A
PROJECT REPORT
ON

"Real Time AI Enhanced Crowd Surveillance with Big Data Analytics"

Submitted by

Bhalerao Chaitrali Pravin	Seat No : B190588501
Bangar Gaurav Somnath	Seat No : B190588506
Kharat Sakshi Ashok	Seat No : B190588538
Pingale Yukta Pankaj	Seat No : B190588556

UNDER THE GUIDANCE OF

Prof. M.S. Khan

Department of Information Technology

Matoshri College of Engineering and Research Center

AT POST ODHAGOAN, TALDIST. NASHIK-422105.

SAVITRIBAI PHULE PUNE UNIVERSITY

Academic Year 2023-24

CERTIFICATE

This is to certify that this project report entitled

"Real Time AI Enhanced Crowd Surveillance with Big Data Analytics"

Submitted By

Bhalerao Chaitrali Pravin	Seat No : B190588501
Bangar Gaurav Somnath	Seat No : B190588506
Kharat Sakshi Ashok	Seat No : B190588538
Pingale Yukta Pankaj	Seat No : B190588556

Have Successfully completed Preliminary Project Report on **"Real Time AI Enhanced Crowd Surveillance with Big Data Analytics"** under the supervision of **Prof. M.S.** Khan and it is approved for the partial fulfilment of the requirements of Savitribai Phule Pune University, for the award of the degree of Bachelor of Engineering (Information Technology).

(Prof. M.S. Khan)
Project Guide

(Prof.N.L.Bhale)
HOD

(Dr.G.K.Kharate)
Principal
Matoshri Colleage of Engineering and Research Centre,Nashik-422105.

Signature of Internal Examiner

Signature of External Examiner

Place: Nashik

SPONSERSHIP LETTER

Date: 30/ 10 /2023

To,
Head of Department
Information Technology
Matoshri College of Engineering & Research Centre,
Eklahare, Nashik
422105

Subject: Sponsorship Letter

We are excited to give your students an opportunity for a meaningful collaboration. As part of our commitment to supporting education and nurturing young talent, **Shree Durga Mata Devasthan Trust, Jail Road, Nashik Road. President Mr.Shailesh Dhage** is pleased to offer sponsorship for an important academic project titled "Real Time Ai Enhanced Crowd Surveillance with Big data Analytics" undertaken by the students of **Matoshri College of *Engineering* & Research Centre**. We believe in the potential of these talented individuals *and their capacity to make* a significant impact through their innovative project.

1. *Sakshi Kharat*
2. *Gaurav Bangar*
3. *Chaitrali Bhalerao*
4. *Yukta Pingale*

The above students are involved in project We believe that supporting educational initiatives like this project aligns perfectly with our organization's mission and values.

Thanks, and Regards
Mr.Shailesh Dhage
(President of Shree Durga Mata Devasthan Trust)

ACKNOWLEDGMENT

First of all, I am indebted to the god almighty for giving me an opportunity to excel in my efforts to complete this seminar on time. I am extremely grateful to **Dr.G.K.Kharate**, Principal, Matoshri College of Engineering and Research Centre, **Prof.N.L.Bhale** Head of Department, Department of Information Technology, for providing all the required resources for the successful completion of my seminar. My heartfelt gratitude to my seminar guide **Prof. M.S. Khan**, for his value able suggestions and guidance in the preparation of the seminar report. I express my thanks to all my teachers professors and friends for all the help and co- ordination extended in bringing out this seminar successfully in time. I will be failing in duty if I do not acknowledge with grateful thanks to the authors of the references and other literatures referred to in this seminar. Last but not the least; I am very much thankful to my parents who guided me in every step which I took.

Thanking You
Bhalerao Chaitrali Pravin
Bangar Gaurav Somnath
Kharat Sakshi Ashok
Pingale Yukta Pankaj

ABSTRACT

The surveillance system employs state-of-the-art AI algorithms to process live video feeds, extracting meaningful insights from the complex dynamics of crowds. Furthermore, the incorporation of big data analytics facilitates the storage, management, and rapid analysis of vast amounts of surveillance data. This not only enhances the real-time monitoring capabilities but also enables historical trend analysis for predictive modeling. Key components of the proposed system include a sophisticated camera network, edge computing capabilities for immediate processing of video data, and a centralized big data infrastructure. The AI models are trained to recognize abnormal crowd behavior, such as sudden movements, overcrowding, or potential security incidents. The system's real-time alerts empower security personnel to respond swiftly to emerging situations, thus improving overall public safety. The proposed real-time AI-enhanced crowd surveillance system with big data analytics represents a holistic approach to urban security, leveraging cutting-edge technologies to enhance situational awareness and response capabilities. By amalgamating the strengths of AI and big data, this system stands at the forefront of intelligent crowd monitoring, contributing to the creation of safer and more secure urban environments.

Keywords: Artificial Intelligence, surveillance system, real-time alerts, big data.

Contents

List of Figures

Chapter 1

Synopsis

1.1 Project Title

"Real Time AI Enhanced Crowd Surveillance with Big Data Analytics."

1.2 Project Option

Application based Project.

1.3 Internal Guide

Prof. M.S. Khan

1.4 Technical Keywords (As per ACM Keywords)

1. Artificial Intelligence
2. surveillance system
3. real-time alerts
4. big data.

1.5 Problem Statement

The problem at hand is the recurring tragedy of crowd-related accidents in India, particularly during religious festivities, where over 70 percent of such incidents have been reported. These unfortunate events highlight the pressing need for advanced crowd safety measures that can overcome the limitations of manual interventions. Manual crowd control methods are susceptible to human errors and are time-consuming, leaving large gatherings vulnerable to overwhelming and potentially dangerous conditions.

To address this challenge, the LT Smart World AI-based crowd management system was implemented during the 2019 Kumbh Mela in Prayagraj, showcasing the potential of Artificial Intelligence to tackle complex crowd management issues. This system, while successful, also aimed to integrate cutting-edge technologies like fire detection through image processing, fall detection using deep learning, and overcrowding detection through Convolutional Neural Networks (CNNs) to enhance crowd safety. Therefore, the problem statement revolves around the imperative to prevent crowd-related disasters and improve the safety of massive gatherings by implementing advanced AI-driven solutions that can efficiently count, manage, and respond to dense crowds while proactively identifying and mitigating potential risks such as fires, falls, and overcrowding.

1.6 Abstract

The surveillance system employs state-of-the-art AI algorithms to process live video feeds, extracting meaningful insights from the complex dynamics of crowds. Furthermore, the incorporation of big data analytics facilitates the storage, management, and rapid analysis of vast amounts of surveillance data. This not only enhances the real-time monitoring capabilities but also enables historical trend analysis for predictive modeling. Key components of the proposed system include a sophisticated camera network, edge computing capabilities for immediate processing of video data, and a centralized big data infrastructure. The AI models are trained to recognize abnormal crowd behavior, such as sudden movements, overcrowding, or potential security incidents. The system's real-time alerts empower security personnel to respond swiftly to emerging situations, thus improving overall public safety. The proposed real-time AI-enhanced crowd surveillance system with big data analytics represents a holistic approach to urban security, leveraging cutting-edge technologies to enhance situational awareness and response capabilities. By amalgamating the strengths of AI and big data, this system stands at the forefront of intelligent crowd monitoring, contributing to the creation of safer and more secure urban environments.

1.7 Goals and Objectives

The goals and objectives of real-time AI-enhanced crowd surveillance with big data analytics typically revolve around enhancing public safety, security, and efficiency in various environments. Here are some common objectives:

- The primary goal is to improve security by detecting and preventing potential threats or incidents in crowded areas such as airports, train stations, stadiums, and public events.
- Utilize AI algorithms to continuously monitor live video feeds from surveillance cameras in crowded areas, enabling immediate response to any suspicious activities or emergencies.
- Implement AI algorithms to analyze crowd behavior and identify anomalies such as overcrowding, sudden movements, or suspicious behaviors that may indicate potential threats or emergencies.

- Utilize big data analytics to analyze historical crowd behavior patterns and predict future events or crowd movements. This helps in proactive planning and resource allocation for managing crowd flow and preventing incidents.
- Optimize resource allocation such as security personnel, emergency services, and crowd control measures based on real-time analysis of crowd data and potential risks.
- Ensure that surveillance and data collection methods comply with privacy regulations and ethical standards to protect the rights and privacy of individuals within the crowd.
- Develop a scalable system that can handle large volumes of data from multiple surveillance cameras and crowds of varying sizes without compromising performance or accuracy.
- Integrate the AI-enhanced crowd surveillance system with existing security infrastructure, such as access control systems, alarm systems, and emergency response protocols, to enhance overall security effectiveness.
- Implement automated alert and notification systems to promptly inform security personnel and relevant authorities about potential threats or incidents detected by the surveillance system.

1.8 Area of Project

The project area for "Real-Time AI-Enhanced Crowd Surveillance with Big Data Analytics" encompasses a wide range of environments crucial for public safety and security. From bustling transportation hubs like airports and train stations to crowded urban centers and public events, the need for effective crowd monitoring is paramount. Additionally, critical infrastructure facilities such as power plants and government buildings, along with border checkpoints and industrial sites, require constant surveillance to mitigate security risks. Furthermore, the application extends to disaster response scenarios and emerging smart city initiatives. By leveraging AI algorithms and big data analytics, this technology enables real-time monitoring, anomaly detection, and predictive analysis, ultimately enhancing security, optimizing resource allocation, and improving emergency response capabilities across various domains.

1.9 Relevant mathematics associated with the Project

System Description: S = (I,O,F) Where,

- S: System.
- Input:
  I = IV, I are set of Inputs
  Where,
  IV : Input Video
  I : Image
- Function:
  F = A, DP, PMare set of Function
  Where,
  A : Authentication
  DP: Data Processing
  PM: Prediction Module
- Output:
  O = CS are set of Output
  Where,
  CS: Crowd Surveillance
- Success Conditions: Proper database.
- Failure Conditions: No database, internet connection

1.10 Names of Conferences / Journals where papers can be published

- International Research Journal of Modernization in Engineering Technology and Science
  (Peer-Reviewed, Open Access, Fully Refereed International Journal)
  Volume:05/Issue:04/April-2023
  Impact Factor- 7.868 www.irjmets.com
- International Journal of Scientific Research in Engineering and Management (IJSREM)
  Volume: 06 Issue: 10 — October - 2022
  Impact Factor: 7.185 ISSN: 2582-3930

1.11 Review of Conference/Journal Papers supporting Project idea

1. D. Helbing and P. Mukerji, "Crowd disasters as systemic failures: analysis of the Love Parade disaster", EPJ Data Sci, vol. 1, no. 7, 2012, [online] Available: www.doi.org/10.1140/epjds7.

2. Available: www.ieeecs-madras.managedbiz.com/icnl/19q1/p72-p75.pdf.

3. Y. LeCun, Y. Bengio and G. Hinton, "Deep learning", Nature, vol. 521, no. 7553, pp. 436-444, May 2015.

4. Nanda Wijermans et al., "A Landscape of Crowd-management Support: An Integrative Approach", Safety Science, vol. 86, pp. 142-164, 2016.

5. Ujwala Bhangale, Suchitra Patil, Vaibhav Vishwanath, Parth Thakker, Amey Bansode and Devesh. Navandhar, "Near Real-time Crowd Counting using Deep Learning Approach", Procedia Computer Science, vol. 171, pp. 770-779, 2020.

6. Yuhong Li, Xiaofan Zhang and Deming. Chen, CSRNet: Dilated Convolutional Neural Networks for Understanding the Highly Congested Scenes, pp. 1091-1100, 2018.

7. Lokesh Boominathan, Srinivas Kruthiventi and R.. Babu, CrowdNet: A Deep Convolutional Network for Dense Crowd Counting, pp. 640-644, 2016.

8. Available: www.timesofindia.indiatimes.com/india/kumbh-mela-sets-threeguinness-world-records/articleshow/68271937.cms.

1.12 Plan of Project Execution

The following Table describes the project plan. It describes the various activities and accountability of the developers for the respective modules. Following are the major activities carried out in this plan :

- Identifying the functional requirements.
- Designing of the Framework.
- Studying the necessary development tools and technologies.
- Define Programming Standards.
- Development of project in 3 Milestones.
- Formal Technical Review and Testing.

Table 1.1: Planner and Progress Report for project

Phase	**Activity**	**Start Date**	**End Date**	**Group Members**
1	Selection of Project Topic	22-08-2023	25-08-2023	Team
2	Functional Requirement Specification(FRS)	29-08-2023	09-09-2023	Team
3	Design Prototype	11-09-2023	21-09-2023	Team
4	Set Theory and Math Model	23-09-2023	06-09-2023	team
5	UML Diagram Prototype	23-09-2023	03-10-2023	Team
6	Project Problem Statement using NP Complete	08-10–2023	19-10-2023	team
7	UML Diagram in StarUML	05-10-2023	22-10-2023	Team
8	Paper Presentation	05-11-2023	05-11-2023	Team
9	Software Requirement Specification	6-11-2023	10-11-2023	Team
10	Paper Publication sem 1	11-11-2023	15-11-2023	Team
11	Report Submission Sem 1	15-11-2023	1-12-2023	Team
12	Module Design (admin, route, user)	1-12-2023	1-1-2023	Team
13	GUI Design	1-11-2024	15-1-2024	Team
14	Arduino Programming	15-1-2024	1-2-2024	Team
15	Hardware Interfacing	1-2-2024	15-2-2024	Team
16	Project Implementation	15-2-2024	1-3-2024	Team
17	QA and Testing	1-3-2024	15-3-2024	Team
18	Outcome of Project	15-3-2024	15-4-2024	Team
19	Paper Publication sem 2	15-4-2024	25-4-2024	Team
19	Report Submission sem 2	25-4-2024	8-5-2024	Team

Chapter 2

Technical Keywords

2.1 Area of Project

The project area for "Real-Time AI-Enhanced Crowd Surveillance with Big Data Analytics" encompasses a wide range of environments crucial for public safety and security. From bustling transportation hubs like airports and train stations to crowded urban centers and public events, the need for effective crowd monitoring is paramount. Additionally, critical infrastructure facilities such as power plants and government buildings, along with border checkpoints and industrial sites, require constant surveillance to mitigate security risks. Furthermore, the application extends to disaster response scenarios and emerging smart city initiatives. By leveraging AI algorithms and big data analytics, this technology enables real-time monitoring, anomaly detection, and predictive analysis, ultimately enhancing security, optimizing resource allocation, and improving emergency response capabilities across various domains.

2.2 Technical Keywords

Technical Key Words:

1. Artificial Intelligence
2. surveillance system
3. real-time alerts
4. big data.

1. C. Computer Systems Organization
    (a) C.2 COMPUTER-COMMUNICATION NETWORKS
        i. C.2.4 Distributed Systems
            A. Client/server
            B. Distributed applications
            C. Distributed databases
            D. Network operating systems
            E. Distributed file systems
            F. Security and reliability issues in distributed applications

Chapter 3

INTRODUCTION

3.1 Project Idea

The Project Idea of implementing a system for real-time AI-enhanced crowd surveillance with big data analytics is to revolutionize public safety in urban environments. This innovative approach combines advanced artificial intelligence techniques, including computer vision and deep learning, with the power of big data analytics to proactively address security challenges. The primary objective is to detect potential threats or abnormal crowd behavior in real-time, empowering security personnel with immediate alerts and enabling swift intervention. By analyzing live video feeds with AI algorithms, the system enhances crowd management and control, allowing for the identification of overcrowding and facilitating timely interventions to ensure public safety. Furthermore, the integration of big data analytics provides valuable insights from historical surveillance data, allowing for the identification of patterns, trends, and anomalies in crowd behavior. This information not only aids in the development of proactive security measures for future events but also optimizes resource allocation for more efficient deployment of personnel and resources. The ultimate goal is to enhance situational awareness, maintain privacy and ethical standards, and create a scalable, adaptable system that continually evolves to meet emerging security challenges, thereby fostering safer and more secure urban environments.

3.2 Overview

The recent tragedies related to crowd management in India, particularly during religious festivities, have underscored the critical need for advanced crowd safety measures. Over 70 percent of crowd-related accidents occurring in such events highlight the urgency of addressing this issue. Manual crowd control methods, while important, are susceptible to human errors and are time-consuming. In response to these challenges, the implementation of the LT Smart World AI-based crowd management system during the world's largest Kumbh Mela gathering in Prayagraj in 2019 showcased the potential of Artificial Intelligence to address issues beyond human capabilities. This system relied on deep learning to efficiently count and manage dense crowds, ensuring the safety

of the staggering 23 crore pilgrims who visited during the 50 days of the Holy Kumbh Mela. This successful application of AI-based crowd control analytics by LT Smart World serves as a compelling example of how cutting-edge technology can be harnessed to minimize the risks associated with overcrowded events, potentially averting devastating humanitarian disasters.

Furthermore, the data collected during this implementation provides a valuable foundation for developing effective crowd management and evacuation strategies. By leveraging AI, event organizers and authorities can now have access to real-time insights and predictive analytics, enabling them to proactively respond to changing crowd dynamics and potential safety threats. This experience highlights the transformative potential of AI in addressing complex challenges and emphasizes the importance of investing in innovative solutions to ensure the safety and well-being of large gatherings, particularly during religious festivals, where the risks are most pronounced. Ultimately, the success of the LT Smart World AI-based crowd management system during the Kumbh Mela sets a precedent for future crowd safety initiatives in India and around the world, demonstrating the efficacy of technology-driven solutions in ensuring public safety during major events.

This system harnessed the power of Artificial Intelligence to tackle challenges that exceeded human capabilities, such as dense crowd counting and management. Notably, it also incorporated cutting-edge technologies like fire detection through image processing and fall detection using deep learning to enhance crowd safety. In addition to effectively managing crowds, the LT Smart World system demonstrated its versatility by incorporating advanced features such as fire detection through image processing and fall detection using deep learning. These innovations further enhanced the safety and security of the massive gatherings at the Kumbh Mela. By employing image processing techniques, the system was capable of swiftly identifying and responding to fire-related incidents, ensuring rapid intervention and evacuation if necessary.

3.3 Motivation

The motivation behind harnessing the power of Artificial Intelligence in crowd management, as demonstrated by the LT Smart World system during the monumental Kumbh Mela event, stems from the imperative to prevent tragic incidents that have plagued gatherings in India in recent years. With over 70 percent of crowd-related accidents occurring during religious festivities, there is an urgent need for innovative solutions that surpass the limitations of manual interventions. The success of this AI-driven approach not only ensures the safety and well-being of millions of attendees but also serves as a compelling example of how cutting-edge technologies, including fire detection through image processing and fall detection using deep learning, can be harnessed to protect human lives during major events. This motivation fuels the drive to embrace AI and advanced technologies in crowd management, with the ultimate goal of preventing potential humanitarian disasters and enhancing the security of public gatherings.

3.4 Literature Survey

In this chapter we will see the various studies and research conducted in order to identify the current scenarios and trends.

- **Manjunath R Kounte; Jonnalagadda Rishitha, Implementation of Realtime design of crowd Enumeration via tracking using AI system, 2023 International Conference on Intelligent and Innovative Technologies in Computing, Electrical and Electronics (IITCEE)** Crowd enumeration can help to evaluate and count the number of visitors to a place. There are many reasons that spana wide range of applications, from security considerations, optimization of operations to efficiency in profitability. In the paper, we propose to develop a prototype for implementing a high frame rate, low processing environment, high performance, and highly efficient real-time crowd enumeration system. The latest method for object detection is deep learning. When it comes to deep learning or machine learning, performance and computation are the key parameters. In our model, there is a provision to schedule the model for the required amount of time. In our work, we are using mobilenet SSD as an object detector to detect humans. It is a preprocessed, highly efficient, and light weight model which can run on low power device like jetson nano and is cost-efficient unlike others. The advantage of our model is if there is overcrowding in a specified location with known capacity, alarm is enabled.[1]
- **Divya Saxena; Santosh Kumar; Pankaj Kumar Tyagi, Automatic Assistance System Based on Machine Learning for Effective Crowd Management, 2022 2nd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)** So here we are going to study about the machine learning and automatic assistance system in machine leering which help in the effective crowd management Machine learning (ML) is a form of artificial intelligence (AI) that enables software programmers to increase prediction accuracy without being specifically intended to do so. Machine learning techniques use previous data as input to anticipate new output values. Because data is so important, developing improved methods for intelligently managing the now-ubiquitous crowd-powered data-gathering systems is a critical next step toward totally autonomous agents. So here we will discuss about the machine learning and its automatic assistance system in crowd management. Learning for use in a variety of sectors is becoming more common as the availability of data expands over time. Computer vision and computer vision have improved a wide range of industries, including medical diagnoses, data display and procedures, science and research, and so on. Such approaches have already been used in the fields of Smartphone apps, computer equipment, online websites, and cyber security. So here we have

reached a conclusion about the automatic assistance system based on machine learning for effective cored management.[2]

- **Mohamed Yasin Noor Mohamed, Modeling of Artificial Intelligence Enabled Crowd Density Classification for Smart Communities, 2022 IEEE 19th International Conference on Smart Communities**
  Improving Quality of Life Using ICT, IoT and AI (HONET), Smart cities are a contemporary phenomenon to involve information and communication technologies (ICTs) in the advancement of large urban cities. It will be helpful in determining the movement of a city through observing general flow of visitors and traffic jams. Crowd management can be one key aspect of smart cities, assisting in enjoyable and safety experiences for visitors and residents. As crowd density (CD) classification methods encounter difficulties such as inter-scene and intra-scene deviations, non-uniform density, occlusion and convolutional neural network (CNN) methods were valuable. This manuscript designs a wolf pack algorithm with deep learning enabled crowd density classification (WPADL-CDC) model for smart communities. The presented WPADL-CDC technique assists in improving the quality of life in smart community environment. In addition, the presented WPADL-CDC model employs deep convolutional neural network (DCNN) based densely connected network (DenseNet) model for feature extraction purposes. Moreover, the WPA is exploited for the optimal hyper parameter tuning of the DenseNet201 method. Furthermore, fuzzy radial basis neural network (FRBNN) model can be utilized for the identification and classification of CDs in the video surveillance system. For examining the enhanced CD classification outcomes of the presented WPADL-CDC method, a detailed experimental analysis is performed. The experimental values demonstrate the promising performance of the WPADL-CDC model.[3]
- **Ashwini Kumar; Swapnil Parikh, ML Based Automated Assistance System for Efficient Crowd Control A detailed investigation, 2023 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)**
  This section covers ML and automated assistance systems for crowd control. ML-based artificial intelligence (AI) lets software programmes enhance prediction accuracy without being designed to. ML techniques forecast correct output using past data. The next step towards truly automated beings is to develop methods for understanding and managing the currently pervasive community info gadgets since data is so important. In this part, we'll discuss ML's automatic crowd control. Data availability is expanding learning for application across sectors. Computer vision has helped medical diagnosis, data presentation and processing, science, and research. Computer hardware, electronics, internet content, and cyber security have used these methods. The machine learning-based automatic assistance system for efficient cored management can now be concluded.][4]

3.5 Summary

In this chapter we discussed the various researches conducted in order to achieve a clear view of our project.

Chapter 4

Problem Definition and Scope

4.1 Problem Definition

The problem at hand is the recurring tragedy of crowd-related accidents in India, particularly during religious festivities, where over 70 percent of such incidents have been reported. These unfortunate events highlight the pressing need for advanced crowd safety measures that can overcome the limitations of manual interventions. Manual crowd control methods are susceptible to human errors and are time-consuming, leaving large gatherings vulnerable to overwhelming and potentially dangerous conditions.

