Crowd Behavior Analysis for Enhanced Event Safety and Management

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CERTIFICATE

Certified that the project entitled "Crowd Behavior Analysis for Enhanced Event Safety and Management" carried out by Jatin B (USN- 1MS20IS054), Manoj S (USN- 1MS20IS070), Pannaga N (USN- 1MS20IS083), and Sanjeev G (USN- 1MS21IS406), bonafide students of M S RAMAIAH INSTITUTE OF TECHNOLOGY, Bangalore is in partial fulfillment for the award of Degree of Bachelor of Engineering in Information Science and Engineering of the Visvesvaraya Technological University, Belagavi during the year 2023-2024. The project work has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

Name and Signature of the Guide Signature of the HOD Signature of the Principal

External Viva

Name of the examiners Signature with date

1.

2.

RAMAIAH
Institute of Technology

DECLARATION

We hereby declare that the entire work embodied in this ISP SENIOR PROJECT report has been carried out by us at Ramaiah Institute of Technology under the supervision of Ms.D.Evangeline. This project report has not been submitted in part or full for the award of any diploma or degree of this or any other University.

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ABSTRACT

Large-scale events like music festivals and sports games necessitate effective crowd management and safety measures to prevent accidents and ensure a smooth experience for attendees. This paper addresses the challenges of crowd control by focusing on crowd density analysis through segmentation and binarization techniques. Additionally, the study aims to enhance safety protocols by implementing anomaly detection using Particle Advection to identify fast-moving individuals within the crowd and detect people moving in different directions. By combining advanced technologies with strategic crowd management strategies, this research seeks to improve the overall safety and security of large events, mitigating risks and enhancing the overall experience for participants and staff.

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Chapter 1

INTRODUCTION

Crowd management and safety at large events are paramount considerations to ensure the well-being and orderliness of attendees. One crucial aspect of crowd management is understanding the density of crowds through segmentation and binarization techniques. . Integration of advanced techniques, including a CNN model comprising VGG, dilatable layers, and ASPP layers, event organizers can gain insights into crowd distribution, movement patterns, and potential overcrowding, enabling proactive measures to maintain safety and security.

Anomaly detection, facilitated by methods like Particle Advection, is pivotal in optimizing crowd management. This interactive approach enables swift identification of unusual behaviors or events within the crowd, empowering event organizers to promptly respond to potential risks.

Efficient crowd management and safety rely on detecting fast-moving individuals and monitoring directional movement within the crowd. Leveraging optical flow analysis enables the identification of fast-moving pixels, thereby facilitating the detection of fast-moving objects. Additionally, YOLO tracking aids in tracking directional movement of objects within the crowd, contributing to effective crowd regulation and accident prevention. Emphasizing these objectives in crowd management strategies significantly enhances the success and safety of large-scale events.

1.1 Motivation and Scope

The motivation for undertaking this major project stems from the critical need for effective crowd monitoring and management in light of the rising population and the increasing frequency of large-scale events worldwide. Tragic incidents such as the Indonesia football stampede in October 2022, where 125 individuals lost their lives, and the Kochi university concert stampede in November 2023, resulting in four student deaths and numerous injuries, serve as stark reminders of the potential dangers associated with overcrowded events.

There is exponential increase in the amount of accidents, fatalatiy and injuries in each decade is as shown in Fig 1.1.

These incidents underscore the urgent necessity for advanced crowd management strategies that can accurately assess crowd density, identify potential risks such as overcrowding and stampedes, and enable swift response mechanisms to prevent casualties and ensure the safety of event attendees. The tragic stampede at the Barea stadium in Madagascar in August 2023, which claimed 12 lives and left 80 injured during the Indian Ocean Island Games' opening ceremony, further emphasizes the critical nature of implementing robust crowd monitoring and safety measures.

The scope of this major project encompasses the development and integration of advanced technologies, including CNN models with VGG, dilatable layers, and ASPP layers, for crowd density analysis and anomaly detection. Additionally, the project will focus on utilizing methods such as Particle Advection for swift identification of unusual behaviors within crowds and optical flow analysis combined with YOLO tracking for monitoring fast-moving individuals and directional movement within the crowd.

The ultimate goal of this project is to contribute to the enhancement of crowd management strategies, thereby mitigating potential risks, ensuring the safety of attendees at large events, and preventing tragic incidents like those mentioned above from occurring in the future. By addressing these pressing concerns through innovative technological solutions, this project aims to make a meaningful impact on event safety and security on a global scale.

Figure 1.1 presents present-day challenges call for solutions that require the utmost precision and accuracy in the developed solutions as shown in Fig 1.1.

This however has led to many research challenges published by various journals.

1.2 Issues and Challenges

The issues and challenges surrounding crowd management and safety at large-scale events are multifaceted and complex. Here are some key points to consider:

1. **Crowd Density and Movement**: One of the primary challenges is accurately assessing and managing crowd density. Large gatherings often result in densely packed crowds, which can lead to discomfort, anxiety, and in extreme cases, stampedes or crushes. Understanding how crowds move and behave is crucial for effective management.

