IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, April 2026
Impact Factor: 8.2

Intelligent Crowd Management System Using Gen AI

Ms. D. Annie Selina, Ms. S. Kavya, Mrs. P. Sujithra, Ms. S. Rathna, Ms. S. Suvetha
Assistant Professor, Department of Computer Science and Technology
Student, Department of Computer Science and Technology
Vivekanandha College of Engineering for Women (Autonomous), Tiruchengode, Namakkal, India
annieselina@vcew.ac.in, kavyanagapriya@gmail.com, sujithra132005@gmail.com
rathnasubramaniyan01@gmail.com, suvethasubramani055@gmail.com

Abstract: *India's urban and pilgrimage environments experience large crowd gatherings, creating challenges in safety and management. Conventional systems are reactive and fail to predict sudden crowd surges. This paper proposes an Intelligent Crowd Management System using Generative AI for proactive crowd prediction. The system analyzes historical and contextual data to forecast crowd scenarios and classify risk levels. A web-based platform enables pilgrims to view crowd forecasts, while administrators manage entries and issue alerts. The solution improves safety, efficiency, and preparedness, making it suitable for large-scale deployments.*

Keywords: Crowd Management, Generative AI, Predictive Analytics, Public Safety

I. INTRODUCTION

Crowd gatherings in India's urban areas and pilgrimage sites have increased significantly due to festivals, special events, and seasonal tourism. Managing large and diverse crowds is a major challenge, as conventional monitoring systems are largely reactive and fail to anticipate sudden surges. This often leads to congestion, discomfort, and potential safety risks for attendees.

Advancements in artificial intelligence, particularly Generative AI, provide opportunities to shift from reactive to proactive crowd management. By analyzing historical and contextual data such as event schedules, seasonal trends, and time slots, AI systems can forecast crowd density and classify risk levels. These predictions enable authorities to take preventive measures, improving safety and operational efficiency.

The proposed Intelligent Crowd Management System integrates AI-driven analytics with a web-based platform, allowing both administrators and pilgrims to access real-time insights. Administrators can dynamically allocate entry slots and issue alerts during high-risk situations, while pilgrims can plan visits based on crowd forecasts. This proactive approach enhances crowd preparedness, optimizes resource allocation, and ensures safer public environments

II. LITERATURE SURVEY

2.1.Deep Learning-Based Crowd Analysis for Real-Time Monitoring

Publication Year: 2024

Authors: (Based on IEEE Paper 10942376)

Journal Name: IEEE Xplore

Deep learning approaches using convolutional neural networks can automatically detect and count individuals from surveillance video to support real time crowd monitoring. These systems process video streams to identify densely populated areas and output crowd estimates with high accuracy, addressing limitations of traditional manual counting methods.

2.2. Smart Crowd Management Using AI and Edge Computing
Publication Year: 2023
Authors: (Based on IEEE Paper 10500823)
Journal Name: IEEE Xplore
Integrating AI with edge computing reduces latency by performing data processing closer to the source, enabling faster analysis of crowd motion and density. Edge based frameworks help object detection and tracking algorithms monitor crowd movement efficiently, improving real time decision making in urban and event settings.

2.3. Computer Vision-Based Crowd Density Estimation System
Publication Year: 2023
Authors: (Based on IEEE Paper 10438436)
Journal Name: IEEE Xplore
Computer vision methods use image processing and machine learning to estimate crowd density by identifying individuals in surveillance footage and computing spatial density levels. These models offer a scalable solution for estimating crowd distribution and supporting efficient planning of crowd control strategies at hubs like transportation nodes and large events.

2.4. Real-Time Crowd Detection and Monitoring System
Publication Year: 2020
Authors: (Based on IEEE Paper 9144582)
Journal Name: IEEE Xplore
Deep learning enhanced crowd detection systems identify the presence and movement of groups of people in video feeds with machine learning classifiers, enabling early detection of dangerous congestion.

2.5. Secure Crowd Monitoring Using IoT and AI Techniques
Publication Year: 2023
Authors: (From IJNSA Paper – aircconline)
Journal Name: International Journal of Network Security & Its Applications (IJNSA)
AI enabled crowd monitoring frameworks combine sensor data from IoT devices with machine learning analysis to detect anomalies and ensure secure handling of collected information.

III. METHODOLOGIES

3.1.Generative AI Algorithm
Generative AI is used to automatically generate intelligent safety alerts, crowd advisories, and announcements based on real-time and predicted crowd conditions. It analyzes crowd density levels, risk severity, and location information to produce meaningful, context-aware messages, reducing manual intervention and ensuring timely communication for effective crowd management.

3.2.OpenCV Image Processing
OpenCV is employed for real-time image and video processing. It extracts frames from CCTV video feeds and applies preprocessing techniques to enhance image quality, improving the accuracy of people detection and enabling smooth integration with detection and prediction models.

3.3.Crowd Density Estimation

The crowd density estimation algorithm calculates crowd levels based on the number of detected individuals within a given area. Density values are classified into low, medium, high, and critical levels, helping identify congested zones and trigger alerts for crowd control and safety management.

3.4.Time-Series Prediction (ARIMA / LSTM)

Time-series prediction models, such as ARIMA or LSTM, forecast future crowd density and waiting times. These models analyze historical and real-time crowd data to identify trends and patterns, enabling proactive decision-making and efficient management during peak periods.

3.5.YOLO Algorithm

YOLO is applied for real-time crowd detection and people counting from CCTV video streams. It identifies individuals within each frame, providing bounding boxes with high accuracy and low latency, making it suitable for real-time crowd density estimation in crowded environments.

IV. SYSTEM ARCHITECTURE

4.1.Crowd Detection Module

The Crowd Detection Module continuously detects and counts people in real time using CCTV footage combined with computer vision techniques. It accurately identifies crowd density and pinpoint overcrowded areas within the monitored environment. This module provides essential data that supports further analysis and monitoring, enabling authorities to track crowd movement across different zones within the temple premises. By doing so, it helps in the early identification of high-density areas, which is critical for preventing congestion and ensuring smooth crowd flow.

4.2.Image Processing & Prediction

This module processes images and videos to extract meaningful information about the crowd. Advanced techniques analyze movement patterns and density levels to provide a comprehensive understanding of crowd behavior. Utilizing both real-time and historical data, it predicts future crowd conditions, helping authorities prepare in advance. Machine learning algorithms are employed to continuously improve the accuracy of these predictions, making the system increasingly reliable over time

4.3.Alert Module

The Alert Module is responsible for generating automated notifications during situations of high crowd density. It provides timely safety instructions and warnings directed at both authorities and devotees to ensure their safety. By enabling quick responses during emergencies or crowd control scenarios, this module plays a crucial role in minimizing risks and maintaining order during peak times.

4.4.Darshan Slot Management

Darshan Slot Management controls the flow of devotees by allocating digital time slots for darshan. It limits the number of people allowed per slot, effectively reducing overcrowding and managing the influx of visitors. This scheduling approach minimizes waiting times and enhances the overall efficiency of crowd management within the temple premises, improving the experience for devotees.

4.5.Festival Calendar Integration

This module maintains detailed records of festivals, special events, and peak days, which significantly influence crowd dynamics. By analyzing event schedules and historical crowd data, it helps forecast crowd expectations accurately. The

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 1, April 2026 Impact Factor: 8.2

integration supports advance planning and optimal resource allocation, enabling better crowd control during busy periods and ensuring safety and convenience for attendees.