To address this challenge, the LT Smart World AI-based crowd management system was implemented during the 2019 Kumbh Mela in Prayagraj, showcasing the potential of Artificial Intelligence to tackle complex crowd management issues. This system, while successful, also aimed to integrate cutting-edge technologies like fire detection through image processing, fall detection using deep learning, and overcrowding detection through Convolutional Neural Networks (CNNs) to enhance crowd safety. Therefore, the problem statement revolves around the imperative to prevent crowd-related disasters and improve the safety of massive gatherings by implementing advanced AI-driven solutions that can efficiently count, manage, and respond to dense crowds while proactively identifying and mitigating potential risks such as fires, falls, and overcrowding.

4.2 Scope

The scope of "Real-Time AI-Enhanced Crowd Surveillance with Big Data Analytics" encompasses the design, implementation, and operation of a comprehensive surveillance system tailored to monitor crowd behavior and ensure public safety across diverse environments. This entails establishing the necessary surveillance infrastructure, including cameras, sensors, and monitoring devices strategically positioned in high-traffic areas. The system integrates advanced AI algorithms and machine learning models to analyze live video feeds and sensor data in real-time, enabling the detection of anomalies, potential threats, and actionable insights. Additionally, big data analytics techniques are employed to process and analyze large volumes of crowd data, facilitating predictive analysis,

resource optimization, and proactive planning for crowd management. Integration with existing security infrastructure, such as access control systems and emergency response protocols, is paramount to ensure seamless operation and effective coordination. Privacy and ethical considerations are carefully addressed through the implementation of data anonymization techniques and privacy safeguards. Scalability, performance, and continuous improvement are prioritized throughout the project lifecycle, with regular evaluations and updates to enhance effectiveness and adaptability. By defining the scope within these parameters, stakeholders can collaboratively work towards the successful deployment of a robust and efficient crowd surveillance system, ultimately enhancing public safety and security in targeted environments.

4.3 Summary

In this chapter we introduced problem definition and scope of our system

4.4 Software Requirement Specifications

The Software Requirement Specification describes the scope of the project, operating environment, user characteristics, design and constraints. It also elaborates the system architecture of the M-Learning Framework.

4.5 Project Scope

The scope of this project encompasses the development, implementation, and validation of an AI-driven crowd management system, with a specific focus on fire detection through image processing and fall detection using deep learning. This project aims to create a comprehensive solution for enhancing crowd safety during large gatherings, particularly religious festivals, by leveraging cutting-edge technologies to minimize the risk of crowd-related accidents. The scope also involves the collection and analysis of data from the 2019 Kumbh Mela to create a framework for effective crowd management and evacuation strategies. Furthermore, this initiative seeks to set a precedent for the integration of AI and advanced technologies in ensuring the safety and security of attendees at similar events in India and globally, with the overarching goal of preventing potential humanitarian disasters.

4.5.1 Operating Environment

The operating environment of a real-time AI-enhanced crowd surveillance system with big data analytics is characterized by its adaptability to the dynamic and complex nature of urban settings. In this context, the system functions within the framework of modern urban environments, utilizing a network of surveillance cameras, edge computing capabilities, and a centralized big data

infrastructure. The system operates seamlessly in diverse physical and digital landscapes, accommodating large crowds in areas such as public events, transportation hubs, and city centers. Its effectiveness is particularly pronounced in real-time scenarios, where the integration of artificial intelligence, including computer vision and deep learning, allows for immediate analysis of live video feeds to detect and respond to potential security threats. Furthermore, the system's reliance on big data analytics enhances its operational capabilities by providing a robust mechanism for storing, managing, and analyzing vast amounts of surveillance data. The environment is characterized by the integration of historical data to identify patterns and trends in crowd behavior. This historical analysis contributes not only to proactive security measures but also to resource optimization and the development of efficient crowd management strategies. Privacy and ethical considerations are integral to the operating environment, ensuring compliance with regulations and respect for individuals' privacy rights. The system is designed to seamlessly integrate with existing surveillance infrastructure and big data platforms, fostering interoperability and ease of implementation. Scalability is a key feature, allowing the system to adapt to varying crowd sizes and different urban contexts. The continuous improvement of the system, including regular updates to AI models based on new data and emerging technologies, is a fundamental aspect of its operating environment. In essence, the operating environment of this system is characterized by its responsiveness to real-time challenges, its adaptability to diverse urban scenarios, and its commitment to privacy, ethics, and continuous enhancement to ensure the safety and security of urban spaces.

4.5.2 User Classes and Characteristics

In the context of real-time AI-enhanced crowd surveillance with big data analytics, there are distinct user classes, each with specific characteristics and roles. These user classes contribute to the effective functioning and management of the surveillance system. Here are the key user classes and their characteristics:

(a) System Administrators:
Characteristics: Highly skilled in IT and system management, system administrators are responsible for the overall maintenance, configuration, and security of the surveillance system. They ensure the seamless integration of AI algorithms, manage data storage, and oversee system updates.

(b) Security Personnel:
Characteristics: Trained in security protocols and emergency response, security personnel utilize the real-time alerts generated by the system to respond swiftly to potential threats. They are adept at interpreting surveillance data and making informed decisions to ensure public safety.

(c) Data Analysts:
Characteristics: Proficient in data analysis and interpretation, data analysts extract valuable insights from the big data generated by the surveillance system. They identify patterns and trends in crowd behavior, con-

tributing to the development of proactive security measures and optimizing resource allocation.

(d) AI Engineers and Data Scientists:
Characteristics: Skilled in artificial intelligence, machine learning, and data science, these professionals design, develop, and refine the AI models used in the surveillance system. They continuously improve the algorithms based on new data and emerging technologies.

(e) Policy Makers and Regulators:
Characteristics: Involved in establishing regulations and policies related to crowd surveillance, policy makers and regulators ensure that the system aligns with legal frameworks and ethical standards. They may contribute to defining permissible uses of surveillance data.

The collaboration and synergy among these user classes contribute to the successful implementation and operation of a real-time AI-enhanced crowd surveillance system with big data analytics. Each class plays a vital role in maximizing the system's effectiveness while addressing privacy concerns and ethical considerations.

4.5.3 Design and Implementation Constraints

The design and implementation of a real-time AI-enhanced crowd surveillance system with big data analytics may encounter several constraints that need careful consideration. Here are some common constraints associated with such a system:

(a) Privacy Concerns: The implementation of a surveillance system raises privacy concerns, especially when dealing with sensitive information about individuals. Striking a balance between ensuring public safety and respecting privacy rights is a significant challenge.

(b) Legal and Regulatory Compliance: Adhering to local and international laws, regulations, and standards regarding surveillance, data storage, and privacy is crucial. Legal compliance may impose limitations on the use, storage, and sharing of surveillance data.

(c) Technical Infrastructure: The availability and quality of technical infrastructure, including network bandwidth, storage capacity, and computing resources, can be a constraint. Inadequate infrastructure may affect the real-time processing and analysis capabilities of the system.

(d) Ethical Considerations: Ethical considerations surrounding the use of AI in surveillance, potential biases in algorithms, and the impact on social trust must be addressed. Ensuring fairness and transparency in the system's operation is a constraint that requires careful consideration.

(e) Data Security: Constraint: Safeguarding the collected data from unauthorized access, cyber threats, and potential breaches is critical. Implementing robust security measures to protect against data tampering and unauthorized use is a constant constraint.

(f) Limited Training Data: Training AI models for crowd surveillance relies on historical data. Limited or biased training data can affect the accuracy and generalizability of the models, posing a constraint on the system's ability to adapt to diverse scenarios.

(g) Algorithm Complexity: Implementing and fine-tuning complex AI algorithms for real-time crowd analysis requires significant computational resources. Balancing algorithm complexity with the available infrastructure can be a constraint.

Addressing these constraints during the design and implementation phases is essential for developing a robust and ethically sound real-time AI-enhanced crowd surveillance system with big data analytics. It involves a multidisciplinary approach that considers technological, legal, ethical, and societal aspects to ensure the system's effectiveness and responsible use.

4.5.4 Assumptions and Dependencies

The Framework is capable of allowing the developer to develop the learning application with ease and import it on the devices which contain web application . This application developed by the vendor will allow the user to use it with high power of interactivity and portability. The commercialization of the web application may take time. It incorporated best practice web research into a practical framework of web based design requirements.

Project Requirement Specification

4.6 Programming Language

Visual Studio Code is a free and open-source code editor developed by Microsoft. It is a popular choice among developers for its versatility and extensive set of features.

Figure 4.1: VS Code programming language

Here are some key aspects of Visual Studio Code (VS Code):

(a) Cross-Platform: VS Code is available for Windows, macOS, and Linux, making it a versatile choice for developers on various platforms.

(b) Lightweight: It's a lightweight code editor that's faster and uses fewer system resources compared to full-fledged integrated development environments (IDEs).

(c) Extensible: VS Code supports a wide range of programming languages and has a rich extension ecosystem. You can install extensions to tailor the editor to your specific needs.

(d) Intelligent Code Editing: It offers features like syntax highlighting, code completion, and linting for various programming languages.

(e) Integrated Git: VS Code has built-in Git support, making it easy to work with version control for your projects.

(f) Debugging: It provides integrated debugging tools for various languages and platforms.

(g) Terminal Integration: You can run terminal commands directly within the editor.

(h) Customizable Themes and Styles: VS Code allows you to choose from a variety of themes and customize the editor's appearance to your liking.

(i) Community and Documentation: There's a large and active community around VS Code, and you can find extensive documentation and tutorials to help you get started.

(j) Visual Studio Live Share: A feature that allows real-time collaboration between developers, making it easier to work on code together.

VS Code has gained popularity in a wide range of development communities, from web development to data science, and it's known for its ease of use, performance, and the ability to adapt it to different coding workflows.

4.6.1 Framework

Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design. It follows the Model-View-Controller (MVC) architectural pattern and is designed to make it easier for developers to build web applications quickly and efficiently.

Django provides a wide range of features and tools, including:

(a) An Object-Relational Mapping (ORM) system for database management.

(b) A built-in admin interface for managing the application's data.

(c) A URL routing system.

(d) A template system for creating dynamic web pages.

(e) Authentication and authorization mechanisms.

(f) Security features to protect against common web application vulnerabilities.

(g) Internationalization and localization support.

(h) Extensibility through reusable apps and plugins.

(i) Community support and a vast ecosystem of third-party packages.

Django is commonly used for developing all sorts of web applications, from small personal projects to large, complex websites. It is known for its robustness, scalability, and the "batteries-included" philosophy, which means that it comes with a lot of built-in functionality to help you get started quickly.

4.6.2 Development Tools

Figure 4.2: Python software programming language

Python is a multi-paradigm programming language. Object-oriented programming and structured programming are fully supported, and many of their features support functional programming and aspect-oriented programming (including metaprogramming and metaobjects).
Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse.

4.6.3 Database

Figure 4.3: SQLite Database

SQLite is an embedded, server-less relational database management system. It is an in-memory open-source library with zero configuration and does not require any installation. Also, it is very convenient as it's less than 500kb in size, which is significantly lesser than other database management systems. Features of SQLite as follows,

- SQLite is used to develop embedded software for devices like televisions, cell phones, cameras, etc.
- It Can manage low to medium-traffic HTTP requests.
- SQLite can change files into smaller size archives with lesser metadata.
- SQLite is used as a temporary dataset to get processed with some data within an application.
- SQLite is an open-source software. The software does not require any license after installation. SQLite is serverless as it doesn't need a different server process or system to operate.
- SQLite facilitates you to work on multiple databases on the same session simultaneously, thus making it flexible.

4.7 Hardware Requirements

- AMD/Intel i3 Processor or above Processor
- 4GB RAM for application development
- 150 GB or above Hard Disk

4.8 Software Requirements

- Windows 7 or above
- Vscode, Xamp
- Python
- Django

4.9 Summary

In this chapter we saw the hardware and software requirements of the project.

Chapter 5

Project Plan

The plan contains an overview of the system, a brief description of the major tasks involved in the implementation, the overall resources needed to support the implementation effort (such as hardware, software. facilities, materials, and personnel), and any site-specific implementation requirements. The outline shows the structure of the Implementation Plan.

5.1 Project Estimation

Here the prediction is made about the size of total project. Effective software project estimation is one of the most challenging and important activity in software development once you have on estimate size of your product you can desire the effort estimate.

5.1.1 Estimation of KLOC:

KLOC according to module
Total number of code required to estimate to be 4.2 KLOC.
Efforts: In which we are calculated efforts done by the each person in month. Efforts are calculated by using formula

Table 5.1: Estimation of KLOC

Sr.No.	Module Estimated	KLOC
1	Graphical user interface	0.7
2	Get Values	1.4
3	Processing data values	0.3
4	Display result	0.5
5	Notification	1.3
6	Total KLOC	4.2

5.1.2 Reconciled Estimates

Cost Estimate

Like all estimation model, the COCOMO model requires sizing information. This information can be specified in the form of
1. Object Point (OP)
2. Function Point (FP)
3. Lines of Source Code (KLOC)
For our project, we use the sizing information in the form of Lines of source code.

5.1.3 Efforts

Equation for calculation of effort in person-month for the COCOMO model is:
E = a * (KLOC) bWhere;
a=3.2
b=1.05, for semi-detached projects
E=Effort in person-months
D = E/N
Where,
E=Effort in person-months
N=Number of persons required
D=Duration of project in months.

5.1.4 Development time per month

E=3.2(KLOC)1:05E = 3:2(4:2)1:05
E=4*30 Person-month
Development time:
D=E/N
D=4*30/4
D=3.82 month

5.1.5 Development time for Project

Requirements analysis require 3 months
Implementation and testing requires 3.82 months.
Total Duration for completion of project D= 6.82 months.

5.1.6 Number of Persons

Total Four persons are required to complete the project successfully within given time span.

5.1.7 Project Resources

Hardware Resources Required Software Resources Required

Table 5.2: Hardware Resources Required

Sr,No	Parameter	Minimum Requirement
1	Processor	Pentium IV/Intel i3 core
2	Speed	1.1GHZ
3	Ram	512MB
4	Hard Disk	20GB
5	Keyboard	Standard keyword
6	Mouse	Two or Three Button
7	Monitor	LED Monitor

Platform :
1. Operating System : Windows XP / 7
2. Programming Language : Js , PHP
3. Software Version : 3.2 or above
4. Tools : Notepad ++
5. Front End : JS
6. Data Base : Mysql or firebase

5.2 Feasibility

The feasibility of the project is analysed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.Dimensions of Software Feasibility are as follows:

- Technology:
  Is project technically feasible?
  Is it within state of art?
  Can defect be reduce to a level matching application's need?
- Finance:
  Is it financially feasible?
  Can development be completed at a cost the software organization and its client or market can afford?
- Time:
  Will project's time to market beat competition?
- Resources:
  Does the organization have resources needed to success?

Two key considerations involved in the feasibility analysis are:
1. Technical Feasibility. 2. Cost Feasibility.

5.2.1 Technical Feasibility

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement,as only minimal or null changes are required for implementing this system. Technical feasibility assessment can be done through following ways: 1)NP-Complete. 2) NP-Hard. 3)Satisfiability.

5.2.2 Cost Feasibility

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

5.3 Project Schedule

5.3.1 Project task set

Major Tasks in the Project stages are:

- Task 1: Requirement Analysis (Base Paper Explanation).
- Task 2: Project Specification (Paper Work).
- Task 3: Technology Study and Design.
- Task 4: Coding and Implementation (Module Development).

5.3.2 Timeline Chart

A project timeline chart is presented. This may include a time line for the entire project. Above points should be covered in Project Planner as Annex C and you can mention here Please refer Annex C for the planner

Table 5.3: Timeline Chart

Milestone	Tasks	Time	Remarks
1	Selecting project domain	June	DONE
2	Understanding project need	June	DONE
3	Understanding project pre-requisite	June	DONE
4	Information gathering	July	DONE
5	Literature Survey	July	DONE
6	Refine project scope	August	DONE
7	Concept understanding	August	DONE
8	Planning and scheduling	September	DONE
9	Reqiurement analysis	September	DONE
10	Risk identification and monitoring	October	DONE
11	Design and module understanding	October	DONE
12	Design review and refinement	December	DONE
13	Paper publishing-Sem I	December	DONE
14	Report Creation	December	DONE
15	Admin module	January	
16	Route module	January	
17	User Module	February	
18	GUI design	February	
19	Implementation	March	
20	Review and suggestions for implementation	March	
21	Outcome assessment	March	
22	Testing and QA	March	
23	Review and suggestions for Testing and QA	April	
24	Refined QA activites	April	

5.3.3 Management reporting and communication

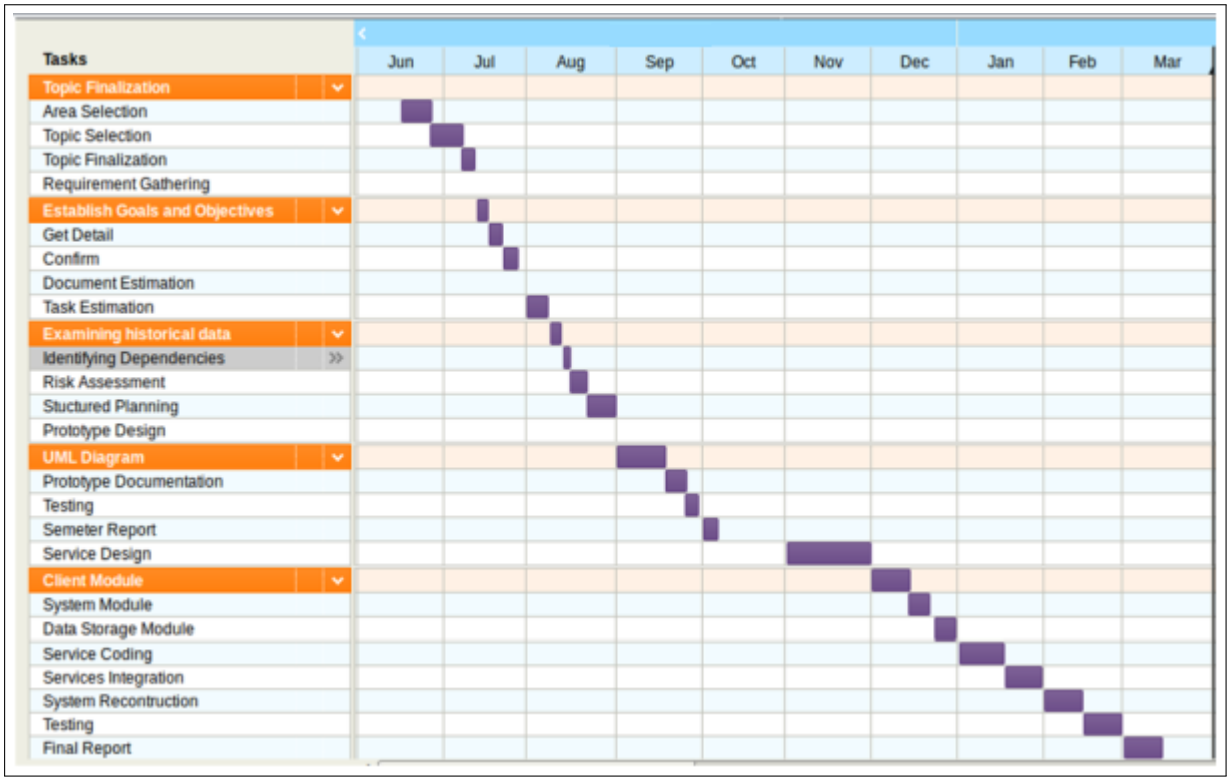


Figure 5.1: Management reporting and communication

5.3.4 Overview of Risk Mitigation,Monitoring,Management

Risk analysis actually helps the project development team to build strategy to handle all possible risk.Following are three important issues(or steps) that must be considered for developing effective strategies:

- Risk mitigation(Risk avoidance)
- Risk monitoring
- Risk management and planning

Chapter 6

Software requirement specification

6.1 System Architecture

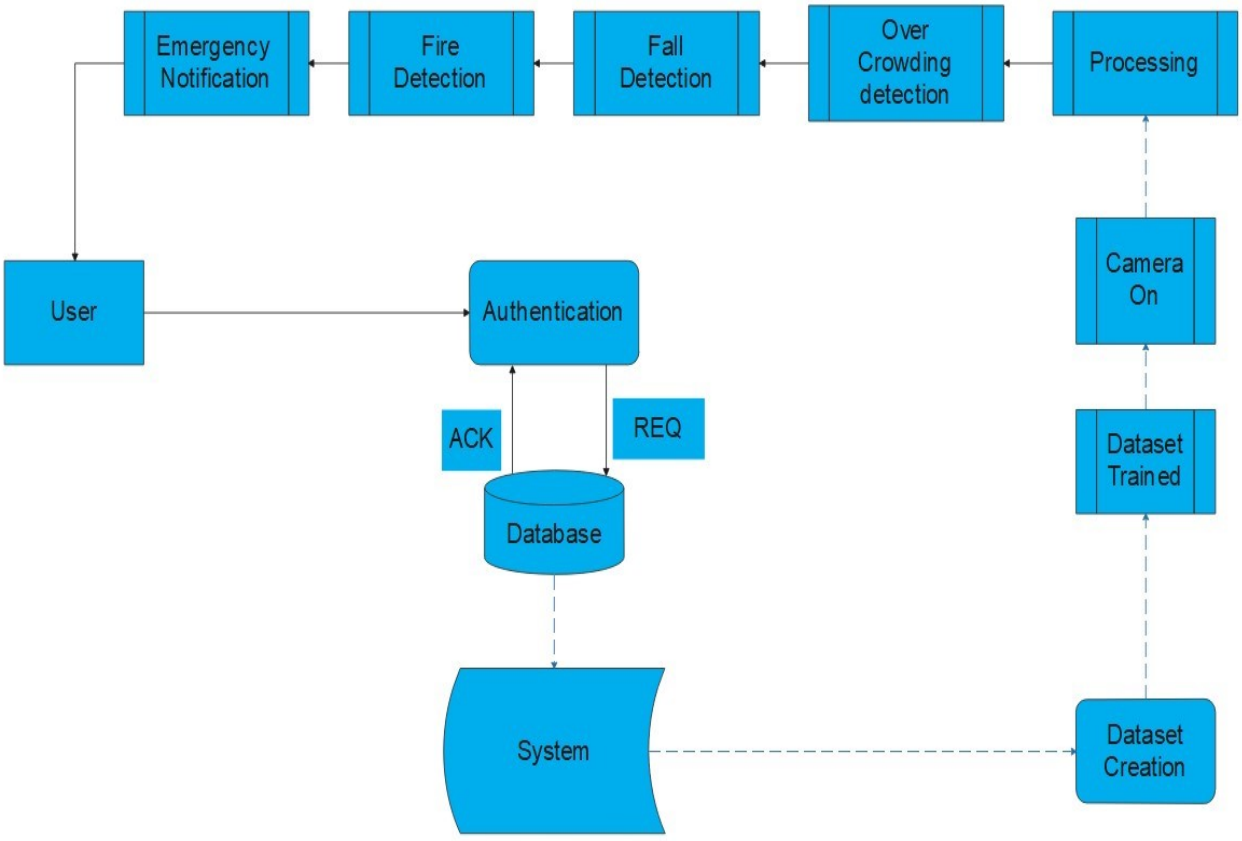


Figure 6.1: Architecture diagram

The proposed system is an integrated AI-based crowd management solution designed to enhance safety during large gatherings, particularly religious festivals, with a primary focus on fire detection through image processing and fall detection using deep learning. Leveraging advanced technologies, the system will offer real-time crowd monitoring, precise crowd counting, and rapid response capabilities in case of emergencies. It will utilize image processing techniques to detect and respond to fire incidents swiftly, ensuring timely evacuation and minimizing fire-related risks. Additionally, deep learning algorithms will be employed to identify individuals in distress due to falls, enabling immediate assistance. The system aims to provide a comprehensive framework for crowd management, backed by data insights from the 2019 Kumbh Mela, setting a precedent for future safety initiatives at similar events, ultimately preventing potential humanitarian disasters. The proposed integrated AI-based crowd management solution will also incorporate an Overcrowding Detection Module, which will utilize Convolutional Neural Networks (CNNs) to monitor and mitigate overcrowding issues during large gatherings. Here's how the CNN algorithm will be integrated into the system. The Overcrowding Detection Module will be a crucial component of the overall system. It will consist of a network of cameras strategically placed throughout the event area, capturing real-time footage. The CNN algorithm will be applied to analyze this footage and detect areas where crowd density exceeds safe limits.

