Maha Kumbh Hackathon(2025)

Team Neuron

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THEME: Security , Surveillance, Mobility & Crowd Management using emerging tech solutions

Objectives:

✓**Crowd Density Monitoring:** Using deep learning and computer vision, the system will continuously analyze video feeds to determine crowd density and identify areas where congestion may occur, allowing authorities to take preventive measures.

✓**Chaos Prevention:** Through video analytics, the system will detect any signs of chaos or disturbances within the crowd and trigger alerts to notify authorities, enabling them to intervene promptly and prevent the situation from escalating.

✓**Geospatial Targeted Notifications:** By integrating geospatial data, the system will be able to send notifications and alerts to individuals based on their location, providing them with relevant information and instructions tailored to their proximity to specific events or areas

✓**Restricted Area Access Control:** Using face recognition technology, the system will authenticate officials and grant them access to restricted areas, enhancing security by ensuring that only authorized personnel are allowed entry.

✓**Traffic Management:** Deep learning algorithms and computer vision techniques will be employed to monitor traffic flow near crowded regions, enabling authorities to optimize traffic signals, reroute vehicles, and prevent congestion to ensure smooth movement of vehicles.

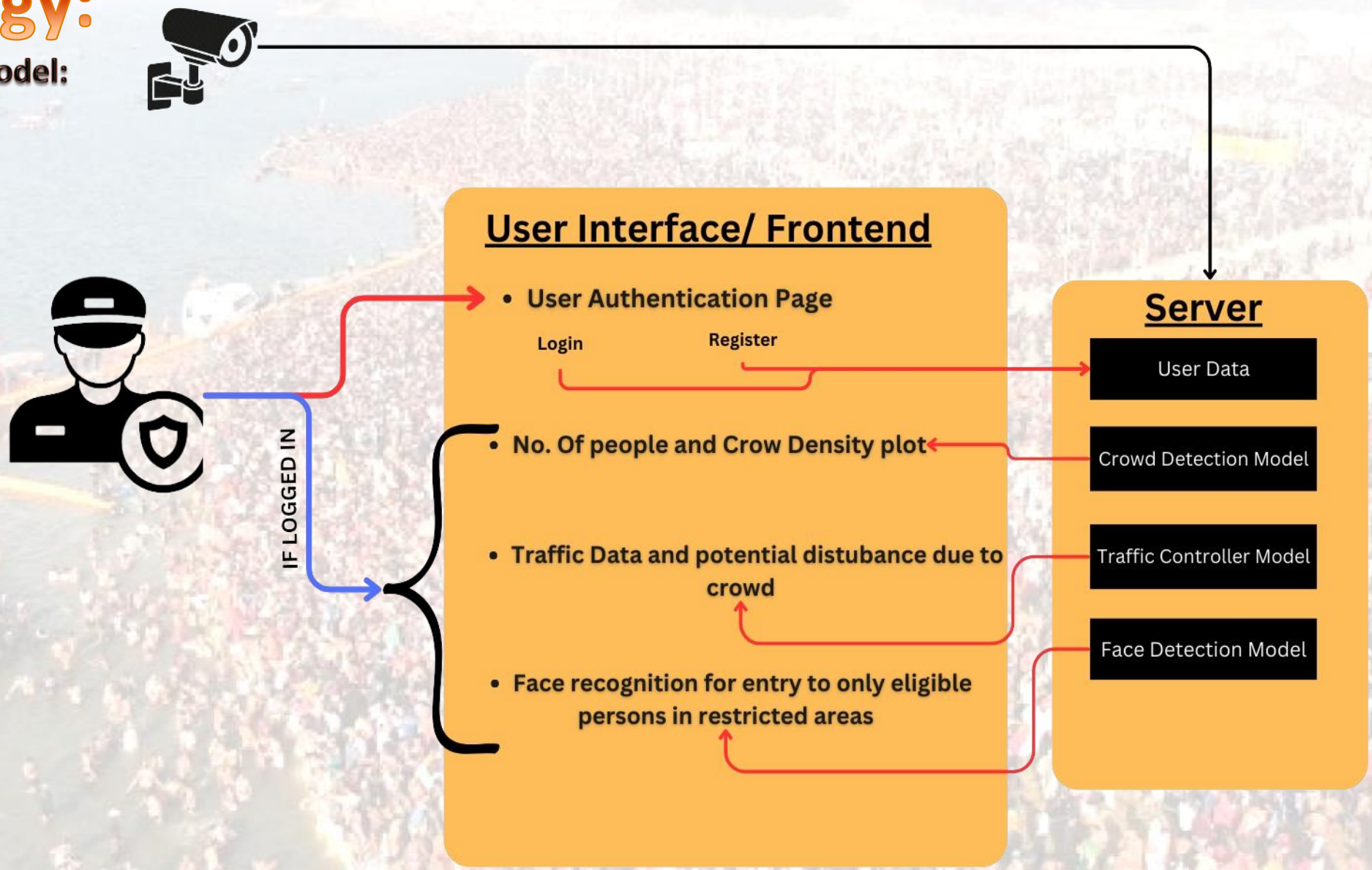
✓**Data Analysis:** Historical data from previous events and relevant sources will be analyzed to identify patterns, trends, and potential challenges, allowing for the refinement and optimization of crowd management strategies for future events.

