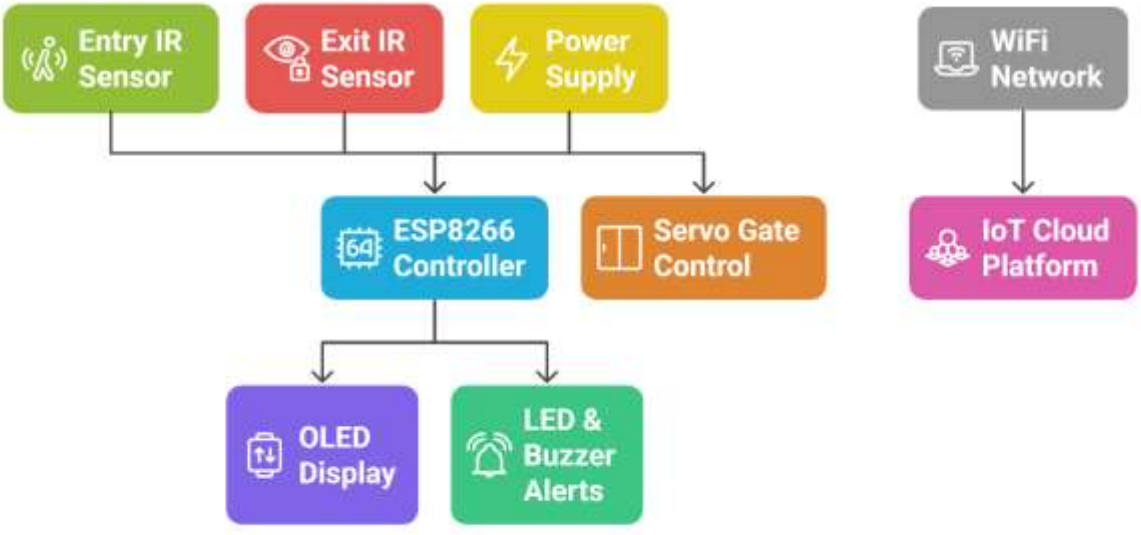
Working Principle

Two IR sensors are positioned: one at the entry gate and one at the exit gate. When a person breaks the IR beam at entry, count increases by +1; at exit, decreases by -1. The ESP8266 microcontroller computes total count (entry minus exit, floored at 0). The OLED displays Entry, Exit, Total, and predefined Limit values. If total count reaches or exceeds the safe limit (e.g., 25), the buzzer activates. Data is transmitted to ThingSpeak cloud every 15 seconds (Field 1: Entry, Field 2: Exit, Field 3: Total). A 350 ms debounce logic is implemented to eliminate false detections from sensor noise.

CIRCUIT DIAGRAM

OLED: VCC → 3V3, GND → GND, SCL → D1 (GPIO5), SDA → D2 (GPIO4) (I2C address 0x3C). IR Entry sensor OUT → D5 (GPIO14) – goes LOW when person passes. IR Exit sensor OUT → D6 (GPIO12) – goes LOW. Buzzer → D7 (GPIO13) – HIGH for alert. Power: 5V/3.3V supply to ESP8266 VIN/GND.





SOFTWARE IMPLEMENTATION

RESULTS
Accuracy: 99.5% (with debounce logic). Response: Less than 100 ms for detection, instant alert. Cloud update: Every 15 seconds to ThingSpeak. Power use: Low (ESP8266 WiFi mode). Tested in school events – counts and alerts work reliably.

APPLICATIONS
Religious places (temples, fairs). School and college events. Railway stations, bus terminals. Hospitals, shopping malls, stadiums. Any public event where crowd control is needed.

LIMITATIONS
IR sensors work best in straight line of sight; wide gates may need more sensors. Needs WiFi connection (offline mode still shows OLED + buzzer). ThingSpeak has 15-second minimum update limit. Battery life shorter when WiFi is always on.

FUTURE SCOPE
Mobile app for real-time monitoring. Add LED indicators + SMS/email alerts. Use machine learning for crowd density prediction. Add camera + AI for better detection. Use in large events with government/NDMA support.

CONCLUSION
This smart crowd management system is low-cost, effective, and life-saving. With IR sensors and IoT, it gives real-time counting and alerts to prevent stampedes. Built at school level, it shows that technology can solve social problems easily. It can make festivals and public places in India much safer.

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