2. **Risk of Overcrowding**: Overcrowding is a significant risk factor at events, especially during popular performances or activities. When venues reach or exceed their capacity, it can pose serious safety hazards, including difficulties in evacuating people in case of emergencies.

3. **Anomalies and Unpredictable Behavior**: Crowd behavior can be unpredictable, and detecting anomalies such as sudden rushes, fights, or medical emergencies can be challenging. Identifying and responding to these anomalies swiftly is essential to prevent escalations and maintain order.

4. **Communication and Coordination**: Communication between event organizers, security personnel, and emergency responders is critical for effective crowd management. Delays or breakdowns in communication can hinder response times and exacerbate safety risks.

5. **Technological Limitations**: While advanced technologies like CCTV cameras, drones, and AI-based analytics offer valuable insights, there are challenges in integrating and interpreting data in real-time. Technical glitches or system failures can impede the effectiveness of these tools.

6. **Cultural and Social Factors**: Cultural norms, social dynamics, and the behavior of specific attendee demographics can influence crowd management strategies. Understanding these factors and tailoring approaches accordingly is vital for successful event management.

7. **Emergency Preparedness and Response**: Being prepared for emergencies such as medical incidents, fires, or terrorist threats is paramount. Effective emergency response plans, including evacuation procedures and medical facilities, are essential components of crowd safety.

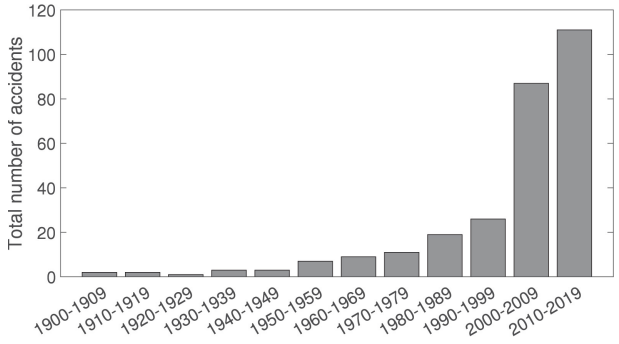
Addressing these issues requires a holistic approach that combines technological innovations, effective communication protocols, comprehensive risk assessments, and rigorous training for event staff and security personnel. Proactive measures, continuous monitoring, and adaptive strategies are key to mitigating risks and ensuring the safety and well-being of all attendees at large-scale events.

1.3 Problem Statement

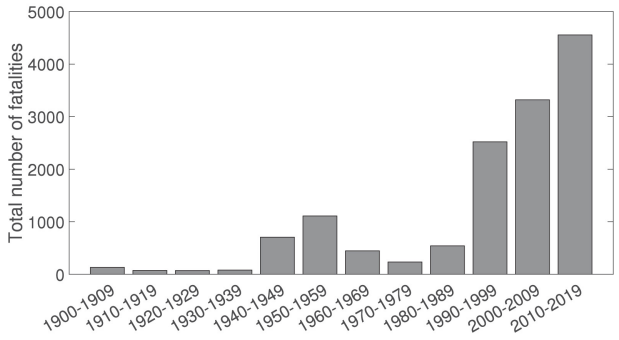
The problem of crowd management and safety at large-scale events poses significant challenges due to the potential for unexpected incidents, overcrowding, and the resulting risks of accidents and stampedes. Despite advancements in event planning and security measures, ensuring the well-being and orderliness of attendees remains a critical concern for event organizers. Addressing this issue requires innovative approaches and technologies that can accurately monitor crowd density, detect anomalies in behavior, and facilitate swift responses to mitigate potential risks and enhance overall event safety.

1.4 Organization of the Report

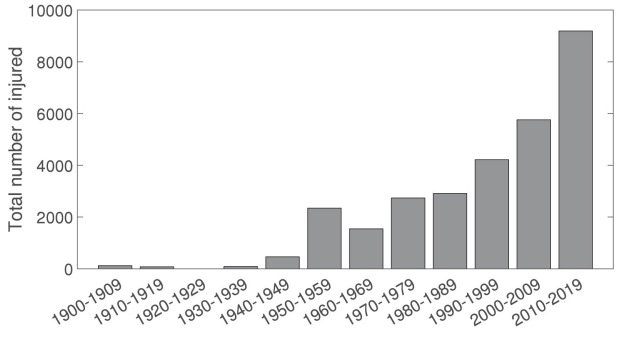
This will be the last section in the introduction section explaining how the report is organized in the remaining chapters.



(a) Accidents by decade



(b) Fatalities by decade



(c) People injured by decade

Figure 1.1: Total number of crowd accidents and related number of fatalities and people injured for each decade from the beginning of the 20th century until the last complete decade

Chapter 2

LITERATURE REVIEW

A literature review is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews are secondary sources and do not report new or original experimental work. Most often associated with academic-oriented literature, such reviews are found in academic journals and are not to be confused with book reviews that may also appear in the same publication. Literature reviews are a basis for research in nearly every academic field [1]. A narrow-scope literature review may be included as part of a peer-reviewed journal article presenting new research, serving to situate the current study within the body of the relevant literature and to provide context for the reader. In such a case, the review societally precedes the methodology and results sections of the work.

