Chapter 7
Crowd Dynamics Analysis: GAN-Powered Insights for Enhanced Public Safety

Harshita Chourasia
https://orcid.org/0009-0009-4604-6067
G.H. Raisoni College of Engineering, India

Neha Tiwari
Oriental Institute of Science and Technology

Shraddha Raut
G.H. Raisoni University, Amravati, India

Anansingh Thinakaran
G.H. Raisoni College of Engineering, India

Anirudh A. Bhagwat
G.H. Raisoni College of Engineering, India

ABSTRACT

Understanding crowd dynamics in densely populated public spaces, such as city centers, stadiums, and transit hubs, is vital for ensuring public safety and efficient management. The complexities of crowded environments introduce various challenges, including traffic congestion, overcrowding, and potential safety hazards. Traditional methods of crowd analysis often fall short of providing comprehensive insights, relying on human observation or outdated sensor technologies. However, recent advancements in artificial intelligence, particularly using generative adversarial networks, opened new avenues for studying crowd behavior and density in real-time video feeds. The integration of GAN-based crowd analysis not only offers real-time monitoring but also enables the anticipation of potential safety hazards before they escalate. The chapter delves into the various applications of GANs in crowd behavior analysis, anomaly detection, and intelligence provision to security personnel.

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INTRODUCTION

Understanding crowd dynamics in crowded public spaces like city centres, stadiums, and transit hubs is crucial for preserving public safety and efficient management. Congested places present a number of challenges, including the potential for traffic jams, crowding, and potential safety hazards. Traditional methods of crowd analysis often rely on human observation or low-tech sensor technologies, which may not provide comprehensive understanding of complex crowd dynamics. However, recent advances in artificial intelligence, particularly the use of Generative Adversarial Networks (GANs), have given rise to a new field of crowd dynamics study. GANs, which are renowned for generating realistic data, have shown a lot of promise in the study of crowd behaviour and density in real-time video feeds. By harnessing the capacity of GANs to acquire analytical knowledge of crowd dynamics, security experts and urban planners can improve crowd management approaches and foresee potential safety hazards in advance. This chapter highlights the ways in which this innovative approach can enhance public safety in a variety of public environments by examining the connection between crowd dynamics research and insights produced by GANs. We investigate the potential applications of GANs in crowd behaviour analysis, anomaly detection, and providing intelligence to security personnel. We also examine case studies and practical examples that show how crowd analysis powered by GANs may be applied to improve crowd control protocols and lessen safety issues. This chapter provides a comprehensive understanding of how combining cutting-edge AI technology with the science of crowd dynamics could revolutionize public safety measures in crowded settings through the use of GAN-powered insights. The utilization of GAN-based crowd analysis presents unprecedented opportunities to enhance public safety and provide more smooth operations in dynamic public spaces, ranging from big events to transportation hubs.

With the flexibility to allow users to select certain behaviors for detection, the project seeks to detect a variety of aberrant behaviors in urban surveillance footage. It also keeps track of discovered abnormal occurrences for inspection. The project's primary focus aberrant behaviors are as follows:

1. Violence: The identification of aggressive conduct, including fights, physical altercations, and assaults.
2. Covering Camera: Recognizing attempts by people to obscure or obstruct the surveillance camera's field of vision, which may suggest malevolent intent or a desire to evade discovery.
3. Choking: Identifying circumstances in which someone is choking or having respiratory difficulty, as they may call for rapid medical attention.
4. Lying Down: Finding people who are unconscious in public areas, as this may point to health problems, mishaps, or suspicious activity.
5. Running: Seeing someone moving quickly or sprinting may indicate a sense of haste, terror, or the need to escape an apparent threat.
6. Motion in Restricted Areas: Tracking movement or activity in places that have been made off-limits or restricted, including private property or secure zones.

Here's a tabular representation of different research approaches to studying crowds: