

Estimating Crowd Density to Detect Sparse Areas to Aid in Crowd Management



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Background:

- Authoritative members of any city should prioritize the safety and security of the citizens
- Crowd surges and stampede-associated crush injuries and deaths are considered as one of the most major non-communicable public health hazards during a mass gathering event
- Davao City Public Safety and Security Office (PSSO) has strengthened their requirements for major event organizers by submitting security and safety plans
- To help prevent accidents during crowding, crowded areas analysis and monitoring can be used

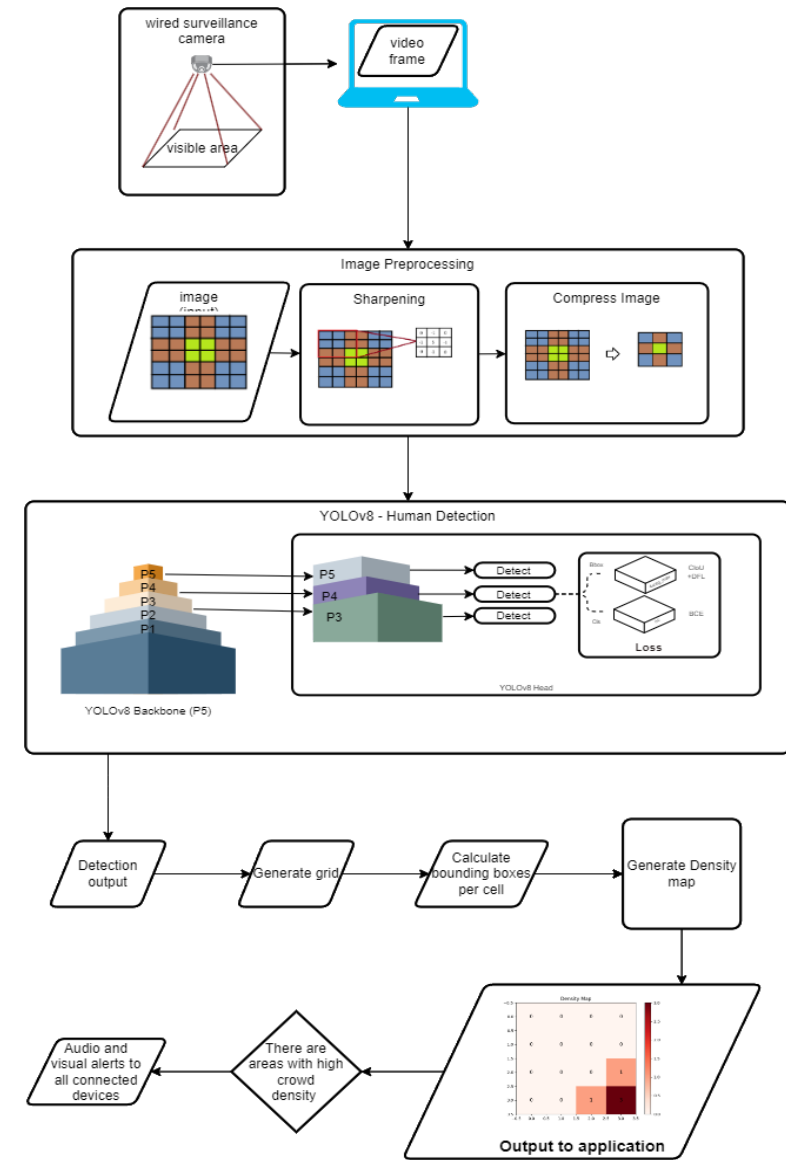
Targets:

Develop an application that would:

- Sharpen and compress images from video streams
- Estimate crowd density and generate heatmaps to detect dense and sparse areas
- Provide visual and auditory alerts for areas that are excessively crowded

Currently at the development stage.

- High-powered CCTV cameras installation (the area captured by the camera must be specified in m^2 for the density calculation)
- OpenCV image preprocessing
- Crowd density estimation
- YOLOv8 for human detection
 - Density calculation measured by $\frac{\text{detected_people}}{\text{area_captured_by_camera}}$ (people/ m^2)
 - Density grid creation
 - Density map indicating dense and sparse regions
- Alert generation
- Notification system