V. FLOWCHART

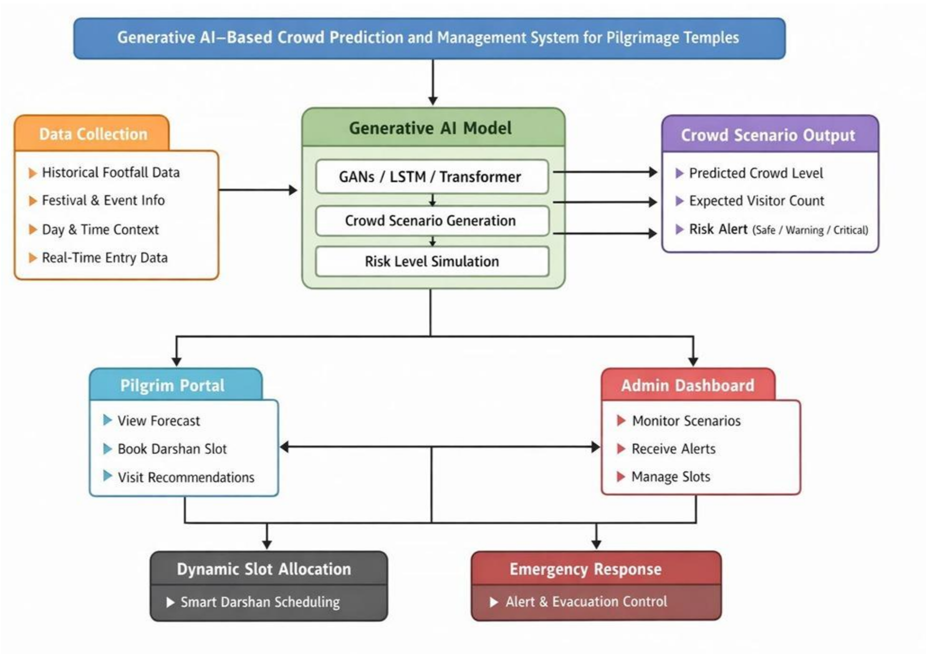

Fig 1-flowchart

VI. RESULT AND DISCUSSION

6.1 OUTPUT

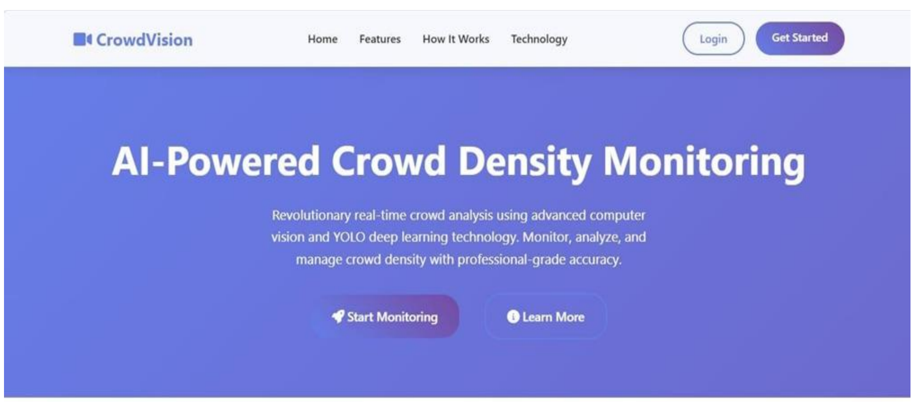

Fig 2-home page

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, April 2026
Impact Factor: 8.2