6.2 Details of each module

The IoT-based bike theft detection system comprises various interconnected modules, each with its specific functions and responsibilities. Here are the steps involved in the operation of each module:

- **User Interface (UI):** The User Interface serves as the front-end of the system, providing a user-friendly platform for educators and administrators to interact with the system. It offers intuitive forms for inputting learning objectives and parameters, customization of question paper generation, and access to the generated questions. The UI's design focuses on usability and accessibility to ensure that users can easily navigate the system and input the necessary data.
- **Question Generation Engine:** The Question Generation Engine is the core of the system, responsible for implementing Bloom's Taxonomy and generating questions aligned with various cognitive levels. It categorizes learning objectives into cognitive domains and structures questions accordingly.
- **Content Repository:** The Content Repository is a centralized database that stores a wide range of educational materials, including textbooks, lecture notes, and other relevant content. It acts as a primary data source for the system, allowing it to access and align generated questions with the specific subject matter and context of the course.
- **AI and NLP Module:** The AI and NLP Module leverages artificial intelligence and natural language processing to analyze and understand

the educational content within the Content Repository. It identifies relevant topics, concepts, and relationships within the content, which aids the Question Generation Engine in creating contextually appropriate questions. This module enhances the system's ability to generate questions that are highly relevant to the curriculum.

- **Question Bank Database:** The Question Bank Database is a repository of pre-existing questions that educators and administrators can draw from to diversify question papers. It provides a resource of validated questions that can be reused, modified, and included in assessments. Users can search, select, and customize questions from the database, thus reducing the workload of creating entirely new questions.
- **Customization and Parameter Control:** This module empowers educators to customize the question paper generation process. It allows them to define parameters such as the number of questions, the weightage of cognitive levels, and specific question formats. Educators can fine-tune the assessment to align with their specific course requirements and learning objectives, ensuring a tailored assessment experience.
- **Security and Privacy Layer:** The Security and Privacy Layer is a critical component responsible for safeguarding sensitive user data and assessment content. It incorporates authentication, authorization, encryption, and access control mechanisms to ensure that data remains confidential and secure. It is essential for protecting user privacy and maintaining the integrity of the assessment process.
- **Analytics and Reporting Engine:** The Analytics and Reporting Engine collects and processes data related to assessment performance, question quality, and student results. It provides valuable insights through visual reports and data analysis, helping educators and administrators make informed decisions about assessment effectiveness and areas for improvement.
- **Feedback and Review System:** The Feedback and Review System facilitates the review and validation of questions by quality assurance specialists. It enables users to validate questions, provide feedback, and track changes, ensuring that questions align with learning objectives and maintain high quality.
- **Database Management System (DBMS):** The Database Management System stores and manages system data, including user profiles, assessment records, and learning objectives. It ensures data integrity, efficient data retrieval, and provides the necessary data storage and management infrastructure.
- **Scalability Layer:** The Scalability Layer is responsible for managing the system's ability to scale and accommodate varying user loads and demands. It ensures that the system can handle the requirements of educational institutions of different sizes, from small schools to large universities, without compromising performance.
- **External Systems Integration:** This component enables seamless integration with external systems, such as learning management systems (LMS) and assessment platforms. It ensures that assessments generated

by the system can be efficiently administered and delivered through existing educational technology infrastructure, streamlining the overall assessment process.

Each of these modules plays a crucial role in the Automatic Question Paper Generation system, contributing to the alignment of assessments with educational objectives, enhancing the quality of assessments, and improving the overall learning experience for students and educators.

Chapter 7

Detailed System Design

7.1 Data Flow Diagrams

A data flow diagram (DFD) is a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement. They are often elements of a formal methodology such as Structured Systems Analysis and Design Methods.

The objective of a DFD is to show the scope and boundaries of a system as a whole. It may be used as a communication tool between a system analyst and any person who plays a part in the order that acts as a starting point for redesigning a system. The DFD is also called as a data flow graph or bubble chart.

DFD 0, also called context diagram of the result management system. As the bubbles are decomposed into less and less abstract bubbles, the corresponding data flow may also be needed to be decomposed.

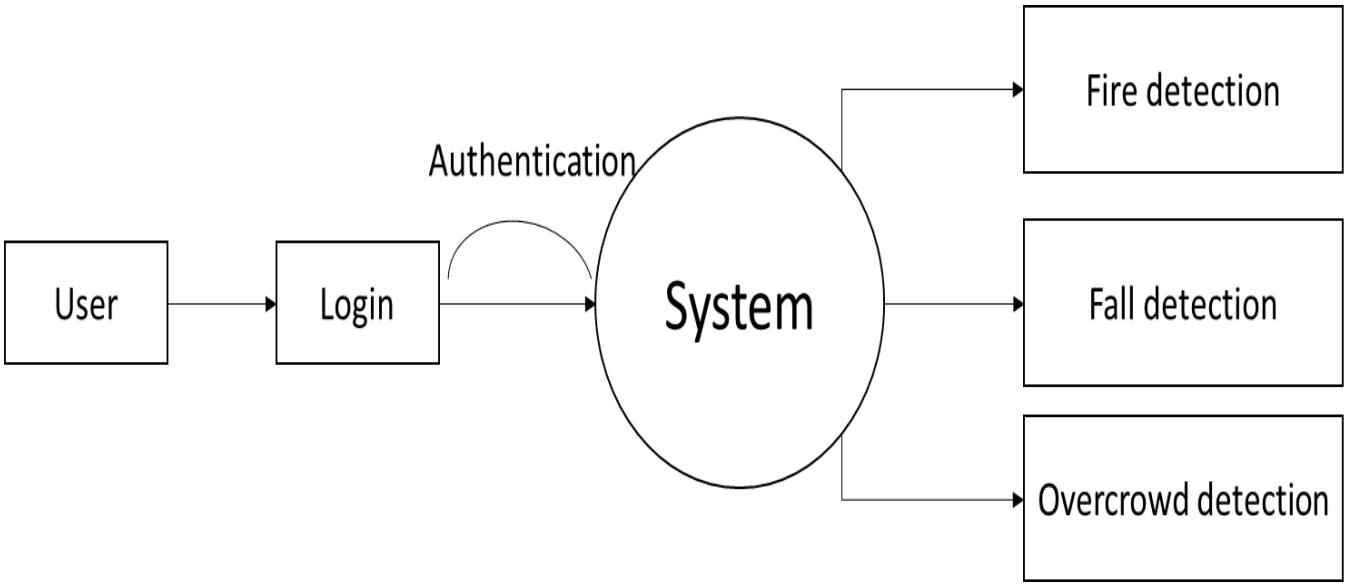


Figure 7.1: DFD 0 Diagram

DFD 1, a context diagram is decomposed into multiple bubbles/processes. In this level, we highlight the main objectives of the system and breakdown the high-level process of 0-level DFD into subprocesses.

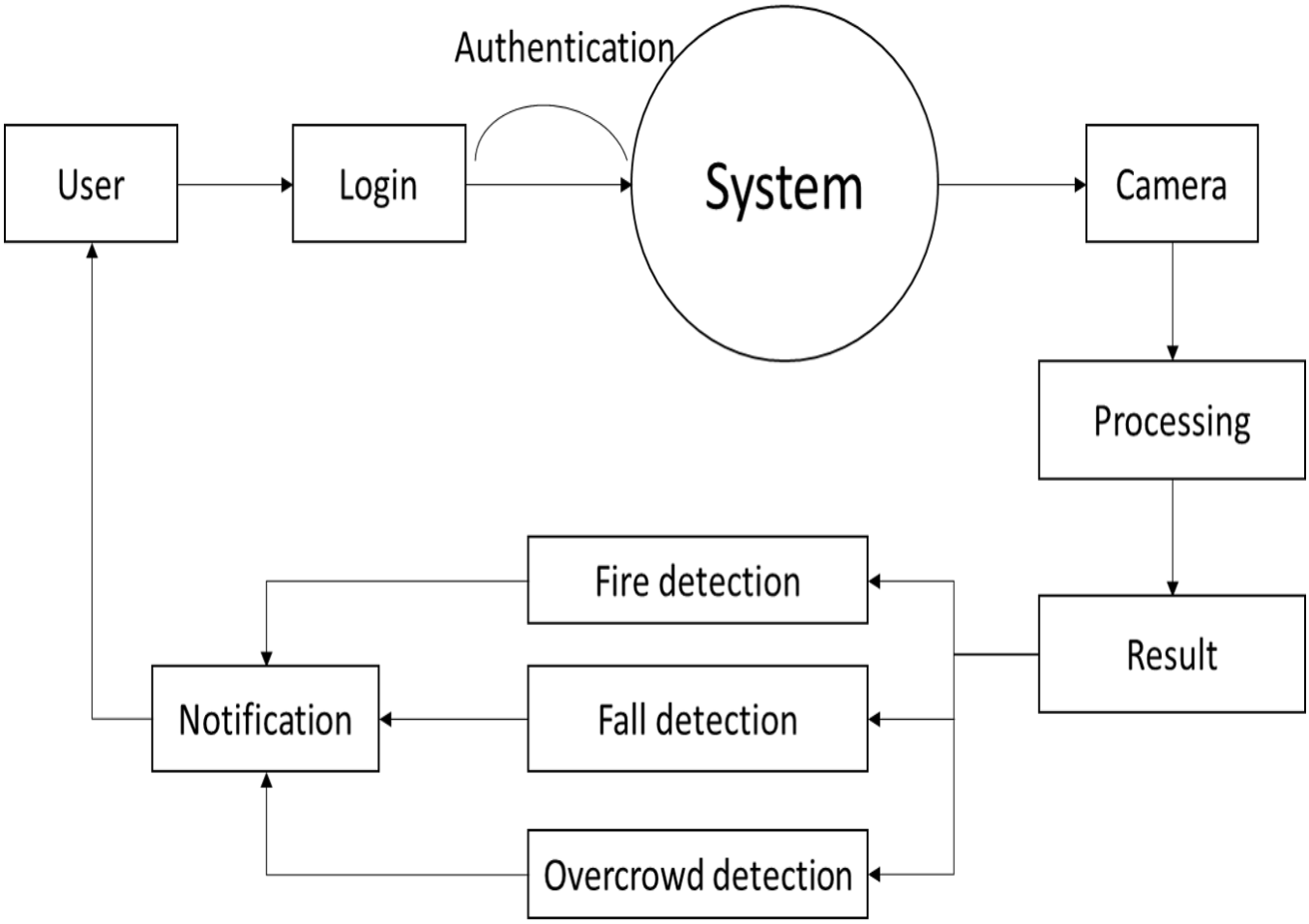


Figure 7.2: DFD 1 Diagram

DFD 2 goes one process deeper into parts of 1-level DFD. It can be used to project or record the specific/necessary detail about the system's functioning.

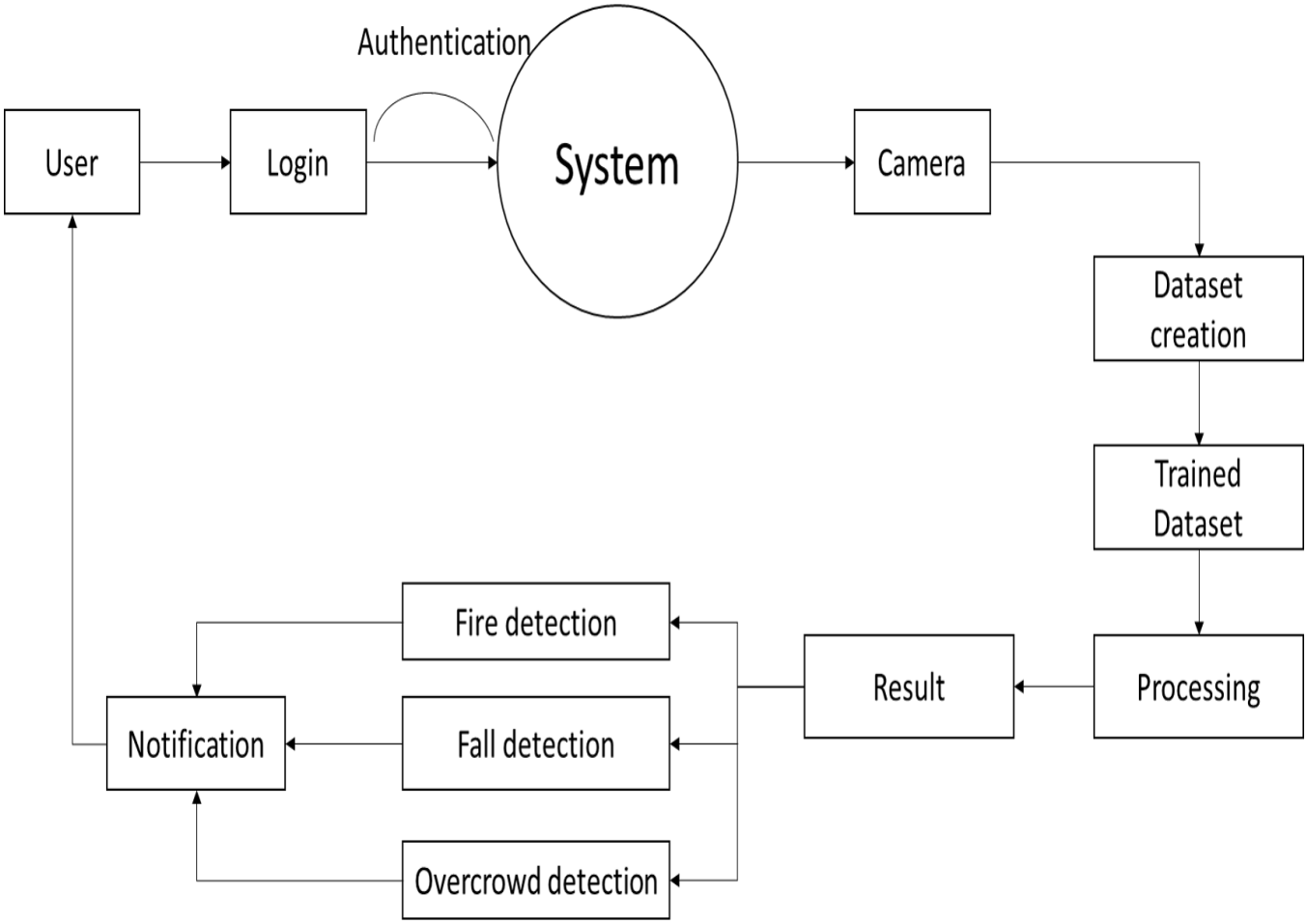


Figure 7.3: DFD 2 Diagram

7.2 ER Diagrams

An entity relationship diagram (ERD), also known as an entity relationship model, is a graphical representation that depicts relationships among people, objects, places, concepts or events within an information technology (IT) system.

Depending on the scale of change, it can be risky to alter a database structure directly in a DBMS. To avoid ruining the data in a production database, it is important to plan out the changes carefully. ERD is a tool that helps. By drawing ER diagrams to visualize database design ideas, you have a chance to identify the mistakes and design flaws, and to make corrections before executing the changes in the database.

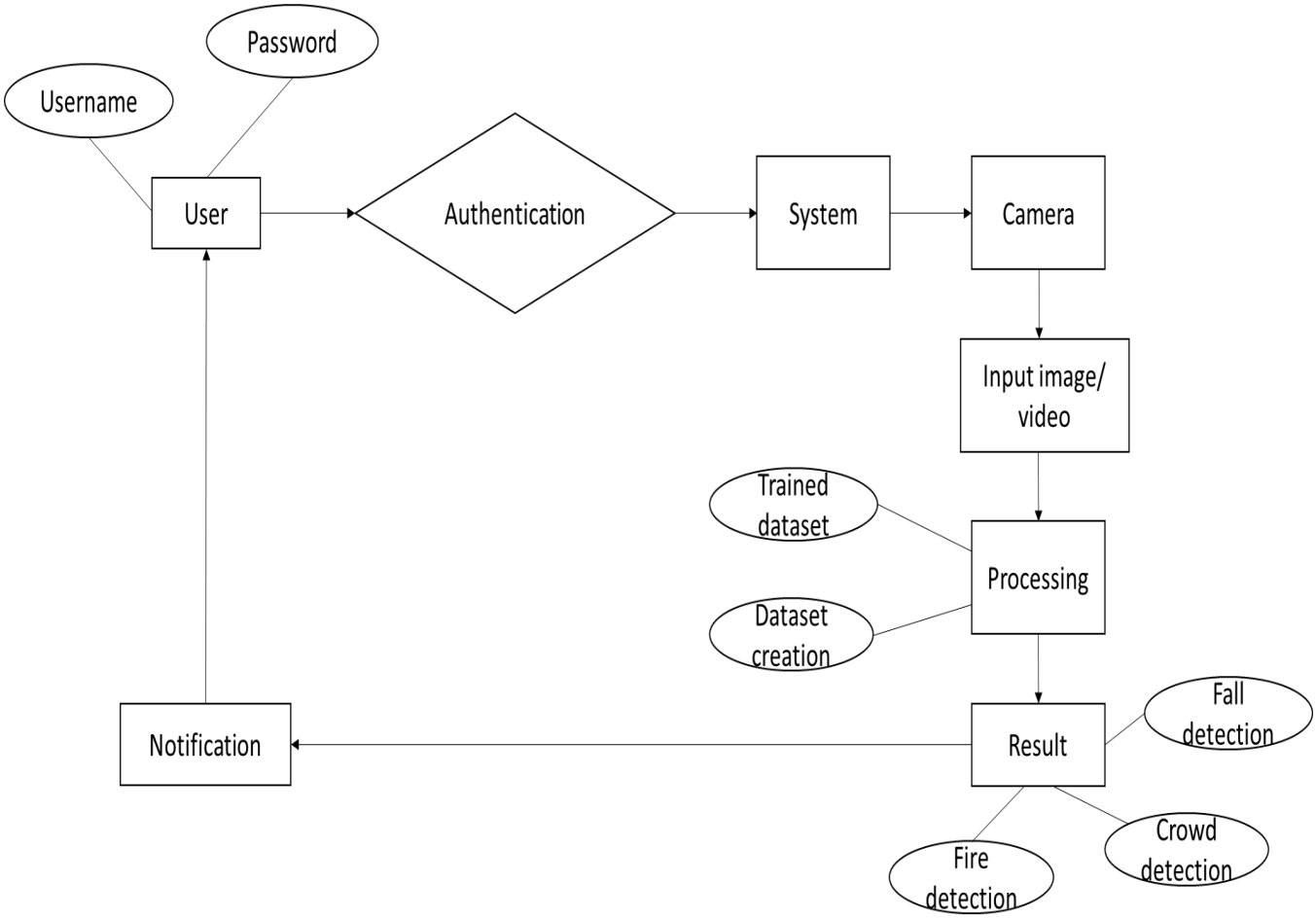


Figure 7.4: ER Diagram

7.3 UML Diagram

7.3.1 Activity Diagram

Use cases show what your system should do. Activity diagrams allow you to specify how your system will accomplish its goals. Activity diagrams show high-level actions chained together to represent a process occurring in your system. An activity diagram is essentially a flowchart, showing flow of control from activity to activity. Unlike a traditional flowchart, an activity diagram shows concurrency as well as branches of control. Activity diagrams focus on the dynamic flow of a system.

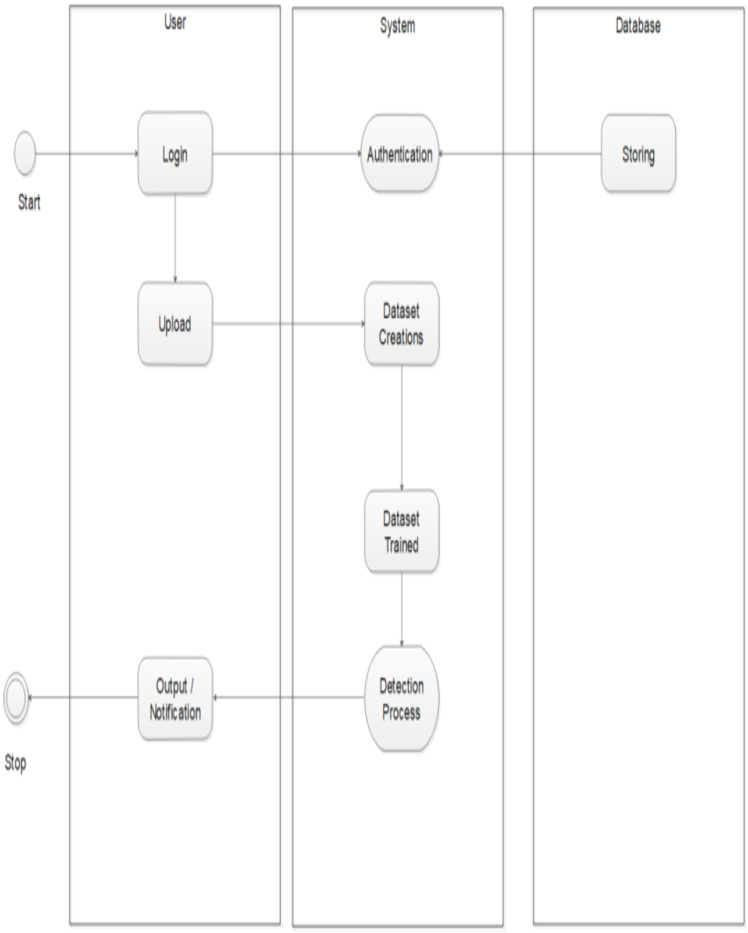


Figure 7.5: Activity Diagram

7.3.2 Sequence Diagram

The sequence diagram is used primarily to show the interactions between objects in the sequential order that those interactions occur. Developers typically think sequence diagrams were meant exclusively for them. However, an organization's business staff can find sequence diagrams useful to communicate how the business currently works by showing how various business objects interact.Sequence diagrams illustrate how objects interact with each other. They focus on message sequences, that is, how messages are sent and received between a number of objects. The main purpose of sequence diagram is to show the order of events between the parts of system that are involved in particular interaction.