The work conducted by [2] has shown several limitations.

Producing a literature review may also be part of graduate and post-graduate student work, including in the preparation of a thesis, dissertation, or a journal article. Literature reviews are also common in a research proposal or prospectus (the document that is approved before a student formally begins a dissertation or thesis) [3, 4].

This was suggested by [5] that recognition is accurate.

2.1 Review Types

The main types of literature reviews are: evaluative, exploratory, and instrumental [4, 6].

A fourth type, the systematic review, is often classified separately but is essentially

a literature review focused on a research question, trying to identify, appraise, select, and synthesize all high-quality research evidence and arguments relevant to that question. A meta-analysis is typically a systematic review using statistical methods to effectively combine the data used on all selected studies to produce a more reliable result.

2.1.1 Process And Product

[7] distinguish between the process of reviewing the literature and a finished work or product known as a literature review. The process of reviewing the literature is often ongoing and informs many aspects of the empirical research project. All of the latest literature should inform a research project. Scholars need to be scanning the literature long after a formal literature review product appears to be completed.

2.2 Page Limitation

A careful literature review is usually 15 to 30 pages and could be longer. The process of reviewing the literature requires different kinds of activities and ways of thinking [4] and [8] link the activities of doing a literature review with Benjamin Bloom's revised taxonomy of the cognitive domain.

hello this is my paper .he quoted a word [9].

The introduction to imbalanced data is mentioned by [10].

Chapter 3

FRAMEWORK AND SYSTEM DESIGN

Flow chart, Activity diagram, State Diagram, Sequence diagram, Framework diagram, Use case diagram, Data flow diagram, ER diagram, Schema diagram any other diagram and explanation specific to your project.

3.1 Design Overview

3.2 Figure

- All Figure Caption should be in the Title Case, TNR 10 pt, and it should be of the Format: Fig Chapter Number.Figure Number Figure Caption
- It should be cited as Fig. **??** Caption must appear below the Figure.
- For Smaller: (4 Figures arranged in Two Columns) / Page; Portrait Mod.
- For Medium: (2 Figures arranged one below the other / Page; Portrait Mode.
- For Larger: 1 Figure / Page; Landscape Mode.
- Figure Label should be in Font TNR 10 pt, Bold.
- Figure Resolution should be minimum of 300 DPI.

Figure 3.1: Sample Picture of Universe

For example, The universe is immense and it seems to be homogeneous, in a large scale, everywhere we look at.

There's a picture of a galaxy above in Fig. 3.1

3.3 Stake-holder Design

3.3.1 Definition and Notations

Let DS denote a binary imbalanced data set. The binary data set comprises Majority and Minority data sets indicated by DS_{ma} and DS_{mi} respectively. Let $|DS_{ma}|$ and $|DS_{mi}|$ be p and q respectively where, $DS_{ma} \cup DS_{mi} = DS$. The class set C consists of majority class and minority class, $C = \{C_{ma}, C_{mi}\}$.

3.4 Architectural Design

3.5 Workflow

Chapter 4

Implementation

Algorithm 4.1 begins with minority training instances, TR_{mi}. This minority training set undergoes the partition synthesis process to arrive at an updated minority training data set with synthetic instance, DS_{Smi}.

Algorithm 4.1: Nearest Neighbor Classifier

Input:

- Minority Training data, TR_{mi}
- Majority Training Data, TR_{ma}
- Test Instance, T

Output: Predicted Class, C, where $C \; \varepsilon \; \{C_{mi}, \; C_{ma}\}$

1 Using TR_{mi}, generate synthetic_minority data set, DS_{Smi};

2 Find k greedy neighbors for the test pattern T from DS_{Smi}. Let it be denoted by ϕmi;

3 Find k greedy neighbors of the test pattern T from the majority set TR_{ma}. Let it be denoted by ϕma;

4 Find k global greedy neighbors of the test tuple T from the union of $\phi mi \cup \phi ma$;

5 Classify T to the class based on the majority vote among the k global neighbors

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4.1 Formats

Other formats are available. Students are allowed to proceed with the other formats.No programs can be included within the implementation chapter.

Chapter 5

Experiments and Results

The results in the form of graphs and tables can be illustrated in this chapter. Sample of writing a mathematical equation is as follows.

Let A be an attribute and C_i be the class predictor variable representing the minority class data. Taking this into account, the confidence for the rule $A \rightarrow C_i$ is as follows, as shown in Eqn. 5.1

$$Confidence(A \rightarrow C_{it}) = \frac{Support(A \cup C_i)}{Support(A)} = \frac{m}{m+p} \tag{5.1}$$

The confidence of a given value of attribute A that it belongs to majority class, $\hat{C}_i$ is as given below as in Eqn. 5.2

$$Confidence(A \rightarrow \hat{C}_i) = \frac{Support(A \cup \hat{C}_i)}{Support(A)} = \frac{p}{m+p} \tag{5.2}$$

Chapter 6

Conclusion and Future Scope

6.1 Conclusion

6.2 Future Scope

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