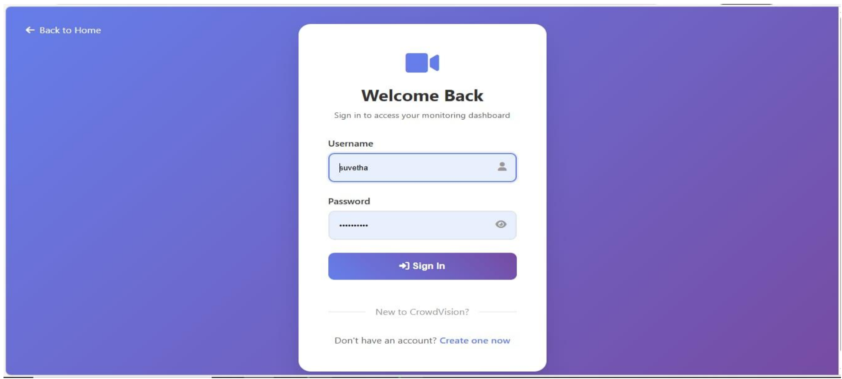

Fig 3-login page

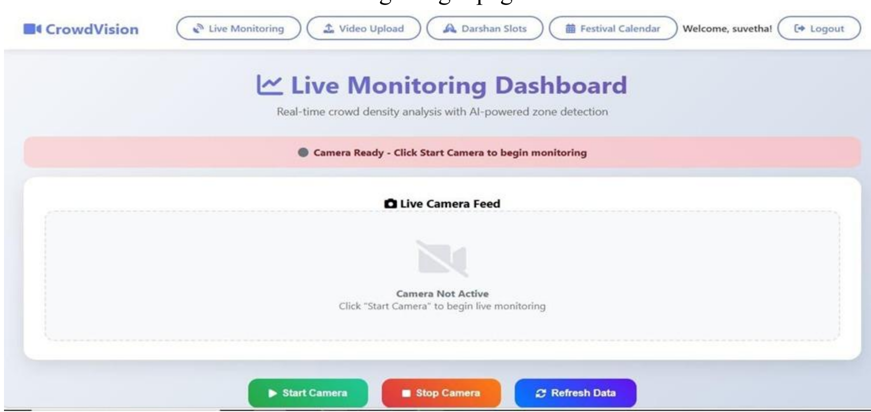

Fig 4-monitoring dashboard

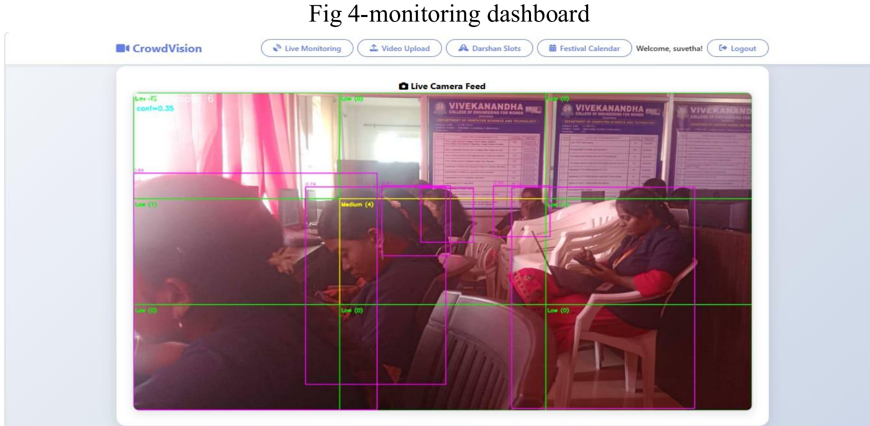

Fig 5-live camera monitoring

DOI: 10.48175/IJARSCT-32375

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, April 2026
Impact Factor: 8.2