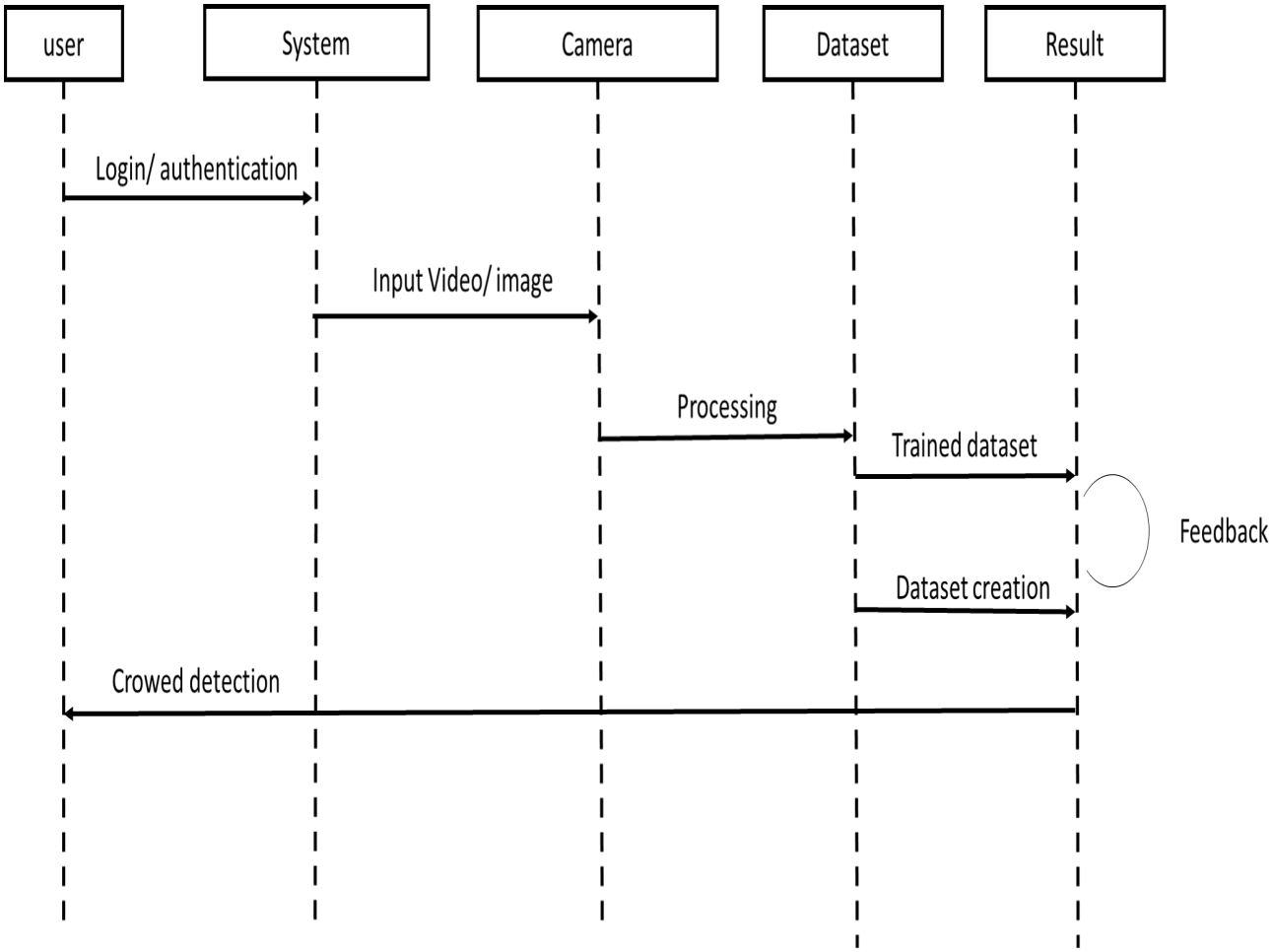


Figure 7.6: Sequence Diagram

7.3.3 Use Case Diagram

Four modeling elements make up the use case diagram; these are:

- **Actors:** Actors refer to a type of users, users are people who use the system. In this case student, teacher developer are the users of the framework and application
- **Use cases:** A use case defines behavioral features of a system. Each use case is named using a verb phrase that express a goal of the system. The name may appear inside or outside the ellipse.
- **Associations:** An association is a relationship between an actor and a use case. The relationship is represented by a line between an actor and a use case.
- **The include relationship:** It is analogous to a call between objects. One use case requires some type of behavior which is fully defined in another use case.

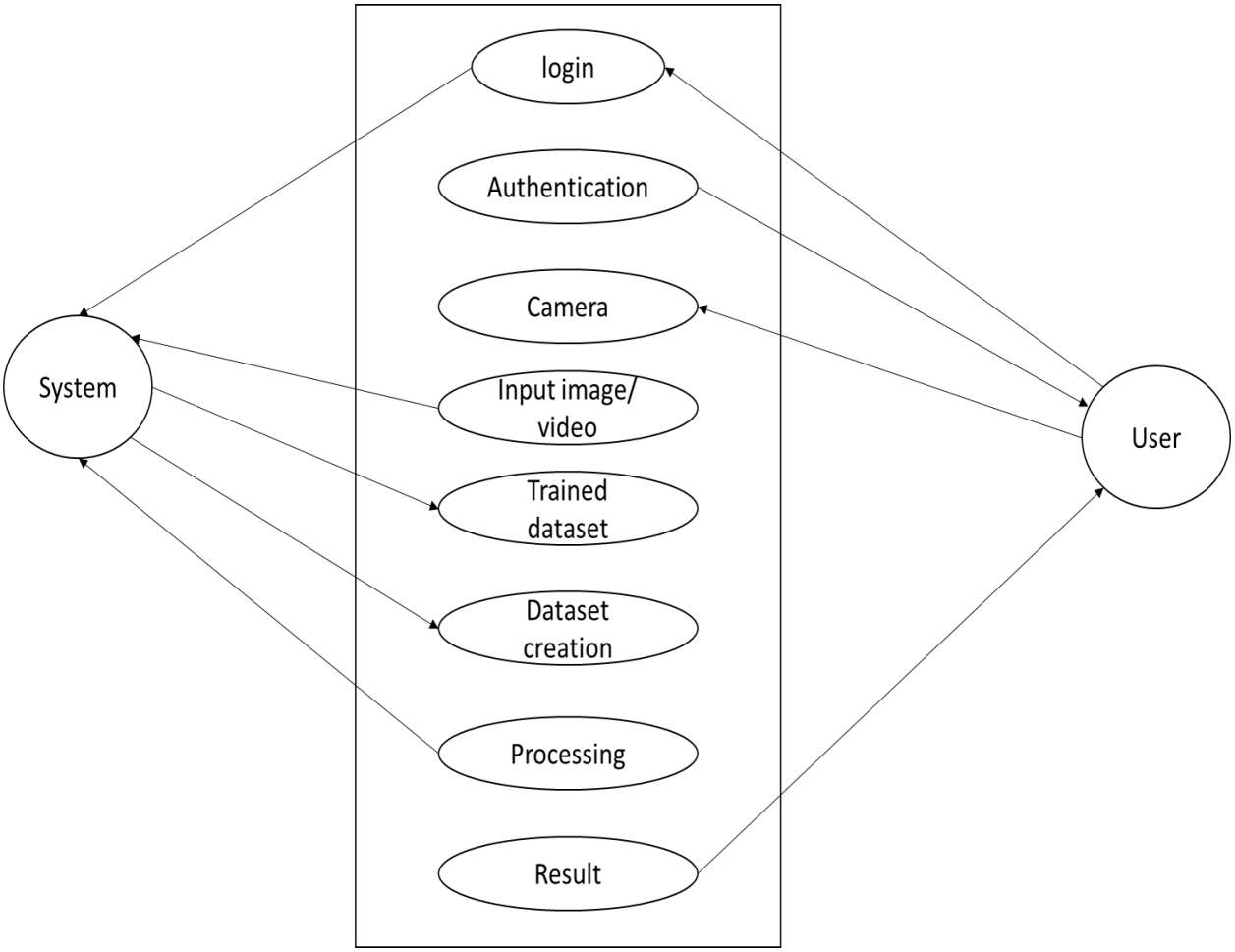


Figure 7.7: Usecase Diagram

7.3.4 Class Diagram

The class diagram shows the building blocks of any object oriented system. Class diagram depicts a static view of the model or part of the model, describing what attributes and behavior it has rather that the detailing the methods of achieving operations. Class diagrams are most useful in illustrating relationships between classes and interfaces. Generalizations, aggregations, and associations are all valuable in reflecting interface, composition or usage and connections receptively.

The Figure 6.2 illustrates aggregation relationships between classes. The lighter aggregation indicates that the class ObjectExplorer used ThumbNail, but does not necessarily contain an instance of it.The strong, composite aggregations by the other connectors indicate ownership or containment of the source classes by the target. Class, for example Video Player values will be contained in Table Of Contents.

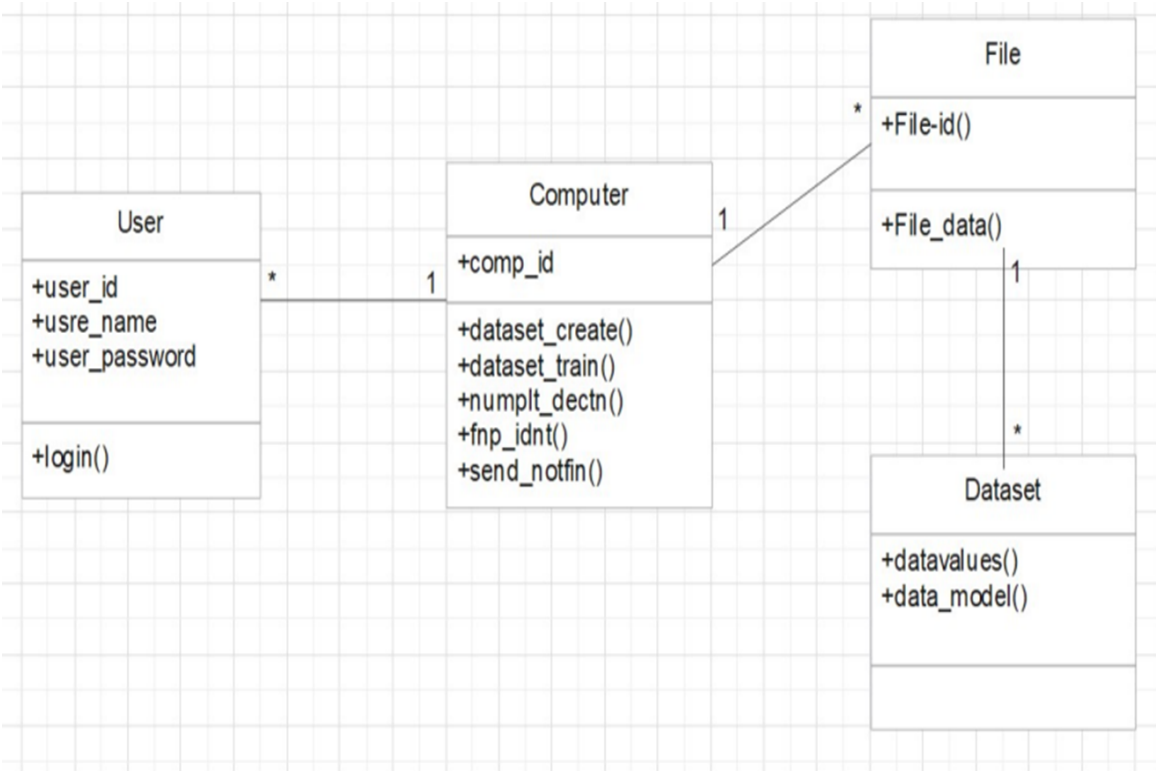


Figure 7.8: Class diagram

7.4 Component Diagram

Component diagram are one of the two kinds of diagrams found in modeling the physical aspects of object oriented systems. A component diagram shows organization and dependencies among set of components. Component diagram can be seen to model the static implementation view of a system. This involves modeling the physical things that resides on a node, such as executables, libraries, tables, files and documents.

Component diagram shows a set of components and their relationships. Graphically a component diagram is a collection of vertices and arcs. Component diagrams commonly contain,

- **Components**
- **Interfaces**
- **Dependency, generalization, association and realization relationships.**

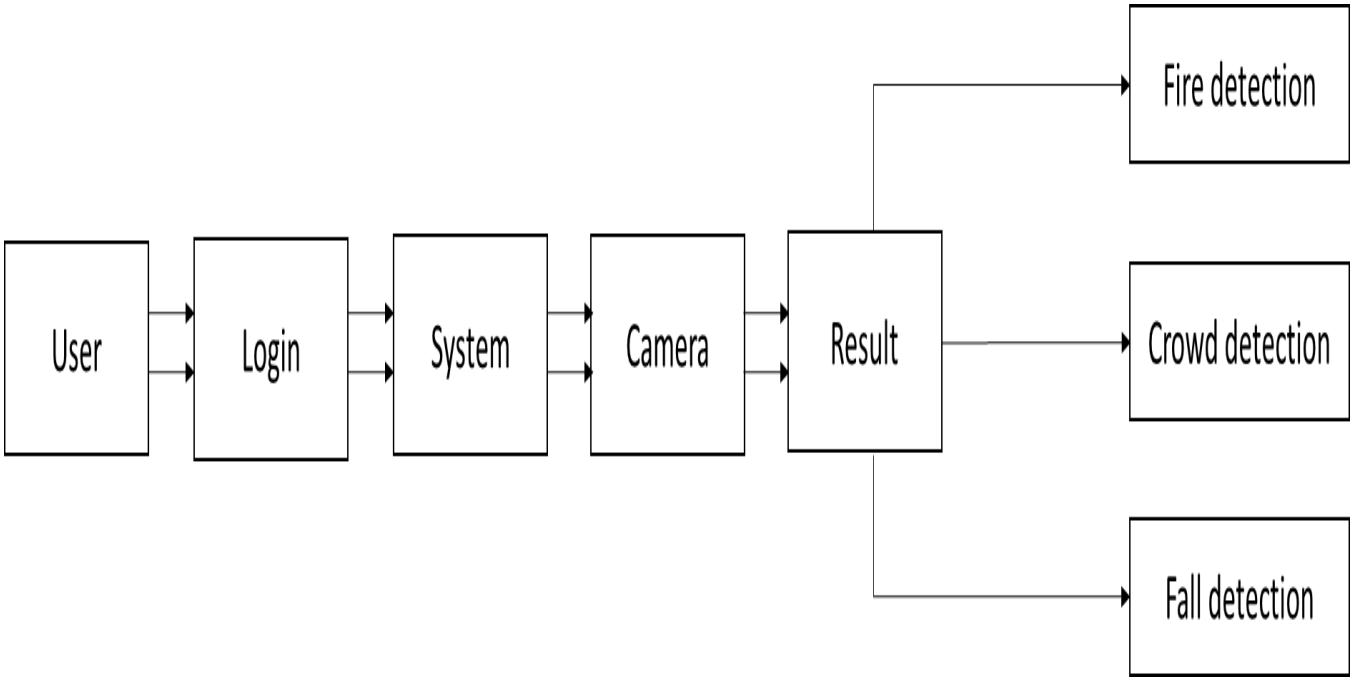


Figure 7.9: Component Diagram

7.5 Summary

Thus we saw the various modeling techniques used for the design of M-Learning Framework and the M-Learning Applications.

Chapter 8

Project Implementation

8.1 Features of project

(a) Live Video Analysis: Real-time monitoring and analysis of live video feeds from surveillance cameras to detect suspicious activities, crowd anomalies, and potential security threats.

(b) Anomaly Detection: Utilization of AI algorithms to identify abnormal crowd behavior, such as overcrowding, sudden movements, or unusual patterns, which may indicate potential risks or emergencies.

(c) Object Recognition: Recognition of specific objects or items of interest within the crowd, such as weapons, bags, or abandoned packages, to facilitate timely intervention and response.

(d) Facial Recognition: Identification and tracking of individuals within the crowd using facial recognition technology, enabling the detection of known persons of interest or suspects.

(e) Crowd Density Monitoring: Analysis of crowd density and flow patterns to assess congestion levels, identify high-traffic areas, and optimize crowd management strategies.

(f) Predictive Analytics: Utilization of big data analytics to analyze historical crowd behavior patterns and predict future trends, facilitating proactive planning and resource allocation for crowd management and security.

(g) Alerting and Notification: Automated alerting and notification systems to promptly inform security personnel and relevant authorities about potential threats or incidents detected by the surveillance system.

(h) Integration with Access Control: Integration with access control systems to monitor entry and exit points, verify credentials, and enforce security protocols within controlled areas.

(i) Scalability and Flexibility: Designing the system to be scalable and adaptable to accommodate varying crowd sizes, environmental conditions, and emerging security threats without compromising performance or accuracy.

(j) Privacy Protection: Implementation of privacy safeguards and data anonymization techniques to protect the rights and privacy of individuals within the crowd, ensuring compliance with privacy regulations and ethical standards.

8.2 Tools and Technologies Used

- Windows 7 or above
- Android Studio, Xamp
- Java

8.3 Technology

8.3.1 Web application (Web app)

A Web application (Web app) is an application program that is stored on a remote server and delivered over the Internet through a browser interface. Web services are Web apps by definition and many, although not all, websites contain Web apps. According to Web.AppStorm editor Jarel Remick, any website component that performs some function for the user qualifies as a Web app.

Web applications can be designed for a wide variety of uses and can be used by anyone; from an organization to an individual for numerous reasons. Commonly used Web applications can include webmail, online calculators, or e-commerce shops. Some Web apps can be only accessed by a specific browser; however, most are available no matter the browser.

Web applications do not need to be downloaded since they are accessed through a network. Users can access a Web application through a web browser such as Google Chrome, Mozilla Firefox or Safari.
For a web app to operate, it needs a Web server, application server, and a database. Web servers manage the requests that come from a client, while the application server completes the requested task. A database can be used to store any needed information.

Web applications typically have short development cycles and can be made with small development teams. Most Web apps are written in JavaScript, HTML5, or Cascading Style Sheets (CSS). Client-side programming typically utilizes these languages, which help build an applications front-end. Server-side programming is done to create the scripts a Web app will use. Languages such as Python, Java, and Ruby are commonly used in server-side programming.
Web applications have many different uses, and with those uses, comes many potential benefits. Some common benefits of Web apps include:

- Allowing multiple users access to the same version of an application.
- Web apps don't need to be installed.
- Can be accessed through multiple browsers.

Chapter 9

Software Testing

9.1 Introduction

Software testing is an activity aimed at evaluating an attribute or capability of a program or system and determining that it meets its required results. It is more than just running a program with the intention of finding faults. Every project is new with different parameters. No single yardstick maybe applicable in all circumstances. This is a unique and critical area with altogether different problems. Although critical to software quality and widely deployed by programs and testers. Software testing steel remains an art, due to limited understanding of principles of software. The difficulty stems from complexity of software. The purpose of software testing can be quality assurance, verification and validation or reliability estimation. Software testing is a trade-off between budget,time and quality. In this chapter there is relevant explanation on testing strategies use to test the system, and test cases. **9.2 Types of Testing**

Testing Strategy used for testing the system are as follows,
1. Manual Testing
2. Automated Testing
3. Unit Testing
4. Integration Testing
5. Regression Testing

9.2.1 Manual Testing

Manual and Automated test are the types of software testing. We are doing a manual test for testing our system that is without using any automated tool or any script. In this type tester takes over the role of an end user and test the software to identify any unexpected behavior or bug. There are different stages for manual testing like unit testing, integration testing, system testing and user

software implementation. Test techniques include the process of executing a program or application with the intent of finding software bugs (errors or other defects), and verifying that the software product is fit for use. Software testing involves the execution of a software component or system component to evaluate one or more properties of interest. In general, these properties indicate the extent to which the component or system under test:

- Meets the requirements that guided its design and development,
- Responds correctly to all kinds of inputs,
- Performs its functions within an acceptable time,
- It is sufficiently usable,
- Can be installed and run in its intended environments, and
- Achieves the general result its stakeholders desire.

As the number of possible tests for even simple software components is practically infinite, all software testing uses some strategy to select tests that are feasible for the available time and resources. As a result, software testing typically (but not exclusively) attempts to execute a program or application with the intent of finding software bugs (errors or other defects). The job of testing is an iterative process as when one bug is fixed, it can illuminate other, deeper bugs, or can even create new ones.

9.4 Black Box Testing

This testing methodology looks at what are the available inputs for an application and what the expected outputs are that should result from each input. It is not concerned with the inner workings of the application, the process that the application undertakes to achieve a particular output or any other internal aspect of the application that may be involved in the transformation of an input into an output. Most black-box testing tools employ either coordinate based interaction with the applications graphical user interface (GUI) or image recognition. An example of a black-box system would be a search engine. You enter text that you want to search for in the search bar, press "Search" and results are returned to you. In such a case, you do not know or see the specific process that is being employed to obtain your search results, you simply see that you provide an input – a search term – and you receive an output – your search results.

9.4.1 Black-box

There are many advantages to black-box testing. Here are a few of the most commonly cited:

1. Ease of use: Because testers do not have to concern themselves with the inner workings of an application, it is easier to create test cases by simply working through the application, as would an end user.

2. Quicker test case development: Because testers only concern themselves with the GUI, they do not need to spend time identifying all of the internal paths that may be involved in a specific process, they need only concern themselves with the various paths through the GUI that a user may take.

3. Simplicity: Where large, highly complex applications or systems exist black-box testing offers a means of simplifying the testing process by focusing on valid and invalid inputs and ensuring the correct outputs are received.
But, for all of the benefits of black-box testing, many attempts to create black-box test systems resulted in several drawbacks that caused people to question the viability of the black-box approach.

Some of the most commonly cited issues were:

1. Script maintenance: While an image-based approach to testing is useful, if the user interface is constantly changing the input may also be changing. This makes script maintenance very difficult because black-box tools are reliant on the method of input being known.

2. Fragility: Interacting with the GUI can also make test scripts fragile. This is because the GUI may not be rendered consistently from time to time on different platforms or machines. Unless the tool is capable of dealing with differences in GUI rendering, it is likely that test scripts will fail to execute properly on a consistent basis.

3. Lack of introspection: Ironically, one of the greatest criticism of black-box testing is that it isn't more like white-box testing; it doesn't know how to look inside an application and therefore can never fully test an application or system. The reasons cited for needing this capability are often to overcome the first two issues mentioned. The reality is quite different.

9.5 White Box Testing

This testing methodology looks under the covers and into the subsystem of an application. Whereas black-box testing concerns itself exclusively with the inputs and outputs of an application, white-box testing enables you to see what is happening inside the application. White box testing provides a degree of sophistication that is not available with black-box testing as the tester is able to refer to and interact with the objects that comprise an application rather than only having access to the user interface. An example of a white-box system would be in-circuit testing where someone is looking at the interconnections between each component and verifying that each internal connection is working properly. Another example from a different field might be an auto-mechanic who looks at the inner-workings of a car to ensure that all of the individual parts are working correctly to ensure the car drives properly.

9.5.1 White-box

Like black-box testing, there are distinct advantages to white-box testing. Here are a few of the most commonly cited:

1. Introspection: Introspection, or the ability to look inside the application, means that testers can identify objects programmatically. This is helpful when the GUI is changing frequently or the GUI is yet unknown as it allows testing to proceed. It also can, in some situations, decrease the fragility of test scripts provided the name of an object does not change.

