

# AI-Based Crowd Prediction System

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## Abstract

The AI Crowd Prediction System is designed to analyze crowd size and predict possible safety risks during events. The system allows users to enter event details such as expected crowd count, event type, and time slot to generate crowd density and risk predictions. It also supports image-based crowd estimation using computer vision techniques. Based on the crowd size, the system classifies the situation as Low, Medium, or High density and provides safety recommendations such as increasing security if needed. It also predicts short-term crowd movement trends and displays results using charts. All predictions are stored for future reference and analysis. This system helps in better event management, public safety monitoring, and decision-making

**Keywords**— Artificial Intelligence, Crowd Prediction, Computer Vision, OpenCV, FlaskWeb Application, SQLite Database, Event Safety Management.

## I. INTRODUCTION

Managing large crowds during public events, festivals, and functions has become a major challenge due to increasing population and event. Uncontrolled crowds can lead to safety risks such as overcrowding, stampedes, and delays in emergency response. Traditional crowd monitoring methods mostly rely on manual observation, which is time-consuming, inaccurate, and ineffective for real-time decision-making. Therefore, there is a strong need for an intelligent and automated system to predict crowd behavior and assess risk levels in advance. The **AI-Based Crowd Prediction System** is designed to address these challenges by using artificial intelligence and computer vision techniques to analyze crowd size and density. The system collects event details such as expected crowd count, event type, and time slot, and also supports image-based crowd estimation. Using this information, the system calculates crowd density, predicts short-term crowd movement trends, and classifies the situation into Low, Medium, or High-density levels. Based on the predicted crowd density, the system determines risk levels such as Safe, Warning, or Dangerous and provides suitable safety and security recommendations.

## II. SYSTEM ARCHITECTURE

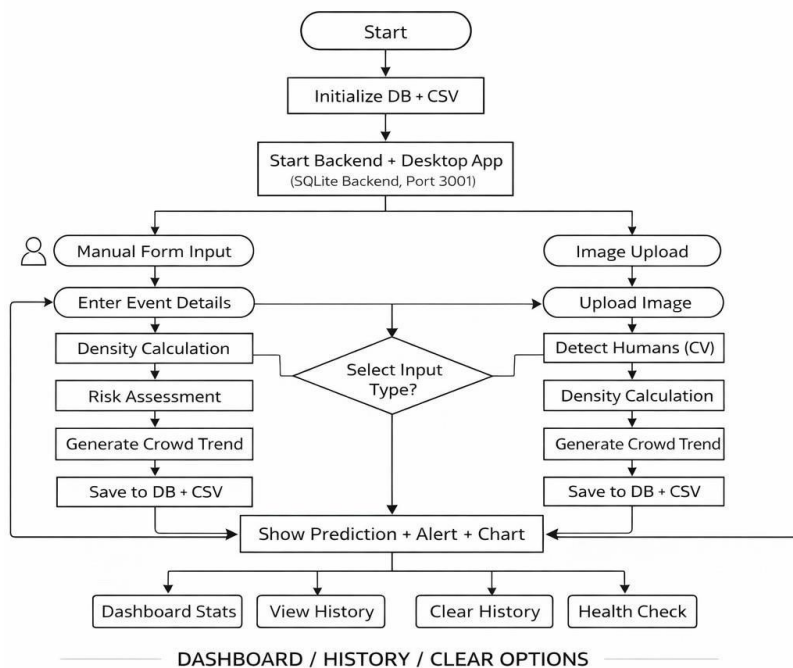
The architecture of the **AI-Based Crowd Prediction System** follows a **three-layer architecture** consisting of the Presentation Layer, Application Layer, and Data Layer. The Presentation Layer includes the user interface built using HTML, CSS, and JavaScript, which allows users to input event details and upload crowd images. The Application

Layer is developed using Python and Flask, which processes user requests, performs crowd density calculations, risk evaluation, image analysis using OpenCV, and trend forecasting. The Data Layer stores prediction results, event information, and historical data using SQLite and CSV storage. The system integrates all modules through REST APIs and displays results using interactive charts generated with Chart.js. This architecture ensures efficient communication between the frontend interface, backend logic, and database storage for real-time crowd prediction and analysis

### III. DATA FLOW DIAGRAM (DFD LEVEL 0)

A Data Flow Diagram (DFD) is a graphical representation of the "flow" of information within a system. It visualizes how data moves through processes, how it's transformed, and where it's stored. DFDs are essential tools for system analysis and design, providing a clear and structured way to understand and document the flow of data.

