

## A Real-Time Stampede Detection and Early Warning System

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### **Abstract:**

The growing number of crowd-related fatalities and stampedes, driven by inadequate crowd management demonstrate the necessity of intelligent surveillance systems that can monitor the situation in real-time and predict risks. Although there has been widespread implementation of CCTV infrastructure, recent tragedies like the 2022 Itaewon crowd crush in South Korea and the 2024 Hathras religious gathering stampede in India show that more traditional human-based monitoring is not able to recognize dangerous crowd environments in time. The rapid increase in density usually leads to stampedes in several seconds, and it is almost impossible to take any action manually. The suggested framework combines CSRNet, DBSCAN and LSTM models to perform crowd density estimation, anomaly detection and motion trend forecasting respectively, aiming at early detection and prevention of stampedes in crowded environments. Conventional surveillance methods are based on human eye or fixed threshold monitoring policies, which cannot be utilized in the analysis of complicated and dynamically developing crowd behaviours. Human operators are fatigued and have a low situational awareness and early computer vision systems that rely on counting and detecting objects are not very well in dense, occluded and challenging visual scenes. The system allows proactive crowd safety management due to its use of real-time analytics, predictive modelling, and automated alerts.

### **Keywords:**

CSRNet, DBSCAN, Ensemble Modelling, Computer Vision, Redis, Automated Alerting.