2. Stability: In reality, a by-product of introspection, white-box testing can deliver greater stability and reusability of test cases if the objects that comprise an application never change.

3. Thoroughness: In situations where it is essential to know that every path has been thoroughly tested, that every possible internal interaction has been examined, white-box testing is the only viable method.

As such, white-box testing offers testers the ability to be more thorough in terms of how much of an application they can test. Despite these benefits, white-box testing has its drawbacks.

Some of the most commonly cited issues are:

1. Complexity: Being able to see every constituent part of an application means that a tester must have detailed programmatic knowledge of the application in order to work with it properly. This high-degree of complexity requires a much more highly skilled individual to develop test case.

2. Fragility: While introspection is supposed to overcome the issue of application changes breaking test scripts the reality is that often the names of

objects change during product development or new paths through the application are added. The fact that white-box testing requires test scripts to be tightly tied to the underlying code of an application means that changes to the code will often cause white-box test scripts to break. This, then, introduces a high degree of script maintenance into the testing process.

3. Integration: For white-box testing to achieve the degree of introspection required it must be tightly integrated with the application being tested. This creates a few problems. To be tightly integrated with the code you must install the white-box tool on the system on which the application is running. This is okay, but where one wishes to eliminate the possibility that the testing tool is what is causing either a performance or operational problem, this becomes impossible to resolve. Another issue that arises is that of platform support. Due to the highly integrated nature of white-box testing tools many do not provide support for more than one platform, usually Windows®. Where companies have applications that run on other platforms, they either need to use a different tool or resort to manual testing.

9.6 Test cases

9.7 Test Results

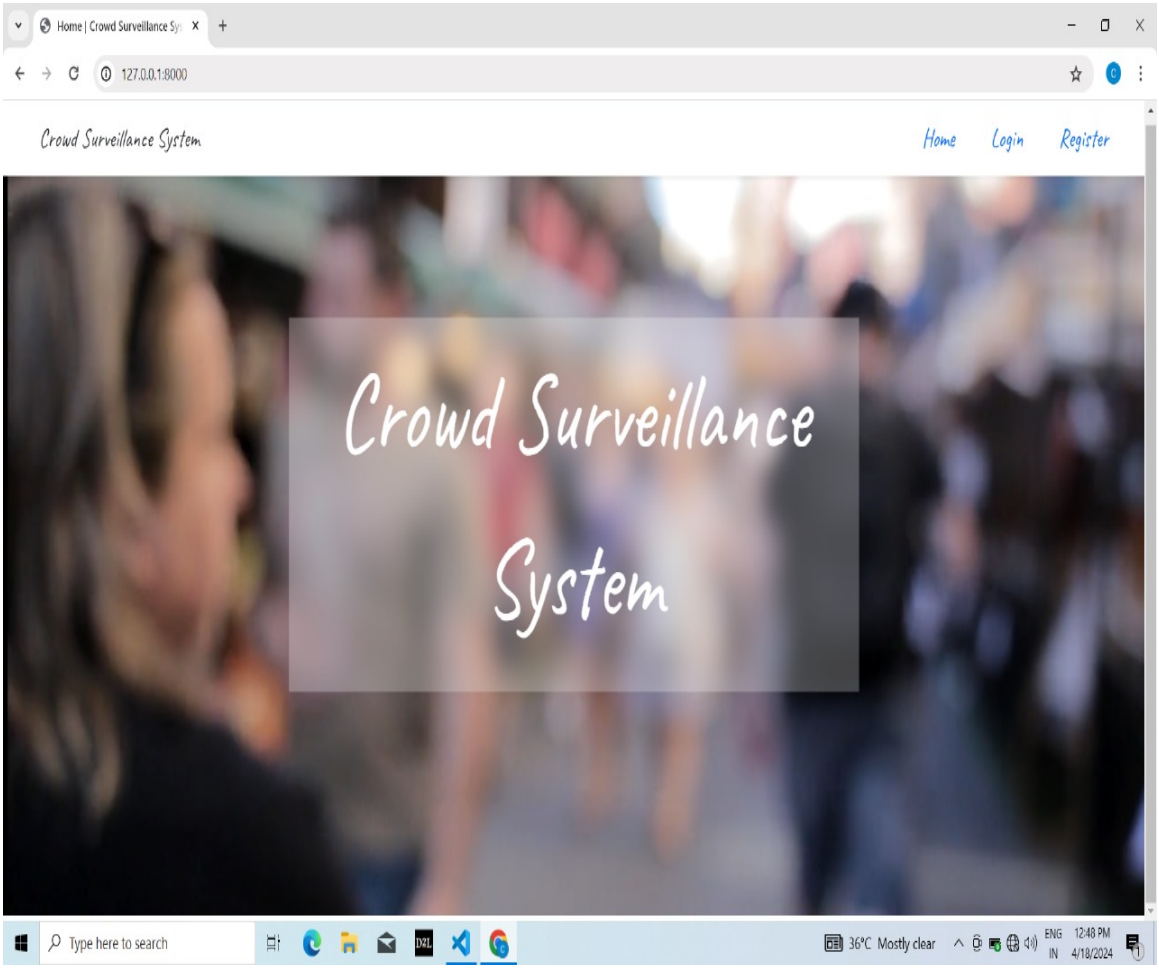
Table 9.1: Test Results

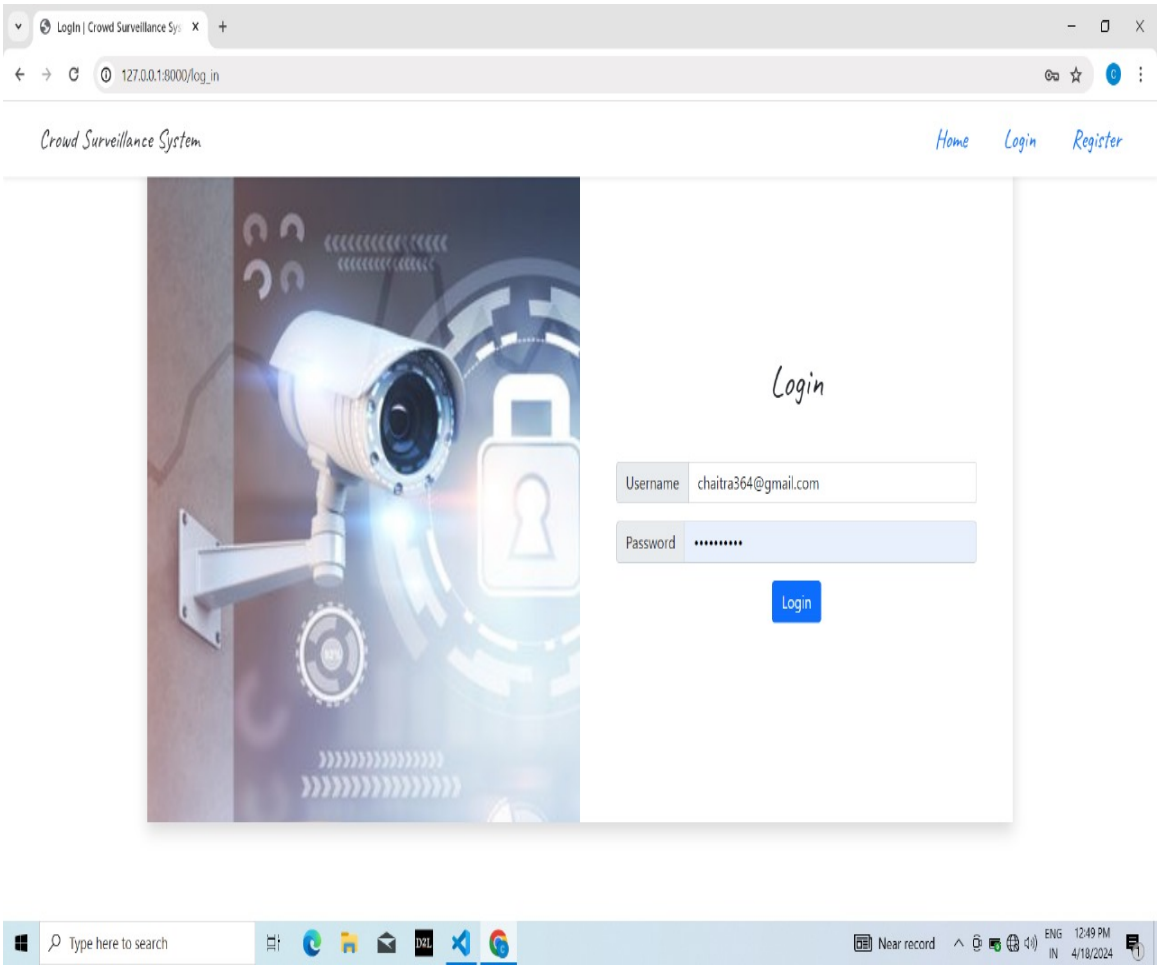
Test ID	Description	Expected Result	Actual Result	Status
001	To check whether user successfully connected in network	User should successfully connected in network	User has successfully connected in network	PASS
002	User Login	User should Login in system	User has logged in system	PASS
003	Data store in database	System should store values in database	System has store values in database	PASS
004	Incorrect Data	If user gives wrong values ,system should show error	System has shown error	PASS
005	System performance	System should perform as per requirements	System able perform as per requirements	PASS
006	Connection to network data protocol	System should able to connect to network protocol	System is connected to network protocol	PASS
007	Delay time management	System should give quick response to	System is giving quick response to	PASS
008	Notification to user on display	System should able to give notification to user on display	System is giving notification to user on display	PASS
009	System Accuracy	System should performance features with accuracy	System able to perform features with accuracy	PASS
010	System output test System	should give all the output as per programming	System is give all the output as per programming	PASS

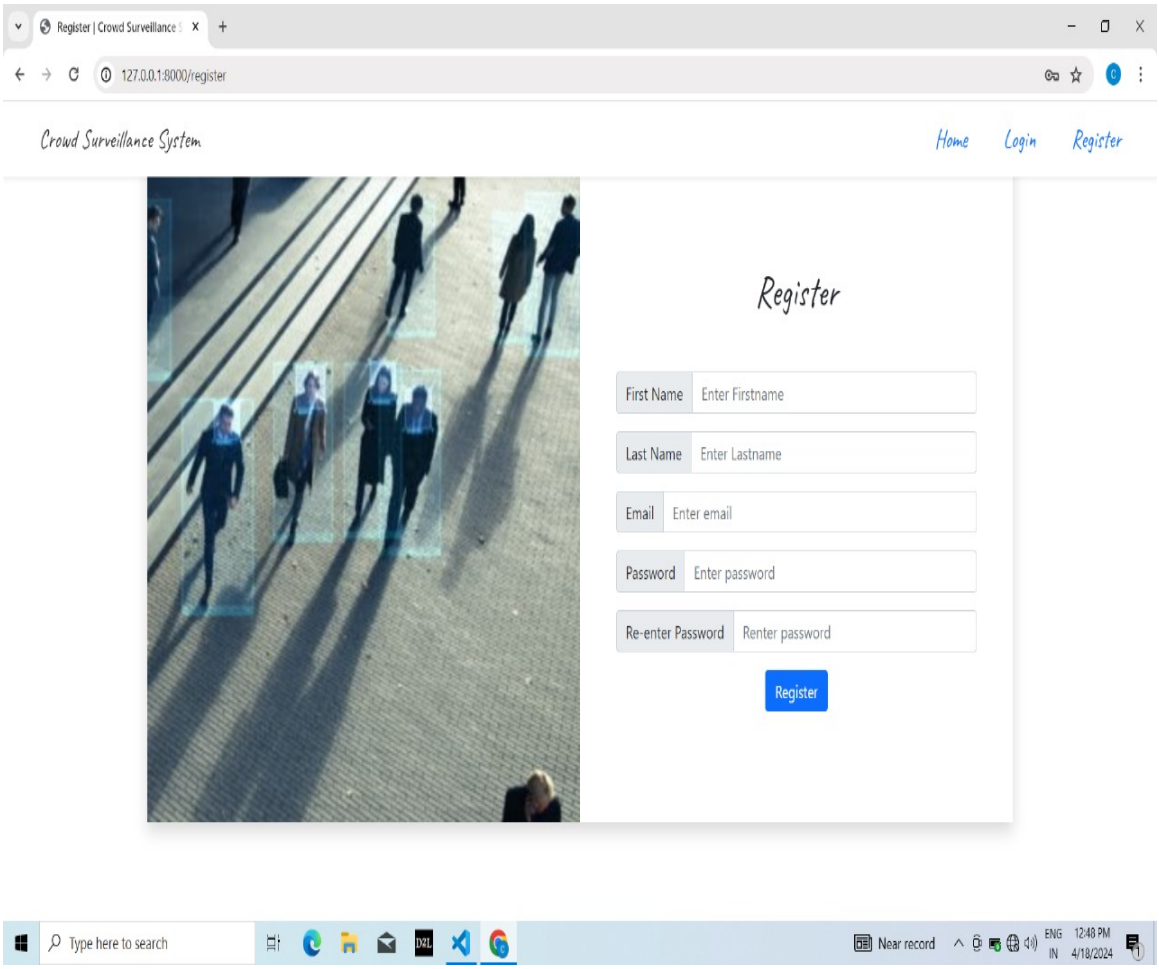
Chapter 10

Results

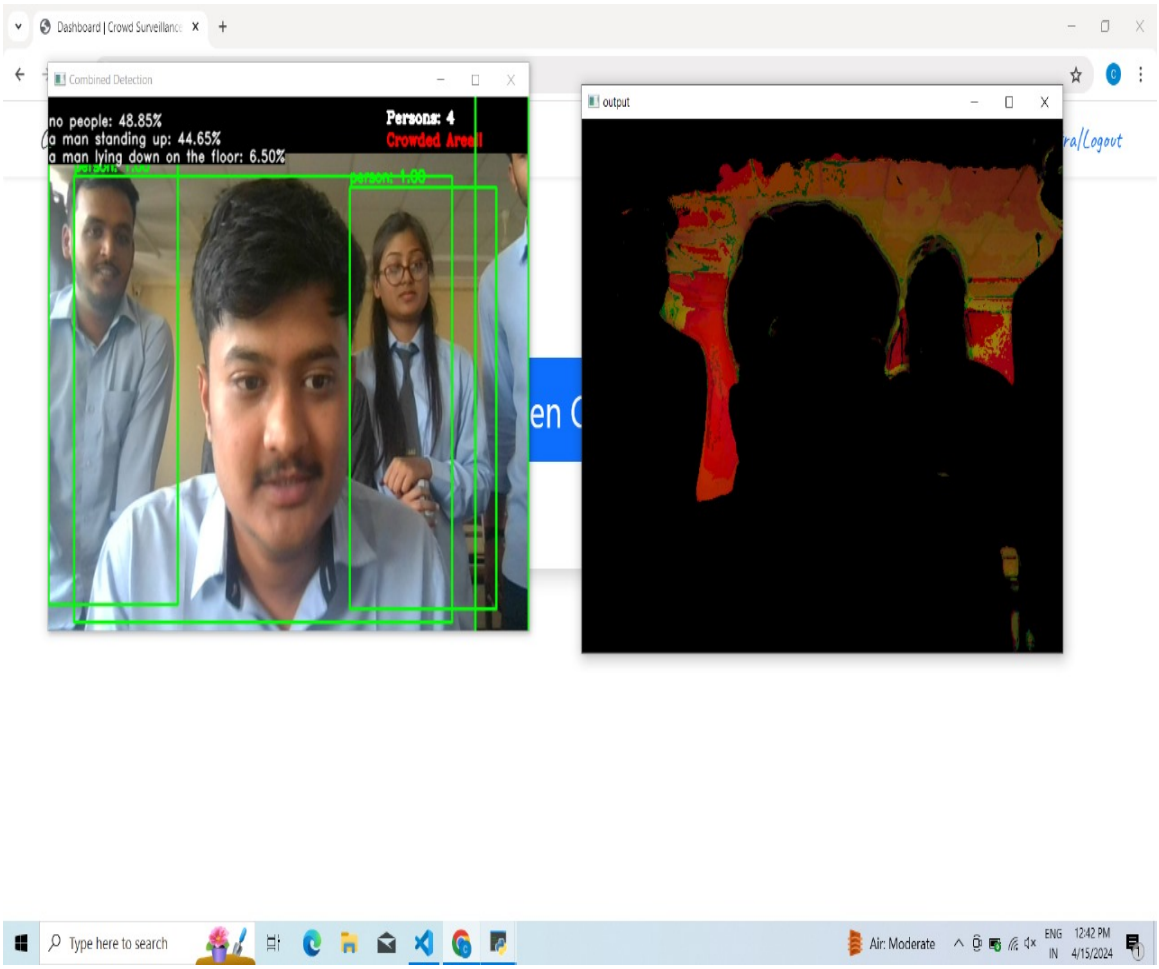
10.1 System Layout

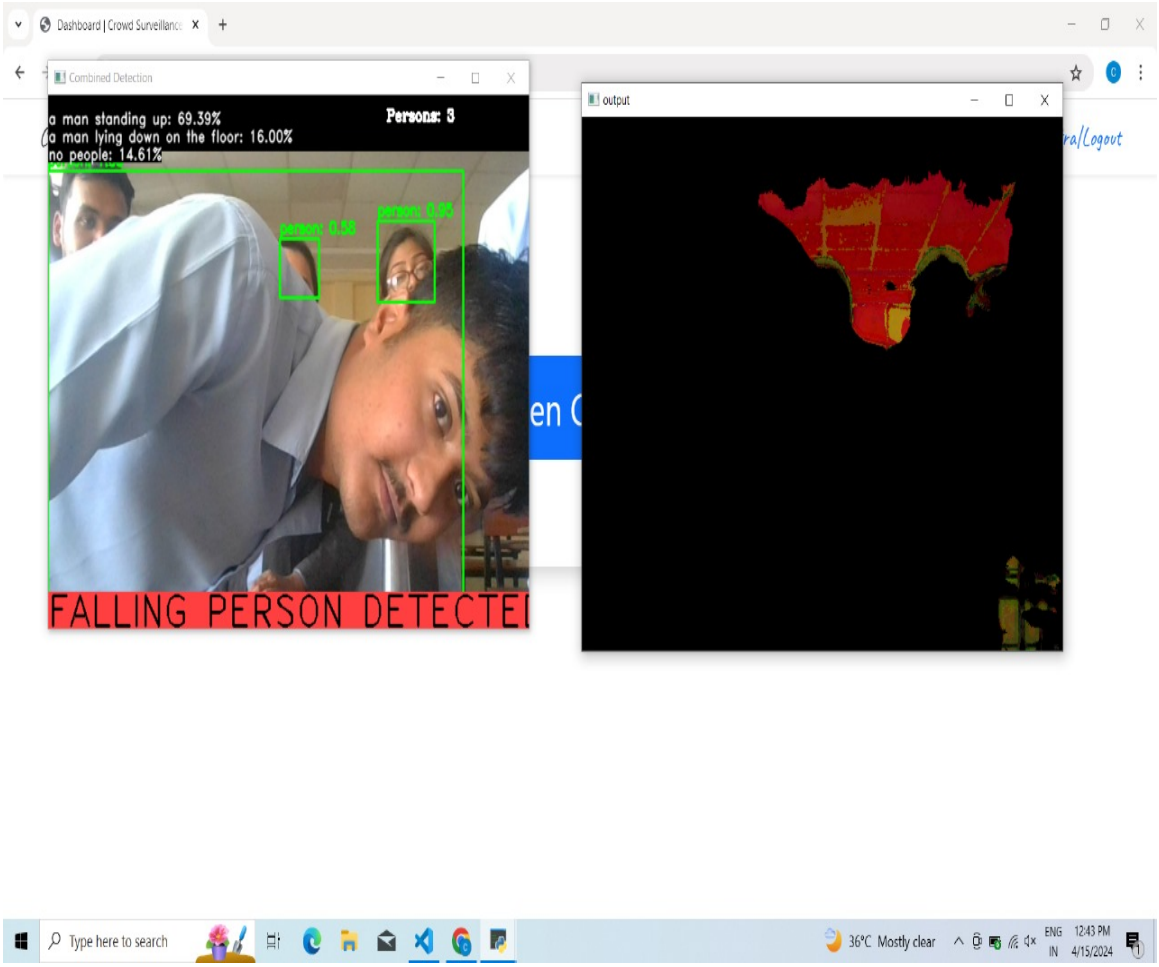


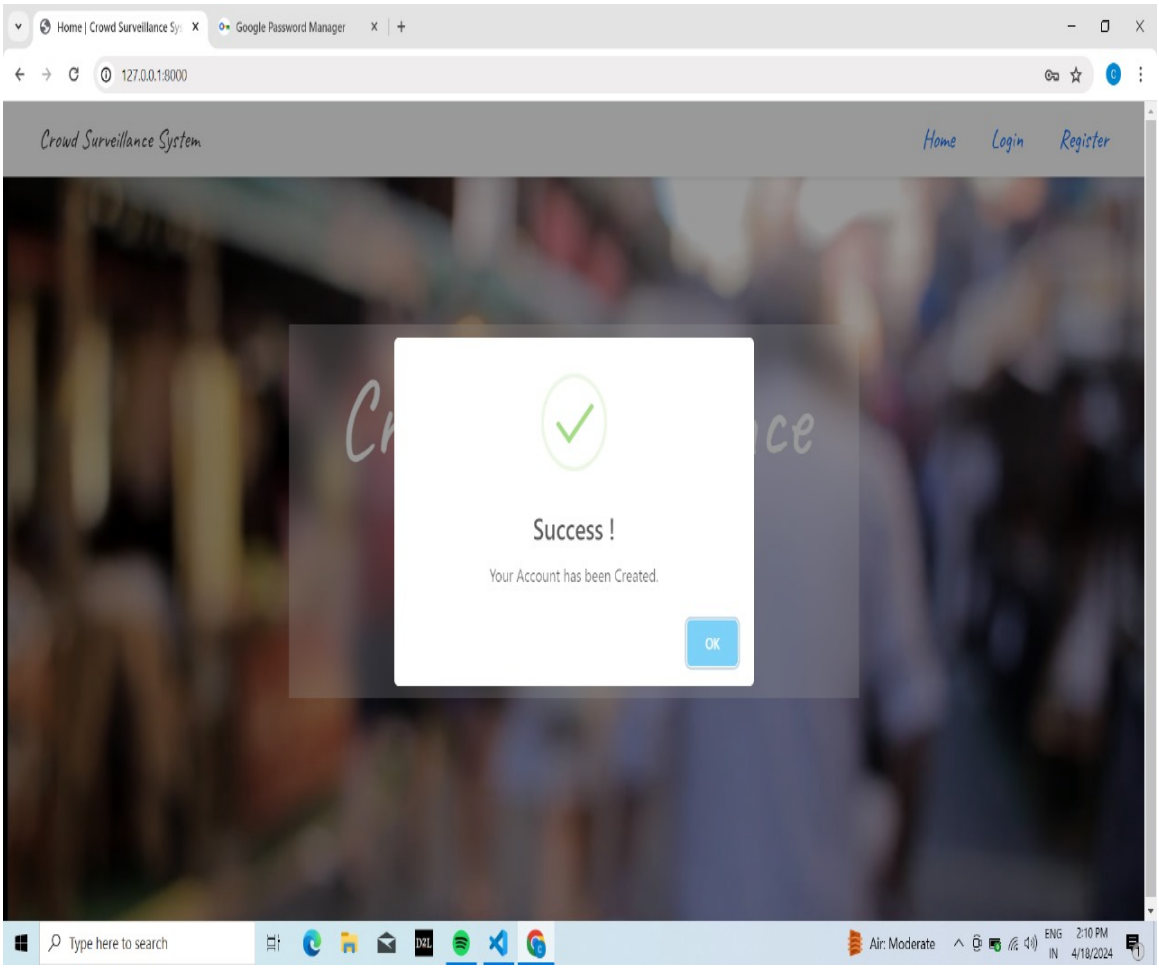

Login | Crowd Surveillance Sy
127.0.0.1:8000/log_in
Crowd Surveillance System
Home
Login
Register
Login
Username
chaitra364@gmail.com
Password
Login
Type here to search
Near record
ENG
IN
12:49 PM
4/18/2024


Register | Crowd Surveillance
127.0.0.1:8000/register
Crowd Surveillance System
Home
Login
Register
Register
First Name
Enter Firstname
Last Name
Enter Lastname
Email
Enter email
Password
Enter password
Re-enter Password
Renter password
Register

Type here to search
Near record
ENG
IN
12:48 PM
4/18/2024


Dashboard | Crowd Surveillanc
Combined Detection
no people: 48.85%
a man standing up: 44.65%
a man lying down on the floor: 6.50%
Persons: 4
Crowded Area!
output
Type here to search
Air: Moderate
ENG
IN
12:42 PM
4/15/2024


Dashboard | Crowd Surveillanc
Combined Detection
a man standing up: 69.39%
a man lying down on the floor: 16.00%
no people: 14.61%
Persons: 3
FALLING PERSON DETECTEI
output
ra/Logout
Type here to search
36°C Mostly clear
ENG
IN
12:43 PM
4/15/2024


Home | Crowd Surveillance Sy
Google Password Manager
127.0.0.1:8000
Crowd Surveillance System
Home
Login
Register
Success !
Your Account has been Created.
OK
Type here to search
Air: Moderate
ENG
IN
2:10 PM
4/18/2024

Chapter 11

Deployment and Maintenance

Deployment and maintenance are crucial aspects of ensuring the effectiveness and longevity of a real-time AI-enhanced crowd surveillance system with big data analytics.