#### AI-Based Crowd Prediction System



### IV. METHODOLOGY

The proposed AI-Based Crowd Prediction System is developed to analyze and predict crowd density during public events using both manual input data and image-based analysis. Initially, users provide event details such as event name, location, expected crowd count, event type, and time slot through a web interface. The system then processes this data using rule-based algorithms to classify crowd density into Low, Medium, or High categories based on predefined thresholds. Additionally, the system supports image-based crowd estimation using computer vision techniques implemented through the OpenCV library. Uploaded images are converted to grayscale and processed using the Haar Cascade human detection algorithm to identify and count individuals in the crowd. Based on the calculated crowd density and contextual factors such as event type and time slot, the system evaluates the risk level as Safe, Warning, or Dangerous and generates appropriate safety recommendations. Furthermore, a mathematical growth-factor model is applied to forecast short-term crowd movement trends, helping event organizers anticipate possible congestion. All prediction results are stored in an SQLite database and visualized using interactive charts to support effective monitoring and decision-making.

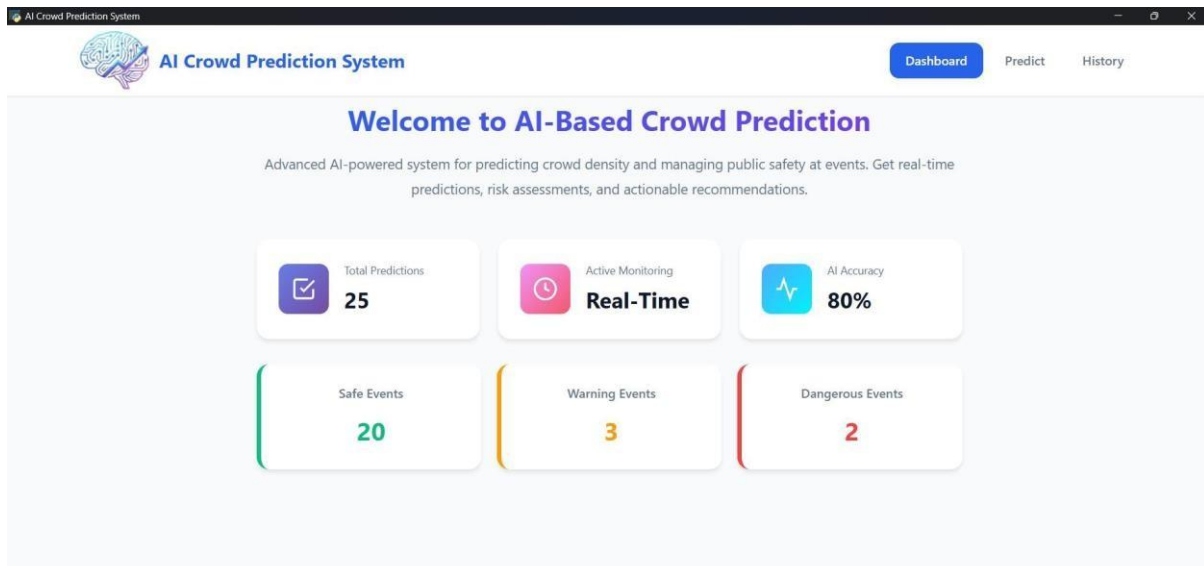
## VI. CONCLUSION

The AI-Based Crowd Prediction System represents a significant advancement in intelligent event management and public safety monitoring. In an era where large-scale gatherings are increasingly common, traditional crowd supervision methods are no longer sufficient to ensure proactive risk prevention. This project successfully addresses those limitations by integrating artificial intelligence logic, computer vision techniques, predictive modeling, and real-time data visualization into a unified, automated platform.

The system is designed to move beyond reactive monitoring and introduce predictive intelligence into crowd management. By combining manual event inputs with image-based crowd estimation using OpenCV, the system provides accurate crowd density classification into Low, Medium, and High categories. This classification is not merely descriptive but forms the foundation for contextual risk evaluation. Based on event type, time slot, and estimated crowd size, the system determines whether the situation is Safe, Warning, or Dangerous, thereby enabling authorities to take preventive measures before risks escalate.