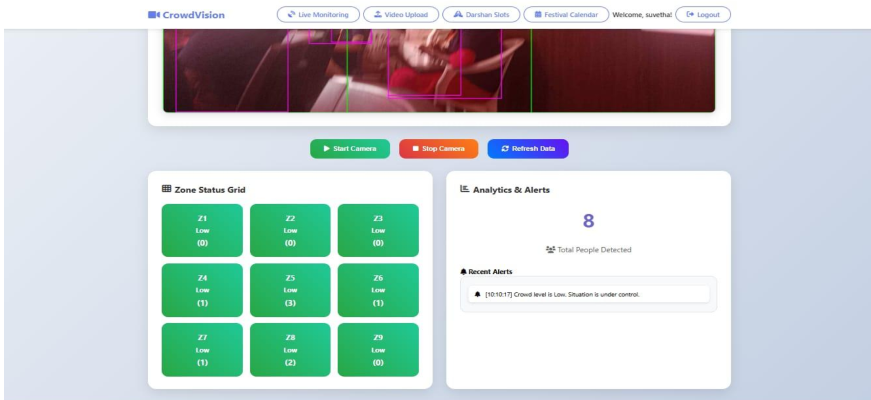

Fig 6-zone grid

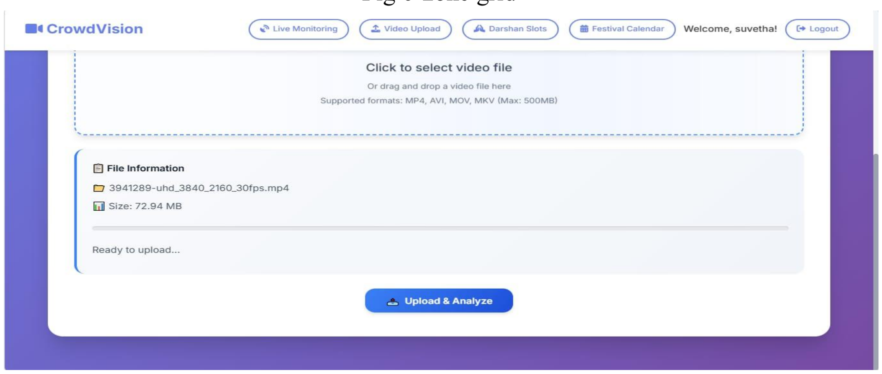

Fig 7- video upload

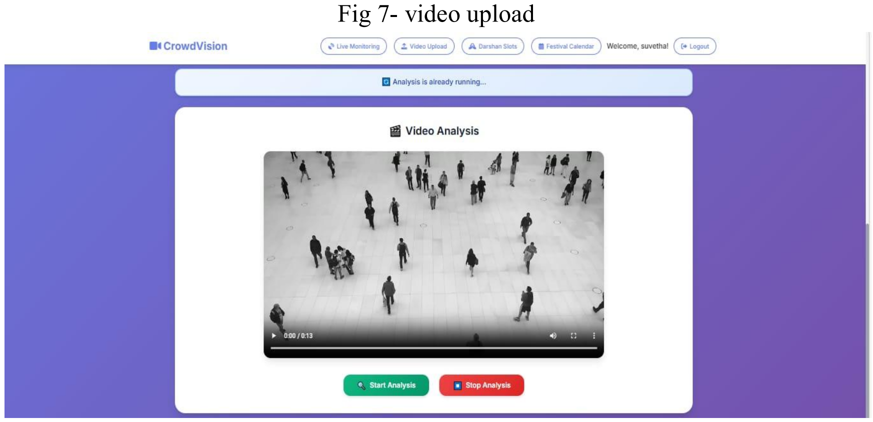

Fig 8- analysis

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 1, April 2026
Impact Factor: 8.2