11.1 Deployment

(a) Infrastructure Setup: Install and configure the necessary hardware components, including surveillance cameras, sensors, data storage systems, and computing resources, in strategic locations to capture crowd activity effectively.

(b) Software Implementation: Deploy the software components of the surveillance system, including AI algorithms, big data analytics platforms, and integration with existing security infrastructure, ensuring compatibility and functionality across all components.

(c) Testing and Validation: Conduct thorough testing and validation of the surveillance system to ensure that it meets performance requirements, accurately detects anomalies, and integrates seamlessly with other systems. This may involve simulated scenarios, real-world testing, and user acceptance testing.

(d) Training and Education: Provide training for security personnel, system administrators, and other stakeholders involved in operating and maintaining the surveillance system. Training should cover system usage, troubleshooting procedures, and best practices for data security and privacy.

(e) Regulatory Compliance: Ensure compliance with relevant regulations, laws, and privacy standards governing surveillance systems, data collection, and data processing, including obtaining necessary permits and approvals for deployment.

Maintenance

(a) Monitoring and Support: Implement continuous monitoring and support mechanisms to ensure the ongoing performance and reliability of the surveillance system. This includes monitoring system health, data quality, and

algorithm performance, as well as providing technical support and troubleshooting assistance as needed.

(b) Data Management: Establish robust data management practices to ensure the integrity, security, and privacy of surveillance data throughout its lifecycle. This may involve data encryption, access controls, regular backups, and compliance with data retention policies.

(c) Software Updates and Upgrades: Regularly update and upgrade software components of the surveillance system to incorporate bug fixes, security patches, and new features. This may involve periodic software updates, firmware upgrades for hardware devices, and integration with third-party APIs or services.

(d) Performance Optimization: Continuously optimize the performance of the surveillance system through fine-tuning of AI algorithms, optimization of data processing pipelines, and hardware upgrades to meet evolving performance requirements and handle increasing data volumes.

(e) Adaptation to Changes: Adapt the surveillance system to changes in the environment, such as new security threats, changes in crowd behavior patterns, or updates to regulations or compliance requirements. This may involve recalibration of algorithms, retraining of machine learning models, or adjustments to system configurations.

(f) Feedback and Iterative Improvement: Solicit feedback from users, stakeholders, and system analytics to identify areas for improvement and implement iterative enhancements to the surveillance system over time. This may involve incorporating user suggestions, addressing performance issues, or adding new features to meet evolving needs.

By prioritizing deployment and maintenance activities, organizations can ensure the long-term effectiveness, reliability, and compliance of their real-time AI-enhanced crowd surveillance system with big data analytics, ultimately enhancing public safety and security in targeted environments.

Chapter 12

Conclusion and Future Scope

12.1 Conclusion

In conclusion, the integration of real-time AI-enhanced crowd surveillance with big data analytics represents a significant leap forward in bolstering urban security and public safety. This synergistic approach harnesses the power of artificial intelligence, particularly computer vision and deep learning, to analyze live video feeds, detect potential threats, and monitor crowd behavior dynamically. The incorporation of big data analytics further amplifies the system's capabilities, enabling the extraction of valuable insights from historical surveillance data to inform proactive security measures and optimize resource allocation. While the implementation of such a system introduces complexities, including privacy considerations, legal compliance, and technical infrastructure challenges, the potential benefits in terms of early threat detection, rapid response capabilities, and overall situational awareness are substantial. Striking a balance between security imperatives and privacy rights, continuous improvement of AI models, and adaptation to diverse urban environments are paramount for the success of this innovative surveillance paradigm. As technology evolves, the continual refinement of these systems will be essential to staying ahead of emerging security challenges, ultimately contributing to the creation of safer and more secure urban spaces.

12.2 Future Scope

Continued research and development in artificial intelligence, machine learning, and computer vision will lead to the creation of more advanced algorithms capable of even more accurate and efficient crowd monitoring, anomaly detection, and threat prediction.Integration of multiple data sources, including video, audio, social media feeds, and IoT sensors, will enable comprehensive multimodal data fusion for a more holistic understanding of crowd behavior and situational awareness.

Bibliography

[1] D. Helbing and P. Mukerji, "Crowd disasters as systemic failures: analysis of the Love Parade disaster", EPJ Data Sci, vol. 1, no. 7, 2012, [online] Available: www.doi.org/10.1140/epjds7.

[2] [online] Available: www.ieeecs-madras.managedbiz.com/icnl/19q1/p72-p75.pdf.

[3] Y. LeCun, Y. Bengio and G. Hinton, "Deep learning", Nature, vol. 521, no. 7553, pp. 436-444, May 2015.

[4] Nanda Wijermans et al., "A Landscape of Crowd-management Support: An Integrative Approach", Safety Science, vol. 86, pp. 142-164, 2016.

[5] Ujwala Bhangale, Suchitra Patil, Vaibhav Vishwanath, Parth Thakker, Amey Bansode and Devesh. Navandhar, "Near Real-time Crowd Counting using Deep Learning Approach", Procedia Computer Science, vol. 171, pp. 770-779, 2020.

[6] Yuhong Li, Xiaofan Zhang and Deming. Chen, CSRNet: Dilated Convolutional Neural Networks for Understanding the Highly Congested Scenes, pp. 1091-1100, 2018.

[7] Lokesh Boominathan, Srinivas Kruthiventi and R.. Babu, CrowdNet: A Deep Convolutional Network for Dense Crowd Counting, pp. 640-644, 2016.

[8] [online] Available: www.timesofindia.indiatimes.com/india/kumbh-mela-sets-threeguinness-world-records/articleshow/68271937.cms.

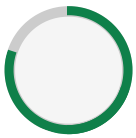
Appendix A

Plagiarism Report l

Dupli Checker

PLAGIARISM SCAN REPORT

20%
Plagiarised



80%
Unique

Date	2024-05-23
Words	603
Characters	5028

Content Checked For Plagiarism

The observation framework utilizes best in class man-made intelligence calculations to process live video takes care of, removing significant experiences from the mind boggling elements of groups. Moreover, the joining of huge information investigation works with the capacity, make due- ment, and quick investigation of huge measures of reconnaissance information. This not just upgrades the ongoing observing capacities yet additionally empowers authentic pattern investigation for pre- dictive displaying. Key parts of the proposed framework incorporate a modern camera organization, edge figuring abilities for sure fire handling of video information, furthermore, an incorporated enormous information framework. The simulated intelligence models are prepared to perceive unusual group conduct, like abrupt developments, congestion, or expected se- curity occurrences. The framework's continuous cautions engage security faculty to answer quickly to arising circumstances, in this manner working on generally speaking public security. The proposed constant man-made intelligence improved swarm observation framework with huge information investigation addresses a all encompassing way to deal with metropolitan security, utilizing state of the art advancements to upgrade situational mindfulness and reaction abilities. By amalgamating the qualities of Computer based intelligence and large information, this framework remains at the front of insightful group checking, adding to the formation of more secure and safer metropolitan conditions

The Project Idea of implementing a system for real-time AI-enhanced crowd surveillance with big data analytics is to revolutionize public safety in urban en- vironments. This innovative approach combines advanced artificial intelligence techniques, including computer vision and deep learning, with the power of big data analytics to proactively address security challenges. The primary objective is to detect potential threats or abnormal crowd behavior in real-time, empow- **ering security personnel with immediate alerts and enabling swift intervention. By analyzing live video feeds with AI algorithms, the system enhances crowd management and control, allowing for the identification of overcrowding and** facilitating timely interventions to ensure public safety. Furthermore, the inte- gration of big data analytics provides valuable insights from historical surveil- **lance data, allowing for the identification of patterns, trends, and anomalies in** crowd behavior. This information not only aids in the development of proac- tive security measures for future events but also optimizes resource allocation for more efficient deployment of personnel and resources. The ultimate goal is **to enhance situational awareness, maintain privacy and ethical standards, and** create a scalable, adaptable system that continually evolves to meet emerging security challenges, thereby fostering safer and more secure urban environments

Manjunath R Kounte; Jonnalagadda Rishitha, Implementation of Realtime design of crowd Enumeration via tracking using AI system, 2023 International Conference on Intelligent and Innovative Technologies in Computing, Electrical and Electronics (IITCEE)
Crowd enumeration can help to evaluate and count the number of visitors to a place. There are many reasons that spana wide range of applications, from security considerations, optimization of operations to efficiency in profitability. **In the paper, we propose to develop a prototype** for implementing a high frame rate, low processing environment, high performance, and highly efficient real-time crowd enumeration system. The latest method for object detection is deep learning. When it comes to deep **learning or machine learning, performance and computation are the key** parameters. In our model, there is a provision to schedule the model for the required amount of time. In our work, we are using mobilenet SSD as an object detector to detect humans. It is a preprocessed, highly efficient, **and light weight model which can run on low power device like jetson nano** and is cost-efficient unlike others. The advantage of our model is if there is overcrowding in a specified location with known capacity, alarm is enabled.[1

Matched Source

Similarity 20%

Title:www.ijirmps.org › papers › 2024/3/230623Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

The Project Idea of implementing a system for real-time AI-enhanced crowd surveillance with big data analytics is to revolutionize public safety in urban en vironments. This innovative approach combines advanced artificial intelligence techniques, including computer vision and deep learning, with the power of

https://www.ijirmps.org/papers/2024/3/230623.pdf/

Similarity 5%

Title:Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

threats or abnormal crowd behavior in real-time, empow ering security personnel with immediate alerts and enabling swift intervention ✔ . By analyzing live video feeds with AI algorithms, the system enhances crowd management and control, allowing for the identification of overcrowding and facilitating timely interventions to ensure public safety.

https://www.ijirmps.org/papers/2024/3/230623.pdf

Similarity 8%

Title:Implementation of Realtime design of crowd Enumeration ...

by MR Kounte · 2023 — In the paper, we propose to develop a prototype for implementing a high frame rate, low processing environment, high performance, and highly efficient real ...

https://ieeexplore.ieee.org/document/10090914

Appendix B

Base Papers

2021 IEEE International Conference on Big Data and Smart Computing (BigComp) | 978-1-7281-8924-6/20/$31.00 ©2021 IEEE | DOI: 10.1109/BigComp51126.2021.00032

Bigdata Enabled Realtime Crowd Surveillance Using Artificial Intelligence And Deep Learning

Logesh Rajendran
L&T Smart World
Chennai, India
r-logesh@lntecc.com

Shyam Shankaran R
L&T Smart World
Chennai, India
shyam-r@lntecc.com

***Abstract*— India has in recent years witnessed significant tragedies related to crowds. Statistics indicate that over 70 per cent of Indian crowd-related accidents happened during religious festivities. A devastating humanitarian disaster may occur if crowd safety measures are not enforced and the massive crowds need to be given special attention. Manual crowd control requires extensive human intervention and is more vulnerable to human error and is a time-consuming activity too. In this paper we emphasize on L&T Smart World AI-based crowd management system implemented during the world's largest Kumbh Mela 2019 gathering in Prayagraj using Artificial Intelligence to solve circumstances that go beyond human capability. The data gathered provides the core for a framework for effective crowd management or evacuation strategies to minimize the risk of overwhelmed and dangerous conditions. Deep learning provides the solution to the dense crowd count and management problems. The crowd control analytics system of L&T Smart World has succeeded in maintaining the safety of 23 crore pilgrims visited during the 50 days of Holy Kumbh Mela in Prayagraj, India, demonstrates the efficacy of the solution implemented.**

Keywords- AI Based Surveillance, Crowd density, Crowd congestion detection, Crowd analysis, crowd counting, Deep learning

I. INTRODUCTION

Crowding happens as a result of gathering an overly large group of people in a specified and significantly smaller area. They often assemble, however, often in greater volume, where specific attractions or activities, such as sporting competitions, political gatherings, religious gatherings, and Melas, take place. The event is indeed one of the world's most peaceful gatherings and is considered "the largest religious pilgrim congregation in the world". Usually secure crowd conditions can be assumed for densities equivalent to 2-3 people per square meter and an overall adequate flow of 82 people per meter and minute [1].

If the crowd significant to recognize about 4 or 5 persons per square meter, congestion will build up rapidly, indicating high risks for stumbling or falling people. AI and Analytics used in an event attended by around 20 crore devotees in the "Kumbh Mela, 2019", aimed to anticipate crowd behavior and the risk of a rampage. Assessment of streams from more than 1,100 Surveillance cameras and monitors provided an understanding of the different actions across the 3,200 hectares area [2].

Prior to the Kumbha mela 2019, sample datasets to train the system were collected from previous mass gathering events across the city. Different neural networks including CSRNet were taken into consideration for training the system with the collected datasets. Since, the accuracy level of CSRNet was promising compared to other neural networks, it was chosen to be implemented in final solution.

II. CROWD MANAGEMENT SOLUTION OVERVIEW

The solution implemented consisted of 20 strategic points and 41 dedicated cameras for Kumbh Mela 2019 which are designed to monitor the density of people at all times of the event. These cameras are intended to perform crowd control analytics such as Line Count to count numbers of people crossing the line in either direction to assess entry and exit at a specific targeted area and crowd density assessment at all targeted points which are regarded as prominent routes.

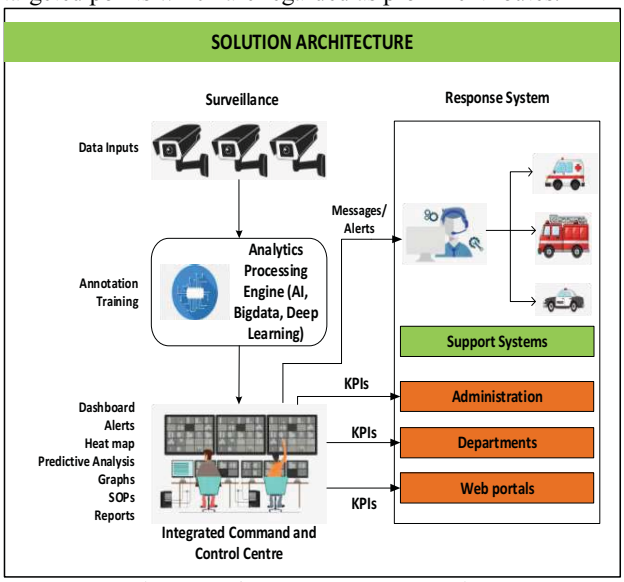


Fig. 1. Crowd management system overview

Artificial Intelligence has been here for over 5 decades but the subdomain of AI called Deep Learning is owing to the accessibility of high-performance GPUs (graphic processing unit) that can render large-scale matrix convolutions at a quick pace. Initially, a deep neural network is designed and then trained to leverage large quantities of data sets and multiple iterations this phase, called learning, occurs on high-end GPUs [3]. Dense crowd images from

2375-9356/21/$31.00 ©2021 IEEE
DOI 10.1109/BigComp51126.2021.00032

surveillance systems were captured and CSRNet was chosen as a Deep learning algorithm for the crowd management solution framework by L&T Smart World because of the accuracy greater than 80%. As the part of implementation 1500, high-resolution images have been collected, 700 Selected images have been annotated, an average of more than 600 headcounts in one image have been analyzed, annotated more than 400 heads and training is done on high-end GPUs for more than 10,000 iterations.

III. Implementation of the Framework

The ICCC includes AI-based software and analytics system focused on Big data to provide crucial warnings & updates during certain incidents. At a broad level, three main subsystems encompasses the framework:

1. Video Surveillance Management System
2. Real-time Analytics processing system
3. Integrated Command and Control system

A. Video Surveillance Management System:

Monitored data are collected in a Command and Control center where video streams and other incoming data are analyzed by the response team and automated equipment measures the number of people and densities and other temporal space measurements at different locations. The entire video feeds are stored in the database in the command center and are then accessed by Real-time analytics processing system for data analytics operations to extract beneficial information to ensure effective decision making.

B. Real-Time Analytics Processing System:

Generally, these raw unstructured data from video management systems require examination and analysis such that critical information can be obtained serious of events that took place in a crowd.

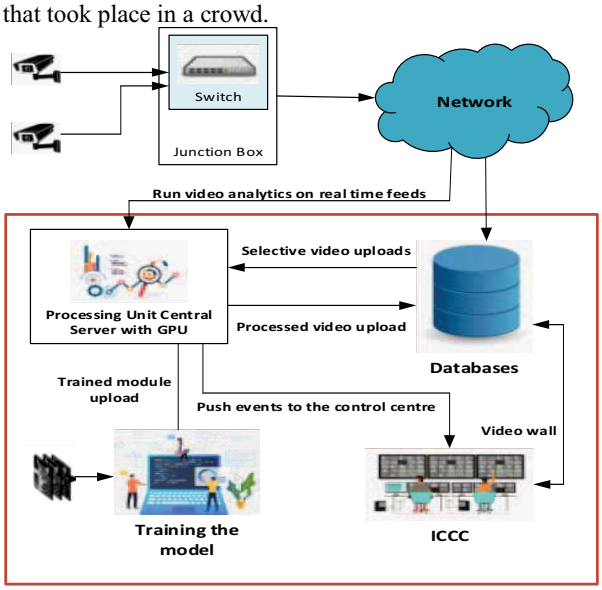


Fig. 2. Process flow of Real time analytics processing system

Usually, this subsystem includes several techniques for data mining, for example, classifications, clustering algorithms, extraction techniques, and a few more [4].The real-time analytics processing system contains two layer. They are:

1. Artificial intelligence layer
2. Big data layer

(1) Artificial Intelligence Layer:

Recently, researchers have gained significant attention from data-driven and supercomputing-intensive methods such as neural networks or deep learning (DL). It can extract dynamic features from raw data because of its effectiveness. CSRNet is one of the popular networks with special emphasis on classification and learning digital image data, among the best profound learning styles. In leveraging the success of deep learning, software alternatives or libraries such as Tensor Flow were built through integration of profound learning with large data frameworks such as Apache Spark.

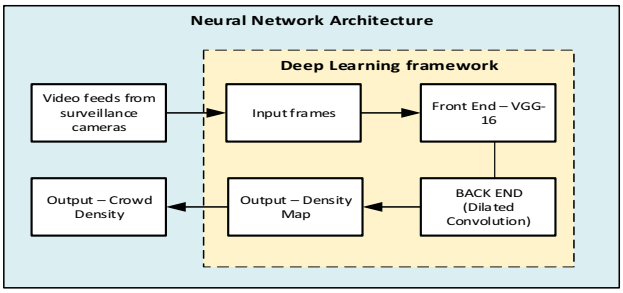


Fig. 3. Architecture of Real time analytics processing system [5]

CSRNet's powerful image classification ability allows the use of VGG-16 as the front end and utilizes the back end of dilated convolutional layers. The VGG output size is 1⁄8th of the initial size of the input. Instead of separately training the front and back end, it is trained by handling the front end and back end together as an end-to-end structure [6]. The stochastic gradient is introduced during the training and the learning rate is held at 1e-6. Euclidean distance is computed between the ground truth count and the expected crowd-count of the suggested technique [6]. The Loss is calculated as

$$L(\theta) = \frac{1}{2N}\sum_{i=1}^{N}\left\| W(X_j;\theta) - W_j^{GT}\right\|_2^2 \qquad (1)$$

Where N is training set's size, $W(X_j;\theta)$ is neural networks output is the image's actual ground truth [7]. W_j represents the input image while $W_j^{GT}$is the ground truth of image W_j.The use of Geometric adaptive kernel as proposed in helps deal with highly congested environments [7].The geometric adaptive kernel is given in equation below,

$$F(w) = \sum_{i=1}^{N}\delta(w - w_j) * G_{\sigma_j}(w), \text{where } \sigma_j = \beta d_j, \qquad (2)$$

Where w_i is the object that was directed at the ground truth δ. And d_j means the average distance of the nearest k neighbours. To create a density map, the image is

convoluted with the Gaussian kernel and '*' represents the convolution operator [5]. W is the location of the pixel in the image, k is held as 3 and β as 0.3. For less crowded crowds, the Gaussian kernel is modified to blur the average head size around the annotated head locations [5].

The algorithm predicts the density map for an input dataset first. If no man is present, the pixel value will be Zero. If that pixel correlates to an individual, a certain pre - determined value will be allocated. Thus, the measurement of the total pixel values corresponding to an individual will provide us the number of individuals in that image. The dataset which is used to train the model has 700 annotated images of the Indian crowds in which a single image contains more than 600 heads.

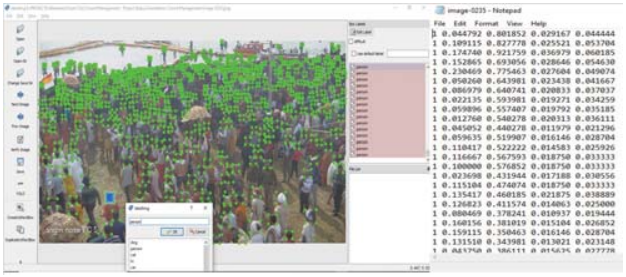


Fig. 3. Annotated images in datasets

The training is done for more than 10000 iterations to make the network converge. The trained prototype is then labelled qualified to evaluate the accuracy of the results. The model is applied in a real-world environment to achieve stable and viable outcomes. For Crowd Density, Moderate & Critical Warning was set above 2.8 & 3.2 people per square meter precisely. As a result, the model could use its learning to draw inferences about real-world scenarios.