One of the major strengths of the system is its rule-based AI logic, which ensures consistent and explainable decision-making. Unlike black-box models that provide outputs without transparency, this system clearly defines density thresholds, growth factors, and contextual evaluation rules. This improves trust, interpretability, and academic validity. Furthermore, the predictive trend forecasting mechanism estimates short-term crowd movement using mathematical growth factor models, helping organizers anticipate congestion within the next 30 minutes to 2 hours.

### SAMPLE SCREEN:



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Completed by Lathika S & Team

AI Crowd Prediction System

Dashboard Predict History

### Generate AI Prediction

**Event Information**

Event Name: Anirudh Concert

Location: Bangalore

Expected Crowd Count: 5000


Event Type: Concert

Time Slot: Night

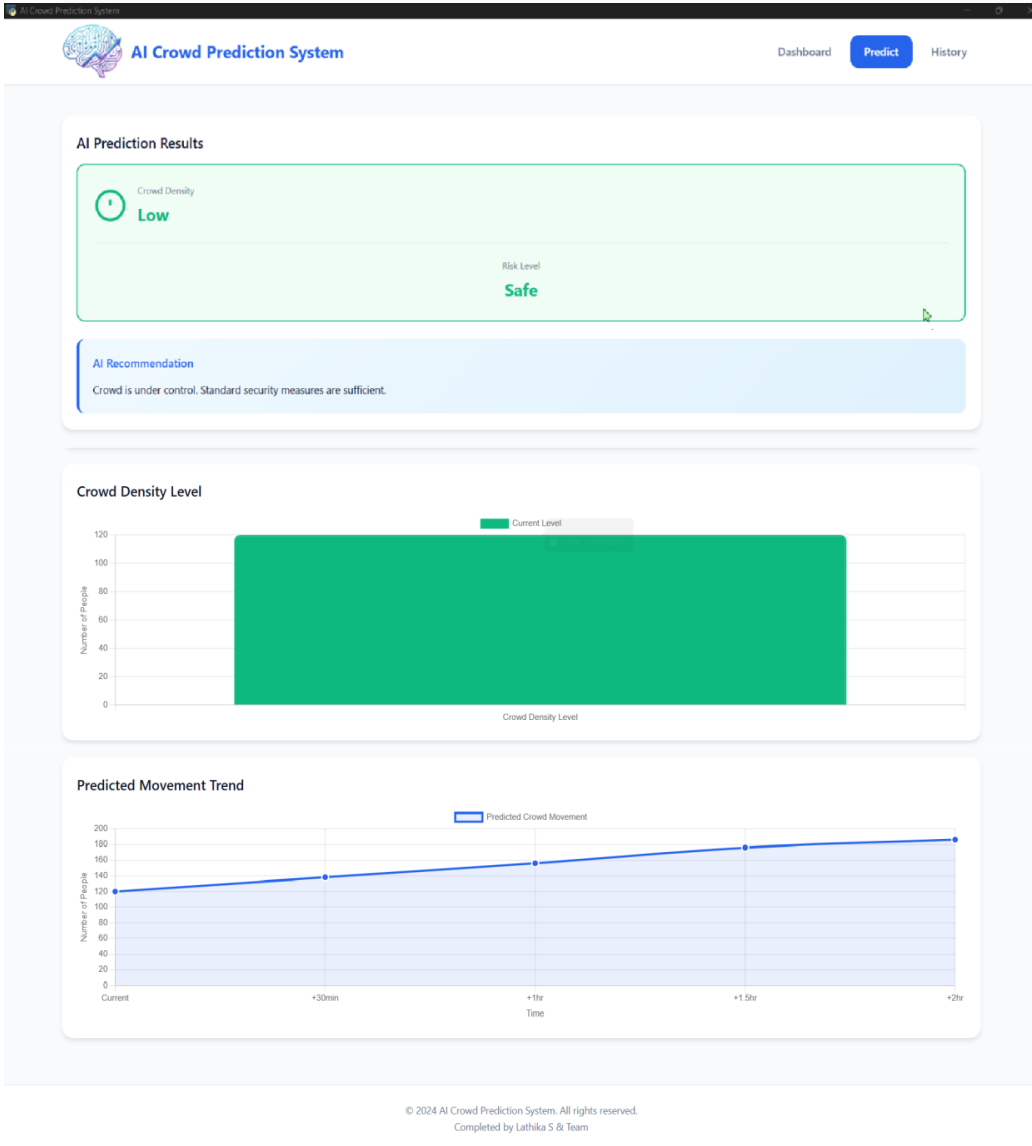
Generate AI Prediction

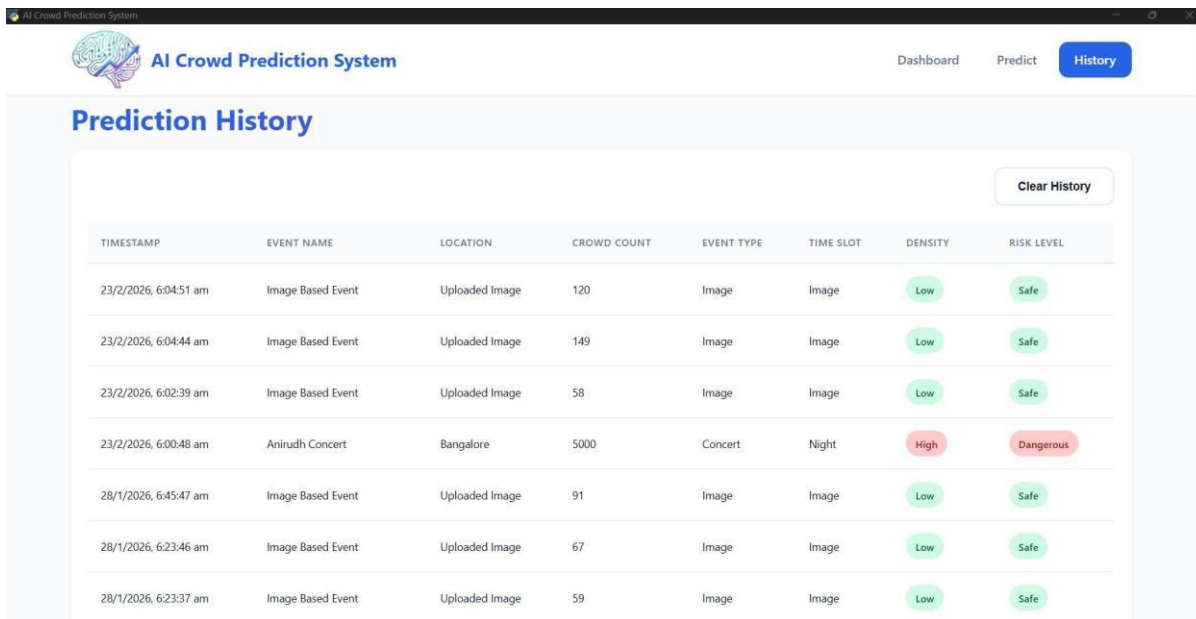
**Upload Crowd Image**

Choose File images (3).jpg



Predict from Image





The screenshot shows the 'AI Crowd Prediction System' interface. At the top, there are navigation tabs for 'Dashboard', 'Predict', and 'History'. The main heading is 'Prediction History'. A 'Clear History' button is located in the top right corner of the table area. The table contains the following data:

TIMESTAMP	EVENT NAME	LOCATION	CROWD COUNT	EVENT TYPE	TIME SLOT	DENSITY	RISK LEVEL
23/2/2026, 6:04:51 am	Image Based Event	Uploaded Image	120	Image	Image	Low	Safe
23/2/2026, 6:04:44 am	Image Based Event	Uploaded Image	149	Image	Image	Low	Safe
23/2/2026, 6:02:39 am	Image Based Event	Uploaded Image	58	Image	Image	Low	Safe
23/2/2026, 6:00:48 am	Anirudh Concert	Bangalore	5000	Concert	Night	High	Dangerous
28/1/2026, 6:45:47 am	Image Based Event	Uploaded Image	91	Image	Image	Low	Safe
28/1/2026, 6:23:46 am	Image Based Event	Uploaded Image	67	Image	Image	Low	Safe
28/1/2026, 6:23:37 am	Image Based Event	Uploaded Image	59	Image	Image	Low	Safe

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