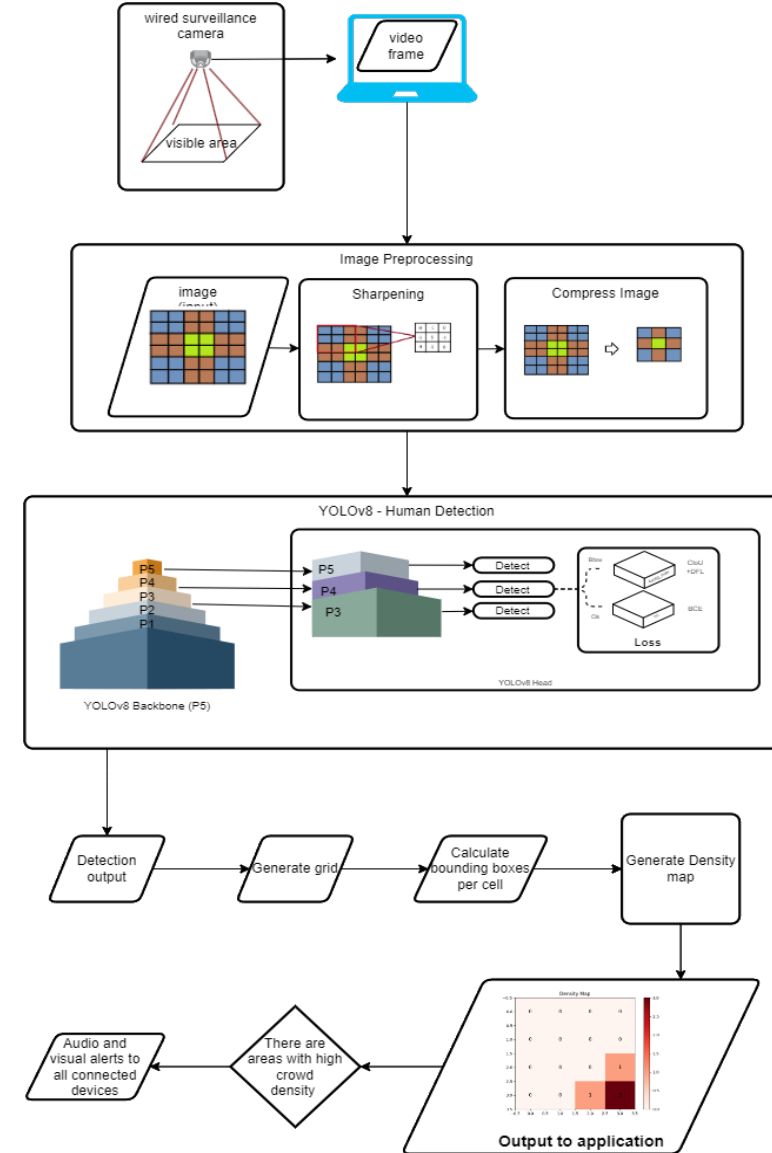
Datasets

- UCF-CC-50
- ShanghaiTech

System Prototype

Testing and implementation will be at:

- Mapua Malayan Colleges Mindanao
- If allowed, to the Barangays of Davao City



SCIENTIFIC

- Advancement in Crowd Management
- Crowd Behavior Analysis
- Data-driven Insights
- Cross-disciplinary Collaboration

TECHNOLOGICAL

- Real-time Monitoring
- Automation & Reduced Human Error
- Scalability & Safety Enhancements
- Cross-domain Applications

