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Stampede Avoider

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Abstract

Stampede disasters caused by sudden overcrowding and uncontrolled human movement remain a critical safety challenge in public gatherings. This paper presents a smart Stampede Avoider system that integrates physical movement control with real-time crowd load monitoring to prevent such incidents. A sand-filled safety mat is used to reduce rapid movement, while underground retractable poles dynamically organize the crowd into regulated line formations. A load cell sensor continuously monitors crowd pressure and activates visual and audio alerts when predefined safety thresholds are exceeded. The proposed system offers a low-cost, scalable, and reliable solution for enhancing crowd safety in high-density public environments.

1. Introduction

Stampedes are sudden, uncontrolled movements of large crowds that often result in serious injuries and loss of life. Such incidents usually occur due to panic, restricted movement, high crowd density, and lack of proper crowd control systems. Traditional crowd management methods depend heavily on human control using barricades and security personnel, which may fail during emergency situations. To overcome these limitations, this project proposes a smart automated Stampede Avoider system that can reduce movement speed, manage crowd flow, and alert authorities in real time when overcrowding reaches dangerous levels.

2. Problem Statement

In crowded places such as temples, stadiums, metro stations, and event venues, people often gather in very limited spaces. When the crowd density increases suddenly, people tend to move faster due to fear or urgency. This rapid movement in a congested area creates pressure waves that result in stampede conditions.

The lack of automated crowd monitoring and real-time warning systems increases the risk of disasters. Therefore, an intelligent system is required to control crowd movement physically and electronically before a stampede occurs.

3. Objectives of the Project

- To prevent stampede accidents caused by overcrowding.
- To slow down crowd movement using a sand-filled safety mat.
- To control crowd direction using underground retractable poles.
- To monitor crowd load using a load cell sensor.
- To provide real-time alerts using LCD display, LED, and buzzer.
- To support police and security forces in managing large crowds effectively.

4. Working Principle of the Stampede Avoider System

The operation of the Stampede Avoider system is divided into three main safety layers:

4.1 Sand-Filled Safety Mat

A specially designed mat filled with sand is placed in high-risk crowd areas. Since sand offers resistance to movement, people cannot walk or run at high speed on it. This automatically slows down the crowd movement and reduces panic-driven running, which is a major cause of stampedes.

4.2 Underground Retractable Poles

Retractable poles are installed beneath the ground surface. Under normal conditions, the poles remain hidden. When crowd control becomes difficult for the police or security personnel, these poles are lifted automatically. Once lifted, they divide the crowd into organized line formations, preventing people from rushing in large groups.

4.3 Load Cell Sensor-Based Crowd Monitoring

A load cell sensor is installed under the pathway to continuously measure the load (crowd pressure). A threshold weight limit is predefined in the system:

- If the measured load is **below the limit**, the LCD displays **"Weight Normal"**.
- If the load **exceeds the safe limit**, the LCD displays **"Overweight Detected"**, and the **LED and buzzer blink** to alert authorities immediately.

5. System Components

- Arduino Microcontroller
- Load Cell Sensor with HX711 Module
- Sand-Filled Safety Mat
- Underground Retractable Poles
- LCD Display
- LED Indicators
- Buzzer
- Power Supply Unit

6. Advantages of the Proposed System

- Prevents stampede by physically reducing movement speed.
- Provides real-time monitoring of crowd load.
- Automated warning system improves emergency response time.
- Reduces dependency on human crowd control alone.
- Low-cost and scalable for large public gatherings.
- Can be installed in temples, stadiums, malls, metro stations, and event venues.

7. Applications

- Religious gatherings and festivals
- Sports stadiums and concert halls
- Railway stations and metro stations
- Public rallies and political events
- Emergency evacuation systems

8. Conclusion

The Stampede Avoider system is an innovative safety solution designed to prevent overcrowding disasters using a combination of physical barriers and smart sensor technology. By integrating a sand-based slowdown mechanism, underground retractable poles for crowd organization, and load cell-based pressure monitoring with real-time alerts, this system provides enhanced public safety and effective crowd management. The proposed model is cost-effective, reliable, and suitable for real-world implementation in high-risk public environments.

9. Future Scope

- Integration with AI-based crowd density analysis using cameras.
- Wireless data transmission to central monitoring stations.
- Automatic emergency gate control.
- Mobile app alerts for authorities.
- Solar-powered system for outdoor installations.