Methodology:

Technology Required:

Methodology:

Workflow of the Model:



Advantages:

✓**Enhanced Safety:** By employing deep learning and computer vision for crowd analysis and surveillance, the system can identify potential congestion areas and detect signs of chaos in real-time, allowing authorities to take proactive measures to prevent accidents or stampedes.

✓**Efficient Crowd Management:** Utilizing advanced technologies enables efficient crowd management by providing insights into crowd density and flow patterns. This allows for better resource allocation and crowd control strategies.

✓**Timely Intervention:** The alert system integrated with video analytics ensures timely intervention in case of any chaotic situations, enabling authorities to respond promptly and prevent the escalation of conflicts or disturbances.

✓**Geospatial Targeting:** Leveraging geospatial data for targeted notifications allows authorities to disseminate relevant information to individuals based on their location, enhancing communication and coordination during large-scale events.

✓**Secure Access Control:** Implementing face recognition technology ensures secure access control to restricted areas, enhancing security by allowing only authorized personnel entry.

✓**Efficient Traffic Management:** Using deep learning and computer vision for traffic analysis enables the prevention of traffic issues near crowded regions, ensuring smooth traffic flow and minimizing congestion.

✓**Informed Decision Making:** Data collection and analysis from previous events provide valuable insights and help in informed decision-making for future crowd management strategies, allowing for continuous improvement and optimization of the system.

✓**Scalability:** The project's modular design allows for scalability, making it adaptable to various event sizes and locations with minimal adjustments.

Possibility of the Implementation considering the massive crowd

Scalability: The system can be designed to scale according to the size of the crowd and the area to be monitored. By utilizing cloud-based infrastructure and distributed computing, the system can handle large volumes of data and processing requirements efficiently.

Real-Time Processing: Advanced technologies such as deep learning and computer vision enable real-time processing of video feeds and data streams. This allows for immediate analysis of crowd dynamics and timely decision-making by authorities.

Robust Infrastructure: Deploying surveillance cameras, sensors, and communication networks in strategic locations ensures comprehensive coverage of the event venue. Robust infrastructure supports seamless data transmission and communication between system components.

High-Performance Computing: Utilizing high-performance computing resources accelerates data processing and analysis tasks, enabling the system to handle the computational demands of crowd monitoring, traffic analysis, and data collection effectively.

Redundancy and Failover Mechanisms: Implementing redundancy and failover mechanisms ensures system reliability and continuity of operations, even in the event of hardware failures or network disruptions. Redundant servers, backup systems, and data replication mechanisms enhance system resilience.

Optimized Algorithms: Developing optimized algorithms for crowd analysis, traffic management, and surveillance minimizes computational complexity and maximizes efficiency. This allows the system to operate effectively even under heavy load conditions.

Adaptive Strategies: Implementing adaptive strategies for crowd management allows the system to dynamically adjust its operations based on changing crowd dynamics and environmental conditions. This flexibility ensures effective response to evolving situations during large-scale events.

Expertise with team:

Harshit Shrivastav
Backend

Pratap Kumar
Object Detection/Computer Vision

Hitanshu Gavri
Frontend and UI

Mayank Raj
Database Management

Abhijeet Kr. Trivedi
Data Collection and analysis

Soumyabrata Das
Machine learning and Software Testing

Implementation requirements

- **Hardware Infrastructure:**
  - Surveillance Cameras: High-resolution cameras strategically placed to cover the entire event venue.
  - Computing Hardware: Servers or cloud infrastructure capable of handling real-time video processing, data analysis, and storage.
  - Networking Equipment: Reliable network infrastructure to facilitate data transmission between cameras, servers, and other system components.
- **Software Components:**
  - Object Detection and Computer Vision Algorithms: algorithms for crowd analysis, object detection, and tracking to monitor crowd density and movement.
  - Video Analytics Software: Software for analyzing video feeds in real-time, detecting anomalies, and triggering alerts.
  - Face Recognition System: face recognition algorithms for access control to restricted areas.

  Geospatial Data Processing: Software for processing and analyzing geospatial data to deliver targeted notifications based on location.
- **Data Management and Storage:**
  - Data Collection: Set up mechanisms for collecting real-time data from surveillance cameras, sensors, and other sources.
  - Data Storage: a robust data storage solution capable of handling large volumes of video footage, geospatial data, and historical event data.
  - Data Security: measures to ensure the security and privacy of collected data, including encryption, access controls, and data anonymization techniques.