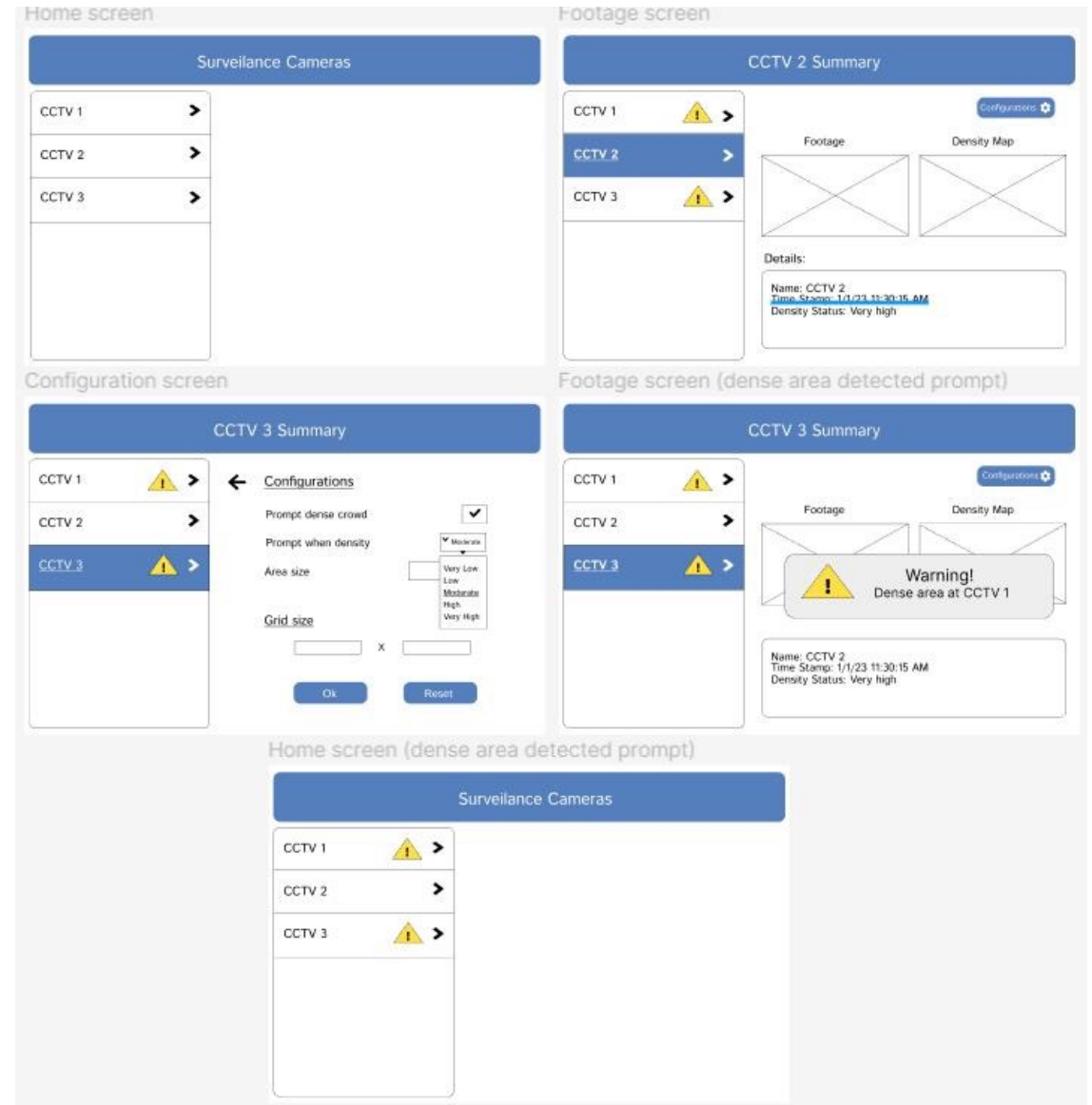
SOCIETAL

- Enhanced Public Safety
- Reduced Congestion & Inclusive Events
- Emergency Response Efficiency
- Improved Urban Planning
- Data-Driven Decision Making

COLLABORATIVE

- Interdisciplinary Collaboration
- Industry Integration
- Knowledge Sharing
- Policy and Regulation Development
- Community Engagement

- Model/Framework
- Dataset for public use
- Desktop application
- Training materials/manual
- Partnership with barangays and local organizations
- Journal articles published



The image displays four screenshots of a surveillance system interface:

- Home screen:** Shows a list of three surveillance cameras: CCTV 1, CCTV 2, and CCTV 3, each with a right-pointing arrow.
- Footage screen (CCTV 2 Summary):** Shows a summary for CCTV 2. It includes a 'Configurations' button, a list of cameras with status indicators (CCTV 1 and 3 have warning icons), and two placeholder boxes for 'Footage' and 'Density Map'. Below, a 'Details' section shows: Name: CCTV 2, Time Stamp: 1/1/23 11:30:15 AM, Density Status: Very high.
- Configuration screen (CCTV 3 Summary):** Shows a 'Configurations' panel for CCTV 3. It includes a 'Prompt dense crowd' checkbox (checked), a 'Prompt when density' dropdown menu (set to Moderate), an 'Area size' selector (set to Very Low), and a 'Grid size' input field. 'Ok' and 'Reset' buttons are at the bottom.
- Footage screen (dense area detected prompt):** Shows a summary for CCTV 3 with a prominent warning box: 'Warning! Dense area at CCTV 1'. It also includes a 'Configurations' button, camera status indicators, and placeholder boxes for 'Footage' and 'Density Map'. The 'Details' section shows: Name: CCTV 2, Time Stamp: 1/1/23 11:30:15 AM, Density Status: Very high.
- Home screen (dense area detected prompt):** Shows the 'Surveillance Cameras' list with warning icons next to CCTV 1 and CCTV 3.

TARGET:

Develop an application that will estimate crowd density and generate heatmaps to detect dense and sparse areas.

METHOD:

Utilize YOLOv8, generate density map indicating crowded/dense and sparse areas, give out alerts through a notification system.

TAKEAWAYS:

- Scientific Advancement
- Technological Innovation
- Societal Benefits
- Collaboration
- Probable Outcomes