Fig. 4. Real time threshold monitoring during Kumbh Mela 2019

(2) Big Data Layer:

The device is expected to ingest 24/7 cloud-based video streaming from millions of multimodal video data streams and large-scale batch video data from millions of users for the purpose of smart video data analysis. The life cycle of the video analytics platform is overly complex and a comprehensive method is needed to effectively apply a wide range of advanced distributed video processing and extraction algorithms to large-scale video analytics problems using Big data models. Technologically, Data Persistent Storage is designed to the top of the Hadoop Distributed File System and NoSQL data stores as a query execution engine. It also offers storage facilities for the storage and management of model learners.

In the Central Server, the camera inputs from different cameras distributed around different locations will be routed across the network and transmitted to the central location of the Video Analytics Software Server. The alerts created by the Video Analytics Software are stored as well as triggered by the Command Control Center.

C. Integrated Command and Control system:

The system is composed of the integrated command and control centre (ICCC) which serves as the master for the entire crowd management operation. The layer is designed to provide real-time analysis of both statistical, locational and video feeds to enable real-time predictive analysis. The network gathers and stores live information in a monitoring room in a command and control centre where the authorities can keep monitor. The ICCC for the Central City region shall allow data acquisition and collaborative monitoring, thus assisting in data analysis for effective decision - making.

IV. Results and Observations

In a record time, smart city integrated control and control centre (ICCC) with interconnected smart infrastructure such as cameras, AI video analytics as well as other sensors is set up. At prime locations about 41 high-speed cameras were mounted with an intention of real-time crowd monitoring. The AI-based video analytics technology has been used to extract crowd data from real-time video feeds, and thousands of such information messages per second were sent to the ICCC database to calculate crowd statistics such as crowd count, crowd intensity, queue lengths, etc.

The crowd statistics is monitored from the ICCC continuously and the data are recorded and presented in dashboard for further insights.

TABLE I. Accuracy Estimation of the Implemented Crowd Monitoring Solution by Random Samples

S.No	Date	Time	Actual Strength	System Count	% of Accuracy
1	03-02-2019	09:00	451	370	82.03
2	03-02-2019	18:00	408	335	82.10
3	04-02-2019	09:00	423	349	82.50
4	04-02-2019	18:00	443	366	82.61
5	05-02-2019	09:00	403	333	82.63
6	05-02-2019	18:00	455	376	82.63
7	06-02-2019	09:00	346	286	82.65
8	06-02-2019	18:00	408	338	82.84
9	07-02-2019	09:00	423	351	82.97
10	07-02-2019	18:00	376	313	83.24

As part of validation the image analysed is compared for the crowd count with actual numbers to study the accuracy. As depicted in the Table. II, the system has the accuracy greater than 80% and the accuracy is improved with increase in iterations. With this accuracy level the system achieves reliability in crowd surveillance and monitoring to avoid stampedes.

TABLE II. SAMPLING OF AVERAGE CROWD DENSITY AT KEY LOCATIONS IN THE CITY ON 08/02/2019

Location	Cluster	Average Crowd Density							
		08:00	10:00	12:00	14:00	16:00	18:00	20:00	22:00
Sangam Nose	I	1.69	1.59	2.02	1.23	1.16	1.35	1.57	1.55
	II	1.4	1.98	2.81	1.74	1.23	1.42	1.32	1.43
Sangam Nose Circulating	I	1.91	2.32	2.96	1.43	1.87	1.56	1.98	1.89
	II	1.21	2.4	3.01	1.78	2.01	2.95	3.14	2.14
	III	1.43	2.95	3.34	1.92	2.43	3.12	3.42	2.01
	IV	1.2	2.43	3.15	1.81	2.31	2.76	2.89	1.92
Arail ghat	I	1.21	1.65	1.29	1.34	1.45	1.56	1.23	1.34
	II	1.26	1.96	1.77	1.42	1.52	1.55	1.14	1.02
	III	1.28	1.74	1.25	1.18	1.34	1.37	1.02	0.97
	IV	1.3	1.79	1.63	1.31	1.54	1.67	1.14	1.15
Ganga Prasar ghat east	I	1.02	1.24	1.13	1.1	1.08	1.09	1.21	1.01
	II	1.03	1.24	1.12	1.08	1.02	1.18	1.14	1.02
	III	1	1.09	1.02	1.02	1.1	1.08	1.09	1..2
Daswamedh Ghat	I	1.1	1.26	1.12	1.15	1.3	1.29	1.13	1.21
Kalpvasi kshetra	I	1.05	1.22	1.07	1.11	1.02	1.77	1.12	1.26
Nagvasuki se snan ghat	I	1.07	1.33	1.19	1.21	1.03	1.25	1.02	1.28
	II	1.11	1.44	1.25	1.18	1	1.63	1.12	1.3

Fig. 5. Real-time monitoring of crowd density in ICCC

The average crowd density of the area is monitored and thresholds for alerts have been employed as policies from the ICCC. If the crowd density increase more than 2.8, the soft alert is triggered and when the crowd density increase more than 3.2, the critical alert is triggered to notify the official to take necessary actions to avoid any crowd related disaster. It was noted in particular location called "Sangam Nose Circulating" the crowd density crossed 3.2 and alert was sent to respective authorities and the crowd was dispersed.

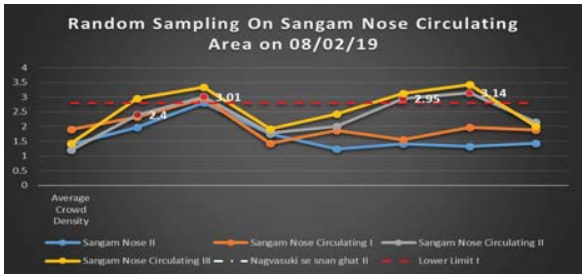


Fig. 6. Control chart on Average Crowd Density on 08/02/19

The Crowd Analytics framework has been integrated with the Centralized Dashboard platform to visualize the alerts in Geographical Maps, and reports were produced hourly, daily, monthly. The operational reports were regularly exchanged with police and operating forces in order to determine the situation on the ground and also to further assist them in the planning for the following period. The project has achieved considerable success in helping the government and local authorities prevent any human catastrophe and also offering the pilgrims with a positive experience.

V. CONCLUSION

The cutting-edge smart technologies deployed by L&T Smart World in Prayagraj during Kumbh Mela 2019 and proved pivotal in the realization of the City Administrators dream of achieving the pilgrims zero harm mandate. The project was an unparalleled real-time implementation, with no prior precedent. The solution resulted in the Guinness book of world records for the greatest exercises in crowd management ever for the religious gatherings [8]. Futuristic approach might include positioning cameras with different viewing angles and training neural networks with granular level inputs would aid in improving the robustness and accuracy of crowd monitoring systems.

REFERENCES

[1] Helbing, D., Mukerji, P. Crowd disasters as systemic failures: analysis of the Love Parade disaster. *EPJ Data Sci.* 1, 7 (2012). www.doi.org/10.1140/epjds7

[2] www.ieeecs-madras.managedbiz.com/icnl/19q1/p72-p75.pdf

[3] Y. LeCun, Y. Bengio, and G. Hinton, "Deep learning," Nature, vol. 521, no. 7553, pp. 436–444, May 2015.

[4] Wijermans, Nanda et al. "A Landscape of Crowd-management Support: An Integrative Approach." *Safety Science* 86 (2016): 142-164.

[5] Bhangale, Ujwala & Patil, Suchitra & Vishwanath, Vaibhav & Thakker, Parth & Bansode, Amey & Navandhar, Devesh. (2020). Near Real-time Crowd Counting using Deep Learning Approach. Procedia Computer Science. 171. 770-779. 10.1016/j.procs.2020.04.084.

[6] Li, Yuhong & Zhang, Xiaofan & Chen, Deming. (2018). CSRNet: Dilated Convolutional Neural Networks for Understanding the Highly Congested Scenes. 1091-1100. 10.1109/CVPR.2018.00120.

[7] Boominathan, Lokesh & Kruthiventi, Srinivas & Babu, R.. (2016). CrowdNet: A Deep Convolutional Network for Dense Crowd Counting. 640-644. 10.1145/2964284.2967300.

[8] www.timesofindia.indiatimes.com/india/kumbh-mela-sets-three-guinness-world-records/articleshow/68271937.cms

Appendix C

Tools and Hardware used

C.1 Tools and Technologies Used

- Windows 7 or above
- Vs code , Python

C.2 Hardware Requirements

(a) Processor - Pentium IV/Intel I3 core
(b) Speed - 1.1 GHZ
(c) RAM - 4 GB (min)
(d) Hard disk - 150 GB
(e) Keyboard - Standard Keyboard
(f) Mouse - Two Or Three Button Mouse
(g) Monitor - LED Monitor

Appendix D

Published Papers

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

[1]Prof. M.S. Khan, [2]Bhalerao Chaitrali, [3]Bangar Gaurav, [4]Kharat Sakshi, [5]Pingale Yukta

[1]Assistant Professor, [2,3,4,5]Students
Department of Information Technology
Matoshri College of Engineering and Research Centre

***Abstract*- In today's rapidly evolving technological landscape, the integration of artificial intelligence (AI) in video surveillance systems has emerged as a paramount solution to address diverse safety and security challenges. This paper presents an AI-powered video surveillance system that leverages advanced computer vision techniques to enhance situational awareness in real-time video streams, both from recorded video input and live web cameras. The system incorporates the following key features: 1. Fall Detection: The system utilizes AI algorithms to detect and promptly respond to incidents of individuals falling within the surveillance area. By identifying such events, the system ensures rapid assistance, especially for vulnerable populations, thereby mitigating potential harm and reducing emergency response time. 2. Overcrowd Detection: Overcrowding in public spaces is a common safety concern. Our system employs AI to analyze video feeds and identify instances of overcrowding. This enables authorities to take proactive measures to manage crowd density, maintain public safety, and prevent potential emergencies. 3. Vehicle Crash Detection: Automated vehicle crash detection is vital for traffic management and immediate response to accidents. The system employs AI algorithms to detect vehicle crashes by analyzing video feeds from roads and highways. This feature not only helps in efficient traffic management but also expedites emergency services to accident sites, potentially saving lives. 4. Fire and Weapon Detection: Early detection of fires and weapons is crucial for public safety and security. The AI-powered system is designed to identify instances of fires and the presence of weapons within the surveillance area. This capability allows for rapid response to fire emergencies and potential threats, ultimately safeguarding lives and property. The system supports real-time video analysis from both recorded video input and live web cameras, making it versatile and adaptable for a wide range of applications**

***Keywords*: Artificial Intelligence, surveillance system, real-time alerts, big data.**

Published in IJIRMPS (E-ISSN: 2349-7300), Volume 11, Issue 6, Nove-Dec 2023

INTRODUCTION

The AI-Powered Video Surveillance System project seeks to address various safety and security challenges. These include the need to detect and respond to falls, a common cause of injuries and accidents, especially among the elderly and in crowded public spaces. Overcrowd detection is crucial to manage crowded areas efficiently and prevent potential hazards, such as stampedes and public disorder. Vehicle crash detection aims to reduce response time to road accidents, potentially saving lives and minimizing injuries. Lastly, the system focuses on fire and weapon detection to promptly identify these critical events, mitigating property damage and ensuring public safety. The project's overarching goal is to leverage artificial intelligence to enhance situational awareness, improve emergency response, and ultimately safeguard lives and property

LITURATURE SURVEY

[1], Every day, there are more crimes committed and criminals are on the loose, which is making people fear for their safety. The primary goal is to detect and deter illicit activity before it occurs. With the aid of cutting-edge technology, CCTV is commonly used in both private and public spaces. It is possible to control crime in this area, but human supervision is required to oversee it. It's difficult for a human to keep track of multiple screens at the same time. Human error is a possibility in many situations. To overcome this drawback, we stipulate a Deep Learning-based Real-Time Crime Detection Technique that analyzes real-time CCTV footage and alerts a nearby supervisor about the crime in the current region. The model tracks the movement of people and classifies it as aggressive or nonviolent behavior using the Multiple Object Detection with Localization technique. Any aggressive conduct filmed by the camera will be detected and instantaneously alerted by the system

K Kishore Kumar et al. [2] presently, the video surveillance system is an important virtue for identifying crimes. The past works related to crime detection using video surveillance are discussed here. The goal of this investigation is to provide a literature review about crime activity recognition using different techniques. The main demerits of video surveillance are facial utterance recognition, and the method consumes more time for detecting the crime. An alert system provided in video surveillance improves crime prediction and also reduces crime activity. This paper presents an overview of present and past reviews for developing future research. The published journals from 2000-2020 were analyzed to know about the video surveillance and crime detection methods in different sectors. A review of the analyzed researchers and their techniques is available in this paper. This survey is useful to improve the crime detection techniques using video surveillance. Moreover, it is a useful tool to gather information

Sharmila Chackravarthy et al. [3] the quick and accurate identification of criminal activity is paramount to securing any residence. With the rapid growth of smart cities, the integration of crime detection systems seeks to improve this security. In the past a strong reliance has been put on standard video surveillance in order to achieve this goal. This often creates a backlog of video data that must be monitored by a supervising official. For large urban areas, this creates a increasingly large workload for supervising officials which leads to an increase in error rate. Solutions have been implemented to help reduce the workload. Currently, auto regressive models have been used to better forecast criminal acts, but also have a list of shortcomings. We propose a solution of using neural networks in combination with a Hybrid Deep Learning algorithm to analyze video stream data. Our system will be able to quickly identify and assess criminal activity which will in turn reduce workloads on the supervising officials. When implemented across smart city infrastructure it will allow for a efficient and adaptable crime detection system.

AIM & OBJECTIVES

• Develop and implement an advanced AI-based video surveillance system capable of real-time fall detection, overcrowd detection, vehicle crash detection, fire detection, and weapon detection.

• Improve public safety by providing immediate alerts and responses to falls, overcrowding, vehicle crashes, fires, and potential security threats within the surveillance area.

• Reduce emergency response time for incidents such as falls and vehicle crashes, thereby minimizing injuries and saving lives.

• Enhance the efficiency of crowd control and public safety measures by identifying and managing overcrowding in real-time.

• Prevent or mitigate property damage and potential harm by detecting fires and weapons as soon as they appear within the surveillance area.

• Enable seamless integration with various video input sources, including live web cameras and recorded video feeds, to ensure versatility and adaptability across different surveillance scenarios and environments.

MOTIVATION

The scope of the AI-Powered Video Surveillance System project encompasses the development and implementation of a comprehensive video surveillance system powered by artificial intelligence. This system will focus on the real-time detection of falls, overcrowding, vehicle crashes, fires, and weapons within the surveillance area. It will include the deployment of advanced computer vision algorithms and machine learning models to enable accurate and timely identification of these critical events. The project's scope

extends to the integration of this system with various video input sources, including both recorded video footage and live web cameras. This adaptability ensures that the system can be applied across a wide range of scenarios, from smart city management to transportation safety and the protection of critical infrastructure and public events. The ultimate goal is to enhance safety and security by providing real-time alerts and responses, thus reducing response times and mitigating potential harm in a variety of settings.

APPLICATION:

- Smart Cities
- Transportation and Traffic Management
- Public Events
- Retail and Commercial Security
- Critical Infrastructure Protection
- Healthcare
- Education
- Airports and Transportation Hubs
- Industrial Facilities
- Public Transportation
- Residential Security

SYSTEM ARCHITECTURE

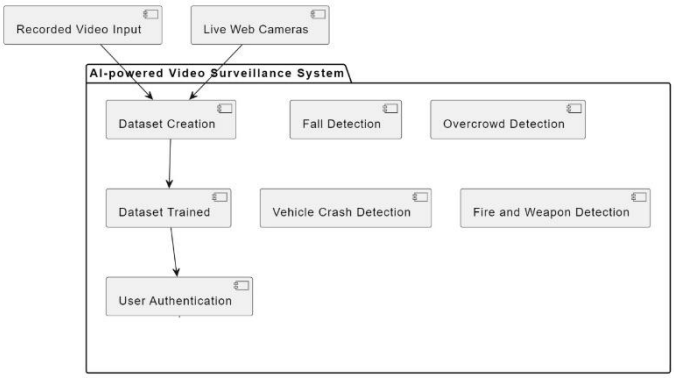


Fig -1: System Architecture Diagram

ADVANTAGES

- Early Incident Detection
- Rapid Response
- Proactive Crowd Management
- Efficient Traffic Management
- Enhanced Public Safety
- Customizability
- Versatility
- Scalability

FUNCTIONAL & NON-FUNCTIONAL REQUIREMENTS

Nonfunctional Requirements

Performance Requirements:

- Real-time Processing: The system must process video streams in real-time, with minimal latency.
- Scalability: It should be able to handle a large number of cameras and video feeds simultaneously.
- Throughput: Achieve a high throughput of video data for analysis

Safety Requirements:
The system must employ robust data security measures to protect sensitive user data, including farm-specific information and soil analysis results. Data should be encrypted during transmission and storage to prevent unauthorized access or data breaches

Security Requirements

• High Availability: The system should have high availability to ensure continuous surveillance and incident detection.
• Fault Tolerance: It must be resilient to hardware failures or software errors.

Security Requirements

• Data Encryption: Implement strong encryption to secure video feeds, incident data, and communication between system components.
• Access Control: Enforce strict access controls to prevent unauthorized access to the system.
• Authentication and Authorization: Ensure that only authorized users and systems can configure and interact with the surveillance system.

SYSTEM REQUIREMENTS

Software Used:

1. Technology Used: Python, Django
2. IDE: VS code
3. Operating System: Windows 8 or above

Hardware Used:

1. Hard Disk: 200 GB
2. RAM: 4 GB
3. Processor: Intel Pentium i5 and above

CONCLUSION

In conclusion, the AI-powered video surveillance system presents a comprehensive and versatile solution to address safety and security challenges across a wide range of sectors and industries. With its advanced computer vision techniques and AI algorithms, the system offers the capability to detect incidents such as falls, overcrowding, vehicle crashes, fires, and weapons in real-time, facilitating rapid responses and enhancing situational awareness. The system's adaptability, scalability, and interoperability make it suitable for diverse applications, including smart city management, transportation safety, and critical infrastructure protection. While the project brings numerous advantages, such as early incident detection and enhanced public safety, it also poses certain limitations and challenges, including privacy concerns and potential false alarms. Effective risk management and compliance with legal and ethical standards are essential for its successful deployment. The AI-powered video surveillance system serves as a testament to the power of technology in bolstering safety and security measures. With continuous improvements and careful consideration of privacy and ethical factors, this project offers the potential to significantly enhance public safety and security in various environments, promoting a safer and more secure future.

REFERENCES:

[1] Lakhani, R. Karim and M. Iansiti, "The truth about blockchain", Harvard Business Review, vol. 95, pp. 118-127, 2017.
[2] Hileman Garrick and Michel Rauchs, "2017 global blockchain benchmarking study", Available at SSRN 3040224, 2017
[3] Mohanta, K. Bhabendu, Debasish Jena, Soumyashree S. Panda and Srichandan Sobhanayak, "Blockchain Technology: A Survey on Applications and Security Privacy Challenges", Internet of Things, pp. 100107, 2019.
[4] Yadav, Vinay Surendra and A. R. Singh, A Systematic Literature Review of Blockchain Technology in Agriculture.
[5] Ghosh Soumalya, A. B. Garg, Sayan Sarcar, PSV S. Sridhar, Ojasvi Maleyvar and Raveesh Kapoor, "Krishi-Bharati: an interface for Indian farmer", Proceedings of the 2014 IEEE Students' Technology

Symposium, pp. 259- 263, 2014. 6. Potts Jason, ”Blockchain in Agriculture”, Available at SSRN 3397786, 2019.
[6] Hua, Jing, Xiujuan Wang, Mengzhen Kang, Haoyu Wang and Fei-Yue Wang, ”Blockchain based provenance for agricultural products: A distributed platform with duplicated and shared bookkeeping”, 2018 IEEE Intelligent Vehicles Symposium (IV), pp. 97-101, 2018. [7] A. Balasubramanian “Earths , Atmospheric and Ocean Sciences in August” 2017.
[8] Girish L “Crop Yield and Rainfall Prediction in Tumakuru District using Machine Learning” 2019.
[9] Ashwani Kumar Kushwaha, Sweta bhattachrya “crop yield prediction using agro algorithm in Hadoop” 2015. [10] N. K, Manju raju M.R, Ashwini, M. N, and D. Vishwakarma, “Crop prediction using machine learning approaches,” International Journal of Engineering Research and, vol. V9, no. 08, 2020.
[11] Archana Gupta, Dharmil Nagda, Pratiksha Nikhare, Atharva Sandbhor “Smart Crop Prediction using IoT and Machine Learning” 2020.
[12] Rushika Ghadge, Juilee Kulkarni, Pooja More, Sachee Nene, Priya R L “Prediction of Crop Yield using Machine Learning” 2018

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org
Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230395

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Prof. M.S. Khan

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 11, Issue 6 (November-December 2023).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Bhalerao Chaitrali, Bangar Gaurav, Kharat Sakshi, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org
Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230395

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Bhalerao Chaitrali

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 11, Issue 6 (November-December 2023).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Prof. M.S. Khan, Bangar Gaurav, Kharat Sakshi, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org

Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230395

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Bangar Gaurav

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 11, Issue 6 (November-December 2023).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Prof. M.S. Khan, Bhalerao Chaitrali, Kharat Sakshi, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org
Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230395

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Kharat Sakshi

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 11, Issue 6 (November-December 2023).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Prof. M.S. Khan, Bhalerao Chaitrali, Bangar Gaurav, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org
Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230395

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Pingale Yukta

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 11, Issue 6 (November-December 2023).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Prof. M.S. Khan, Bhalerao Chaitrali, Bangar Gaurav, Kharat Sakshi

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

[1]Prof. M.S. Khan, [2]Bhalerao Chaitrali, [3]Bangar Gaurav[3], [4]Kharat Sakshi, [5]Pingale Yukta

[1]Assistant Professor, [2,3,4,5]Students
Department of Information Technology
Matoshri College Of Engineering And Research Centre
Eklahare, Nashik

Abstract- The surveillance system employs state-of-the-art AI algorithms to process live video feeds, extracting meaningful insights from the complex dynamics of crowds. Furthermore, the incorporation of big data analytics facilitates the storage, manage ment, and rapid analysis of vast amounts of surveillance data. This not only enhances the real-time monitoring capabilities but also enables historical trend analysis for pre dictive modeling. Key components of the proposed system include a sophisticated camera network, edge computing capabilities for immediate processing of video data, and a centralized big data infrastructure. The AI models are trained to recognize abnormal crowd behavior, such as sudden movements, overcrowding, or potential se curity incidents. The system's real-time alerts empower security personnel to respond swiftly to emerging situations, thus improving overall public safety. The proposed real-time AI-enhanced crowd surveillance system with big data analytics represents a holistic approach to urban security, leveraging cutting-edge technologies to enhance situational awareness and response capabilities. By amalgamating the strengths of AI and big data, this system stands at the forefront of intelligent crowd monitoring, contributing to the creation of safer and more secure urban environments.

Keywords: Artificial Intelligence, surveillance system, real-time alerts, big data.