Time plan of the actual implementation

What we have done Till Now??

- Gathered valuable information and Data regarding Mahakumbh through various articles, reports

- Develop a detailed project plan, including milestones and timelines.

- Gathered data of crowds from various sources including previous organizations of Kumbh and trained model for detecting the number of peoples in realtime.

What's Next and when ??

- Data collection and computer vision model design for 'Traffic Control System' and 'Face Recognition System'**. (By mid March).**

- Integrating the model with Web interface to make it use friendly. **(By Mid May)**

- Deployment of the Project. **(By June End)**

Estimated Cost of Implementation:

Hardware Infrastructure: This could range from tens of lakhs to crores INR, depending on the number and quality of *surveillance cameras, sensors, servers, networking equipment, and storage devices* required.

Software Development: Software development costs can vary widely based on the complexity of the system and the expertise required. This could range from thousands to lakhs, including licensing fees, deploymentcosts, and customization expenses.

Data Management: Expenses related to data storage, backup solutions, and management tools could range from INR 5 to 50 Lakhs, depending on the volume of data and the chosen storage infrastructure.

Infrastructure Setup: Setting up infrastructure for data processing, analysis, and communication could cost from ₹10 lakhs to ₹1 crore+, including expenses related to server deployment, network infrastructure, cloud computing services, and cybersecurity measures.

Testing and Validation: Costs associated with testing tools, equipment, and personnel for testing and validation could cost lakhs, as intense testing is required for the project to be deployed.

Contingency and Miscellaneous Costs: Budgetary reserves for unforeseen expenses and miscellaneous costs could add an additional 10-20% to the total estimated cost of the project.

Total estimation : May range between ₹ 2 crores to ₹ 10 crores

Scalability and performance

❖**Scalability**:

- **Architecture Design:** Design the system with scalability in mind, utilizing a modular architecture that allows for easy scaling of components based on demand.

▪**Cloud Infrastructure:** Utilize cloud computing resources, which offer scalability and elasticity, allowing you to dynamically allocate resources as needed.

▪**Load Balancing:** Implement load balancing techniques to distribute incoming traffic evenly across multiple servers or instances, ensuring optimal performance and resource utilization.

▪**Horizontal Scaling:** Employ techniques such as horizontal scaling, where additional instances or servers are added to handle increasing workload, to accommodate growing user base and data volume.

❖**Performance**:

▪**Optimized Algorithms:** Develop and optimize algorithms for crowd analysis, traffic management, and surveillance to minimize computational complexity and maximize efficiency.

▪**Parallel Processing:** Utilize parallel processing techniques to leverage multiple CPU cores or GPU accelerators for faster data processing and analysis.

▪**Caching:** Implement caching mechanisms to store frequently accessed data in memory, reducing the need for repetitive computations and improving response times.

▪**Compression:** Use data compression techniques to reduce the size of data transmitted over the network, minimizing latency and improving overall system performance.

▪**Real-time Processing:** Utilize streaming data processing frameworks and real-time analytics tools to process and analyze data as it arrives, enabling timely decision-making and response.

Commitment of the demonstration of prototype in Round 2

By Round 2 our team will complete working on the following :

- **Crowd Detection**
- **Traffic Management**
- **Face recognition**
- **Alert system**

A complete prototype will be ready by the organization of round 2 with all important featrures and commitments functional.

Implementation of the project in Mahakumbh 2025

The complete implementation plan is divided into following phases

Phase 1: Planning and Requirements Gathering

- Define project scope, objectives, and requirements.
- Collect Data
- Develop a detailed project plan and timeline.

Phase 2: System Design and Architecture

- Design the overall system architecture.
- Define data models, interfaces, and integration points.

Phase 3: Development and Prototyping

- Develop software components and algorithms.
- Build prototypes for key system functionalities.
- Conduct iterative development and testing cycles.

Phase 4: Testing and Validation

- Integrate and test individual components.
- Conduct system testing and validation.
- Address any issues or bugs discovered during testing.

Phase 5: Deployment and Rollout

- Deploy the system in a controlled environment.
- Optimize system performance and scalability.

A glimpse of the model :

) 205 peoples,

```
image 1/1 C:\Users\PRATAP\Downloads\img.jpg: 448x640 205 peoples, 272.8ms
Speed: 8.0ms preprocess, 272.8ms inference, 3.0ms postprocess per image at shape (1, 3, 448, 640)
[ultralytics.engine.results.Results object with attributes:

 boxes: ultralytics.engine.results.Boxes object
 keypoints: None
 masks: None
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THANK YOU