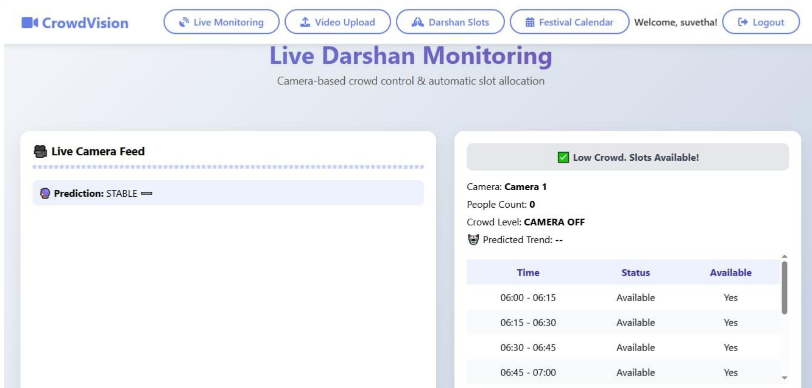

Fig 9-darshan slot allocation page

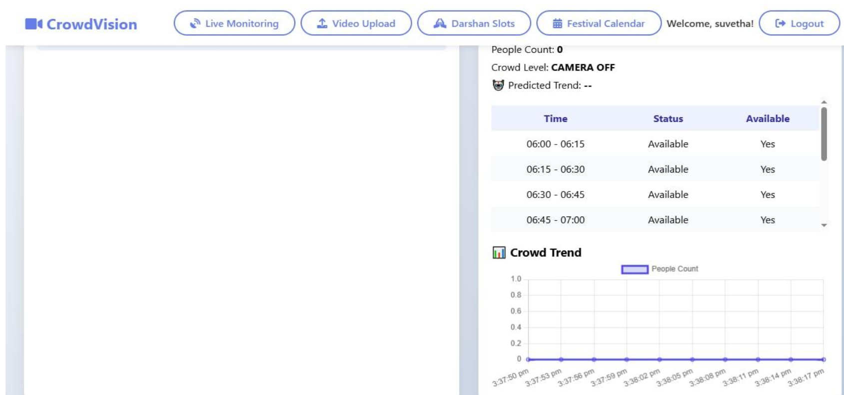

Fig 10-crowd trend graph

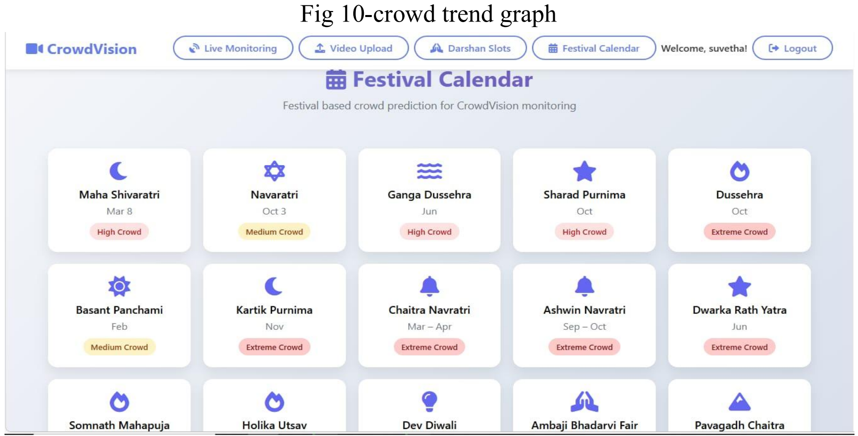

Fig 11-festival calender

6.2 PERFORMANCE ANALYSIS

The system's accuracy in detecting and counting individuals was rigorously tested using real-time CCTV video feeds. Advanced computer vision algorithms, particularly YOLO, provided precise identification of people even in dense crowds, minimizing false positives and ensuring reliable crowd density estimation. This accuracy is crucial for issuing timely alerts and maintaining safety in high-traffic areas.

Response time was another critical performance metric. With the integration of OpenCV for image preprocessing and optimized processing pipelines, the system could analyze video frames rapidly. Low latency ensured that alerts and predictions were delivered in real time, enabling authorities to respond promptly to emerging crowd situations.

The predictive capabilities of the system were evaluated using both historical and live crowd data. Generative AI models effectively forecasted future crowd densities and identified potential high-risk areas. This proactive approach allowed administrators to plan and allocate resources efficiently, reducing congestion and improving overall crowd management.

Finally, the system's scalability and reliability were tested across different scenarios, including peak festivals and special events. It consistently maintained performance under varying crowd densities and environmental conditions. The combination of AI-driven prediction, real-time detection, and automated alerts ensured that the system could handle complex, dynamic crowd environments effectively and safely.

VII. CONCLUSION

The proposed Intelligent Crowd Management System effectively integrates real-time crowd detection, predictive analytics, and generative AI to enhance safety and operational efficiency in high-density environments. By combining YOLO-based detection, OpenCV processing, time-series forecasting, and automated alert generation, the system enables proactive crowd management and minimizes the risk of congestion. The inclusion of darshan slot management and festival calendar integration further optimizes crowd flow and resource allocation. Performance analysis demonstrates the system's accuracy, responsiveness, and scalability, making it suitable for deployment in urban and pilgrimage settings. Overall, this approach provides a reliable, intelligent solution for ensuring public safety and improving crowd management efficiency.

REFERENCES

[1] Helbing, D., & Molnár, P., 1995, "Social force model for pedestrian dynamics," Physical Review E, vol. 51, no. 5, pp. 4282–4286.

[2] Johansson, A., Helbing, D., & Shukla, P. K., 2007, "Specification of the social force pedestrian model by evolutionary adjustment to video tracking data," Advances in Complex Systems, vol. 10, no. 02, pp. 271 288.

[3] Li, T., Chang, H., Wang, M., Ni, B., Hong, R., & Yan, S., 2014, "Crowded scene analysis: A survey," IEEE Transactions on Circuits and Systems for Video Technology, vol. 25, no. 3, pp. 367–386.

[4] Idrees, H., Saleemi, I., Seibert, C., & Shah, M., 2013, "Multi-source multi-scale counting in extremely dense crowd images," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 2547–2554.

[5] Marsden, G., McCarthy, J., & Gilbert, N., 2001, "Simulation of crowd behavior for emergency evacuation," Journal of Artificial Societies and Social Simulation, vol. 4, no. 2.