Published in IJIRMPS (E-ISSN: 2349-7300), Volume 12, Issue 3, May- June 2024

INTRODUCTION

The Project Idea of implementing a system for real-time AI-enhanced crowd surveillance with big data analytics is to revolutionize public safety in urban en vironments. This innovative approach combines advanced artificial intelligence techniques, including computer vision and deep learning, with the power of big data analytics to proactively address security challenges. The primary objective is to detect potential threats or abnormal crowd behavior in real-time, empow ering security personnel with immediate alerts and enabling swift intervention. By analyzing live video feeds with AI algorithms, the system enhances crowd management and control, allowing for the identification of overcrowding and facilitating timely interventions to ensure public safety. Furthermore, the inte gration of big data analytics provides valuable insights from historical surveil lance data, allowing for the identification of patterns, trends, and anomalies in crowd behavior. This information not only aids in the development of proac tive security measures for future events but also optimizes resource allocation for more efficient deployment of personnel and resources. The ultimate goal is to enhance situational awareness, maintain privacy and ethical standards, and create a scalable, adaptable system that continually evolves to meet emerging security challenges, thereby fostering safer and more secure urban environments.

LITERATURE SURVEY

[1], Every day, there are more crimes committed and criminals are on the loose, which is making people fear for their safety. The primary goal is to detect and deter illicit activity before it occurs. With the aid of cutting-edge technology, CCTV is commonly used in both private and public spaces. It is possible to control crime in this area, but human supervision is required to oversee it. It's difficult for a human to keep track of multiple screens at the same time. Human error is a possibility in many situations. To overcome this drawback, we stipulate a Deep Learning-based Real-Time Crime Detection Technique that analyzes real-time CCTV footage and alerts a nearby supervisor about the crime in the current region. The model tracks the movement of people and classifies it as aggressive or nonviolent behavior using the Multiple Object Detection with Localization technique. Any aggressive conduct filmed by the camera will be detected and instantaneously alerted by the system

K Kishore Kumar et al. [2] presently, the video surveillance system is an important virtue for identifying crimes. The past works related to crime detection using video surveillance are discussed here. The goal of this investigation is to provide a literature review about crime activity recognition using different techniques. The main demerits of video surveillance are facial utterance recognition, and the method consumes more time for detecting the crime. An alert system provided in video surveillance improves crime prediction and also reduces crime activity. This paper presents an overview of present and past reviews for developing future research. The published journals from 2000-2020 were analyzed to know about the video surveillance and crime detection methods in different sectors. A review of the analyzed researchers and their techniques is available in this paper. This survey is useful to improve the crime detection techniques using video surveillance. Moreover, it is a useful tool to gather information

Sharmila Chackravarthy et al. [3] the quick and accurate identification of criminal activity is paramount to securing any residence. With the rapid growth of smart cities, the integration of crime detection systems seeks to improve this security. In the past a strong reliance has been put on standard video surveillance in order to achieve this goal. This often creates a backlog of video data that must be monitored by a supervising official. For large urban areas, this creates a increasingly large workload for supervising officials which leads to an increase in error rate. Solutions have been implemented to help reduce the workload. Currently, auto regressive models have been used to better forecast criminal acts, but also have a list of shortcomings. We propose a solution of using neural networks in combination with a Hybrid Deep Learning algorithm to analyze video stream data. Our system will be able to quickly identify and assess criminal activity which will in turn reduce workloads on the supervising officials. When implemented across smart city infrastructure it will allow for a efficient and adaptable crime detection system.

AIM & OBJECTIVES

• The primary goal is to improve security by detecting and preventing potential threats or incidents in crowded areas such as airports, train stations, stadiums, and public events.

Utilize AI algorithms to continuously monitor live video feeds from surveillance cameras in crowded areas, enabling immediate response to any suspicious activ ities or emergencies.

Utilize big data analytics to analyze historical crowd behavior patterns and predict future events or crowd movements. This helps in proactive planning and resource allocation for managing crowd flow and preventing incidents.

MOTIVATION

The scope of the AI-Powered Video Surveillance System project encompasses the development and implementation of a comprehensive video surveillance system powered by artificial intelligence. This system will focus on the real-time detection of falls, overcrowding, , fires, and within the surveillance area. It will include the deployment of advanced computer vision algorithms and machine learning models to enable accurate and timely identification of these critical events. The project's scope extends to the integration of this system with various video input sources, including both recorded video footage and live web cameras. This adaptability ensures that the system can be applied across a wide range of scenarios, from smart city management to transportation safety and the protection of critical infrastructure and public events. The ultimate goal is to enhance safety and security by providing real-time alerts and responses, thus reducing response times and mitigating potential harm in a variety of settings.

APPLICATION:
• Smart Cities
• Transportation and Traffic Management
• Public Events
• Retail and Commercial Security
• Critical Infrastructure Protection
• Healthcare
• Education
• Airports and Transportation Hubs
• Industrial Facilities
• Public Transportation
• Residential Security

SYSTEM ARCHITECTURE

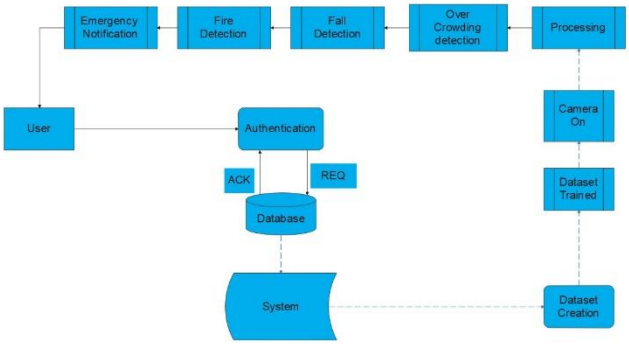


Fig -1: System Architecture Diagram

ADVANTAGES
• Early Incident Detection
• Rapid Response
• Proactive Crowd Management
• Enhanced Public Safety
• Customizability
• Versatility
• Scalability

FUNCTIONAL & NON-FUNCTIONAL REQUIREMENTS
Functional Requirements
The system must be capable of processing live video feeds in real-time.
It should enable historical trend analysis for predictive modeling.
The system should enhance real-time monitoring capabilities.
Nonfunctional Requirements
Performance Requirements:
• Real-time Processing: The system must process video streams in real-time, with minimal latency.
• Scalability: It should be able to handle a large number of cameras and video feeds simultaneously.
• Throughput: Achieve a high throughput of video data for analysis
The system should generate real-time alerts for abnormal crowd behavior such as sudden movements, overcrowding, or potential security incidents.
Safety Requirements:
The system must employ robust data security measures to protect sensitive user data,. Data should be encrypted during transmission and storage to prevent unauthorized access or data breaches

Security Requirements

• Data Encryption: Implement strong encryption to secure video feeds, incident data, and communication between system components.
• Access Control: Enforce strict access controls to prevent unauthorized access to the system.
• Authentication and Authorization: Ensure that only authorized users and systems can configure and interact with the surveillance system.

SYSTEM REQUIREMENTS

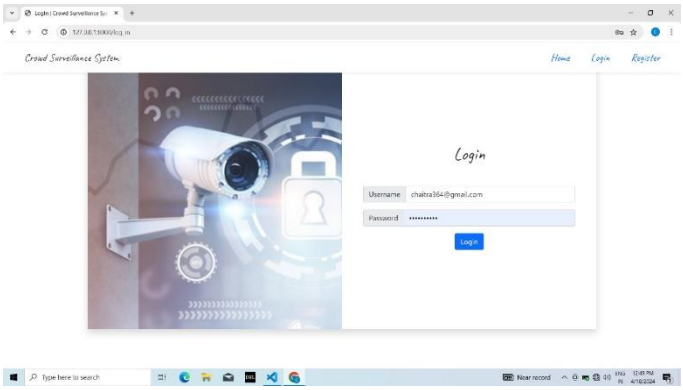
Software Used:

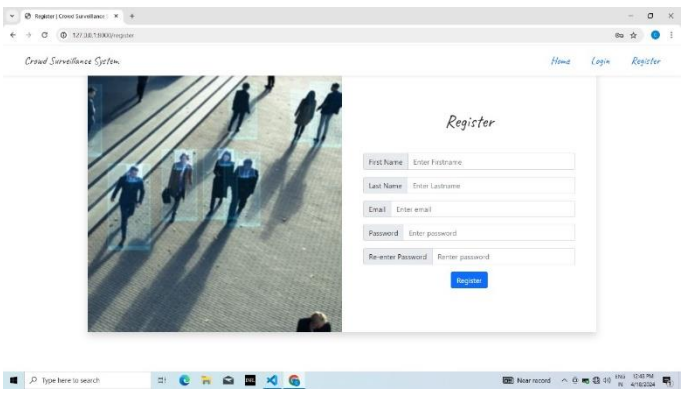
1. Technology Used: Python, Django
2. IDE: VS code
3. Operating System: Windows 8 or above

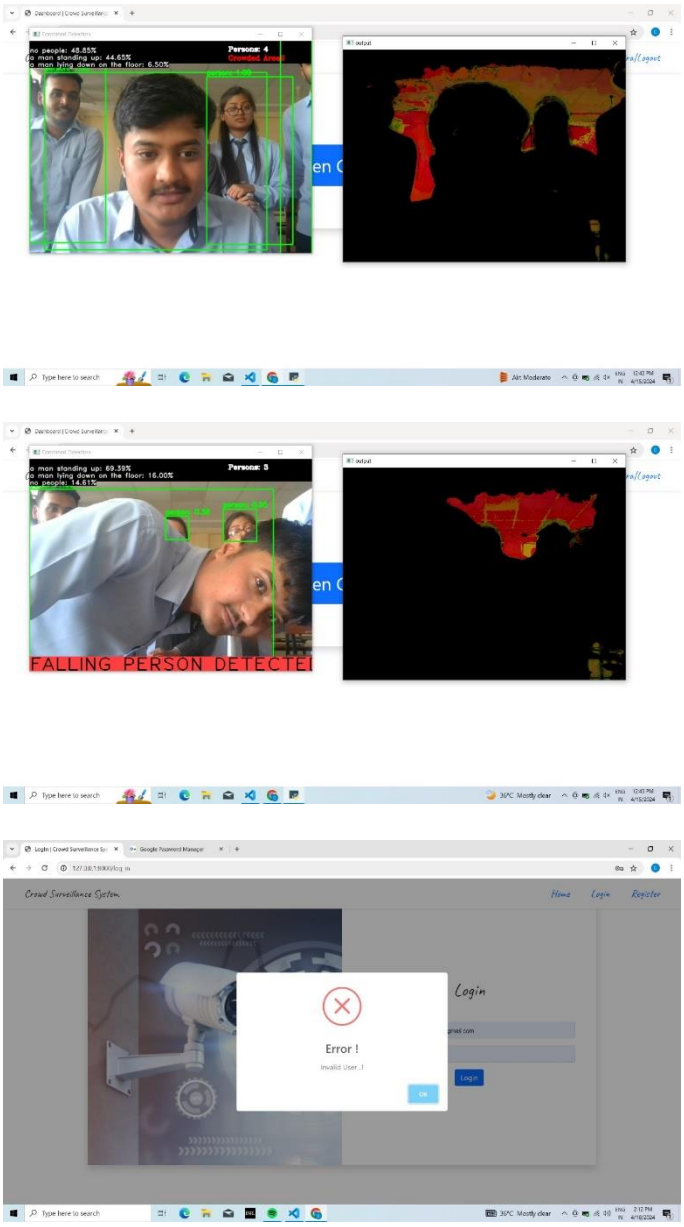
Hardware Used:

1. Hard Disk: 200 GB
2. RAM: 4 GB
3. Processor: Intel Pentium i5 and above

RESULT







CONCLUSION

In conclusion, the integration of real-time AI-enhanced crowd surveil lance with big data analytics represents a significant leap forward in bolstering urban security and public safety. This synergistic approach harnesses the power of artificial intelligence, particularly computer vision and deep learning, to an alyze live video feeds, detect potential threats, and monitor crowd behavior dynamically. The incorporation of big data analytics further amplifies the sys tem's capabilities, enabling the extraction of valuable insights from historical surveillance data to inform proactive security measures and optimize resource allocation. While the implementation of such a system introduces complexi ties, including privacy considerations, legal compliance, and technical infras tructure challenges, the potential benefits in terms of early threat detection, rapid response capabilities, and overall situational awareness are substantial. Striking a balance between security imperatives and privacy rights, continuous improvement of AI models, and adaptation to diverse urban environments are paramount for the success of this innovative surveillance paradigm. As tech nology evolves, the continual refinement of these systems will be essential to staying ahead of emerging security challenges, ultimately contributing to the creation of safer and more secure urban spaces.

REFERENCES:

1. A. Shah, S. Kumar, and P. Singh, "Real-time crowd behavior analysis using deep learning," 2020 IEEE 17th India Council International Conference (INDICON), Kharagpur, India, 2020, pp. 1-6. [DOI: 10.1109/INDICON50945.2020.9343905]

2. T. A. Habeeb, A. I. Idowu, A. A. Alreshidi and A. Alshammari, "Smart Crowd Management: An Analysis on Automated Surveillance Techniques Using Deep Learning Models," 2020 International Conference on Information and Communication Technology for Sustainable Development (ICT4SD), Dubai, United Arab Emirates, 2020, pp. 1-6. [DOI: 10.1109/ICT4SD50287.2020.9274825]
3. M. Al-Qassas, M. A. Ali and A. K. Sangaiah, "Deep learning techniques for crowd analysis: A comprehensive review," 2020 IEEE/ACS 17th International Conference on Computer Systems and Applications (AICCSA), Antalya, Turkey, 2020, pp. 1-8. [DOI: 10.1109/AICCSA50417.2020.9360281]
4. A. Awasthi, A. K. Pandey, A. K. Singh and S. Maurya, "Real-Time Monitoring and Anomaly Detection in Public Places Using Computer Vision," 2020 11th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Kharagpur, India, 2020, pp. 1-6. [DOI: 10.1109/ICCCNT49239.2020.9225436]
5. K. Ganesh, V. M. Thakare and S. Chaudhari, "An Efficient and Intelligent Video Surveillance System for Crowd Monitoring and Crowd Counting using Deep Learning," 2020 7th International Conference on Computing for Sustainable Global Development (INDIACom), New Delhi, India, 2020, pp. 1863-1868. [DOI: 10.1109/INDIACOM48259.2020.9152703]
6. A. Yadav and S. Gautam, "Crowd behavior analysis using machine learning techniques: A review," 2020 4th International Conference on Inventive Systems and Control (ICISC), Coimbatore, India, 2020, pp. 151-156. [DOI: 10.1109/ICISC50120.2020.9314419]
7. R. Bhavsar, S. K. Patel, B. N. Patel and R. Modi, "A Review on Deep Learning Techniques for Crowd Behavior Understanding," 2020 International Conference for Emerging Technology (INCET), Nadiad, India, 2020, pp. 1-5. [DOI: 10.1109/INCET50156.2020.9353249]
8. N. M. Nisar, I. Nisar and W. Shah, "A Survey of Deep Learning Techniques for Crowd Analysis," 2020 IEEE 16th International Conference on Emerging Technologies (ICET), Islamabad, Pakistan, 2020, pp. 1-6. [DOI: 10.1109/ICET49805.2020.9278651]
9. K. P. Nair, M. M. Raghavendra and A. Das, "Recent Advances in Crowd Behavior Analysis: A Survey," 2020 International Conference on Advances in Computing, Communication Control and Networking (ICACCCN), Bangalore, India, 2020, pp. 279-283. [DOI: 10.1109/ICACCCN48820.2020.9074610]
10. M. H. Al-Tamimi, M. A. Ali and A. K. Sangaiah, "An overview on recent advances in crowd behavior analysis," 2020 International Conference on Engineering and Emerging Technologies (ICEET), Lahore, Pakistan, 2020, pp. 1-5. [DOI: 10.1109/ICEET48874.2020.9118297]
11. V. B. Patil, P. R. Deshmukh, P. R. Borekar and P. A. Deshpande, "Real-time crowd detection and management system using deep learning and computer vision," 2020 International Conference on Smart City and Emerging Technology (ICSCET), Mumbai, India, 2020, pp. 1-6. [DOI: 10.1109/ICSCET48435.2020.9084852]
12. N. S. Kadlaskar, S. V. Khot, A. A. Surve and M. A. U. Mulla, "A Review on Anomaly Detection in Crowd Video Surveillance using Deep Learning," 2020 3rd International Conference for Convergence in Technology (I2CT), Pune, India, 2020, pp. 1-6. [DOI: 10.1109/I2CT49388.2020.9051293]
13. S. L. Nalamwar, A. K. Tiwari, P. B. Meshram and S. S. Dorle, "Smart crowd monitoring system using deep learning," 2020 International Conference for Emerging Technology (INCET), Nadiad, India, 2020, pp. 1-5. [DOI: 10.1109/INCET50156.2020.9353270]
14. A. Mittal and S. S. Kathuria, "A Review Paper on Techniques of Crowd Behavior Analysis," 2020 4th International Conference on Inventive Computation Technologies (ICICT), Coimbatore, India, 2020, pp. 1036-1039. [DOI: 10.1109/ICICT49075.2020.9105960]
15. N. V. Thakare, V. M. Thakare and S. Chaudhari, "Crowd Density Estimation using Deep Learning for Smart City Applications," 2020 International Conference for Emerging Technology (INCET), Nadiad, India, 2020, pp. 1-5. [DOI: 10.1109/INCET50156.2020.9353247]
16. A. S. Kalbande, S. R. Suralkar, A. M. Ingale and V. R. Satpute, "Real-time Crowd Density Estimation using Deep Learning," 2020 International Conference for Emerging Technology (INCET), Nadiad, India, 2020, pp. 1-5. [DOI: 10.1109/INCET50156.2020.9353264]
17. P. V. Balbudhe, V. M. Thakare and S. Chaudhari, "Crowd Density Estimation using Deep Learning Techniques for Crowd Monitoring," 2020 International Conference for Emerging Technology (INCET), N

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org
Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230623

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Prof. M.S. Khan

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 12, Issue 3 (May-June 2024).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Bhalerao Chaitrali, Bangar Gaurav, Kharat Sakshi, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org
Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230623

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Bhalerao Chaitrali

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 12, Issue 3 (May-June 2024).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Prof. M.S. Khan, Bangar Gaurav, Kharat Sakshi, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org
Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230623

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Bangar Gaurav

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 12, Issue 3 (May-June 2024).

Co-Author(s): Prof. M.S. Khan, Bhalerao Chaitrali, Kharat Sakshi, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org

Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230623

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Kharat Sakshi

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 12, Issue 3 (May-June 2024).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Prof. M.S. Khan, Bhalerao Chaitrali, Bangar Gaurav, Pingale Yukta

INTERNATIONAL JOURNAL

of Innovative Research in Engineering & Multidisciplinary Physical Sciences

IJIRMPS • E-ISSN 2349-7300 • ijirmps.org • editor@ijirmps.org

Widely Indexed Open Access Peer Reviewed (Refereed) Online Scholarly / Academic Journal

CERTIFICATE OF PUBLICATION

IJIRMPS

Paper # 230623

The editorial board of **IJIRMPS** is hereby awarding the certificate to

Pingale Yukta

in recognition of publication of the paper titled

Real Time AI Enhanced Crowd Surveillance with Big Data Analytics

published in Volume 12, Issue 3 (May-June 2024).

IJIRMPS E-ISSN: 2349-7300

Co-Author(s): Prof. M.S. Khan, Bhalerao Chaitrali, Bangar Gaurav, Kharat Sakshi

NetLeap
IT Training & Solutions
Presents

kaushalya

In Association with

SABEDOR
Software India (SSI)

Powered by

GWS Fiber
GWS Web

Associate Sponsors

महाराष्ट्र टाइम्स
PROFOUND
Edutech Private Limited
RAYBOT
CAFE JUNCTION
NDI
McDonald's
RAG RAG MEIN NASHIK CITY FM BOLE TOH
Radio City
ANI
HANSITA

Guru Gobind Singh College of Engineering and Research Centre, Nashik
Computer Engineering Student's Association
ESTD. : 2013

kaushalya

29th Feb & 1st March 2024

National Level Competition

Certificate

This is to certify that Mr./Ms. Gaurav Bangar
of Matashri has participated in Project competition Event at National Level Competition Organized by Guru Gobind Singh College of Engineering And Research Centre, Nashik for academic year 2023-2024 and secured Participant position.

Congratulations...!

Prof.Pramod Patil	Prof.Sandeep Shukla	Dr.Neelkanth G. Nikam
Event Co-ordinator	HOD Comp.Department	Principal GCOERC

NetLeap
IT Training & Solutions
Presents

kaushalya

In Association with

SABEDOR
Software India (SSI)

Powered by

GWS Fiber
GWS Web

Associate Sponsors

महाराष्ट्र टाइम्स
PROFOUND
Edutech Private Limited
RAYBOT
CAFE JUNCTION
NBT
McDonald's
RAG RAG MEIN NASHIK CITY FM BOLE TOH
Radio City
HANSITA

Guru Gobind Singh College of Engineering and Research Centre, Nashik
Computer Engineering Student's Association
ESTD. : 2013

kaushalya

29th Feb & 1st March 2024

National Level Competition

Certificate

This is to certify that Mr./Ms. chaitrali bhalerao
of Matoshri has
participated in project competition Event at National Level
Competition Organized by Guru Gobind Singh College of Engineering And Research
Centre, Nashik for academic year 2023-2024 and secured Participant
position.

Congratulations...!

Prof.Pramod Patil
Event Coordinator

Prof.Sandeep Shukla
HOD Comp.Department

Dr.Neelkanth G. Nikam
Principal GGSREC

NetLeap
IT Training & Solutions
Presents

kaushalya

In Association with

SABEDOR
Software India (SSI)

Powered by

GWS Fiber
GWS Web

Associate Sponsors

महाराष्ट्र टाइम्स
PROFOUND
Edutech Private Limited
RAYBOT
JUNCTION
McDonald's
HANSITA

Guru Gobind Singh College of Engineering and
Research Centre, Nashik
Computer Engineering Student's Association
ESTD. : 2013

kaushalya

29th Feb & 1st March 2024

National Level Competition

Certificate

This is to certify that Mr./Ms. Sakshi khamt
of Matoshri has
participated in Project competition Event at National Level
Competition Organized by Guru Gobind Singh College of Engineering And Research
Centre, Nashik for academic year 2023-2024 and secured Participant
position.

Congratulations...!

Prof.Pramod Patil
Event Co-ordinator

Prof.Sandeep Shukla
HOD Comp.Department

Dr.Neelkanth G. Nikam
Principal GCOERC

NetLeap
IT Training & Solutions
Presents

kaushalya

In Association with

SABEDOR
Software India (SSI)

Powered by

GWS Fiber
GWS Web

Associate Sponsors

महाराष्ट्र टाइम्स
PROFOUND
Edutech Private Limited
RAYBOT
CAFE JUNCTION
NBH
McDonald's
RAG RAG MEIN NASHIK CITY FM BOLE TOH
Radio City
ANI
HANSITA

Guru Gobind Singh College of Engineering and Research Centre, Nashik
Computer Engineering Student's Association
ESTD. : 2013

kaushalya

29th Feb & 1st March 2024

National Level Competition

Certificate

This is to certify that Mr./Ms. Yukta Pingale
of Matoshri, Nashik has
participated in Project competition Event at National Level
Competition Organized by Guru Gobind Singh College of Engineering And Research
Centre, Nashik for academic year 2023-2024 and secured Participant
position.

Congratulations...!

Prof.Pramod Patil
Event Co-ordinator

Prof.Sandeep Shukla
HOD Comp Department

Dr.Neelkanth G. Nikam
Principal GCOERC