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Sachin Choudhari
Associate Professor, Computer Science and Engineering, Jhulelal Institute of Technology, Nagpur, Maharashtra, India

Bhushan Rajani
Department of Computer Science and Engineering, Jhulelal Institute of Technology, Nagpur, Maharashtra, India

Mayank Sahajramani
Department of Computer Science and Engineering, Jhulelal Institute of Technology, Nagpur, Maharashtra, India

Nikhil Nanwani
Department of Computer Science and Engineering, Jhulelal Institute of Technology, Nagpur, Maharashtra, India

Sujal Nawani
Department of Computer Science and Engineering, Jhulelal Institute of Technology, Nagpur, Maharashtra, India

Sujal Bhojwani
Department of Computer Science and Engineering, Jhulelal Institute of Technology, Nagpur, Maharashtra, India

Corresponding Author:
Sachin Choudhari
Associate Professor, Computer Science and Engineering, Jhulelal Institute of Technology, Nagpur, Maharashtra, India

Crowd monitoring with alerting system

Sachin Choudhari, Bhushan Rajani, Mayank Sahajramani, Nikhil Nanwani, Sujal Nawani and Sujal Bhojwani

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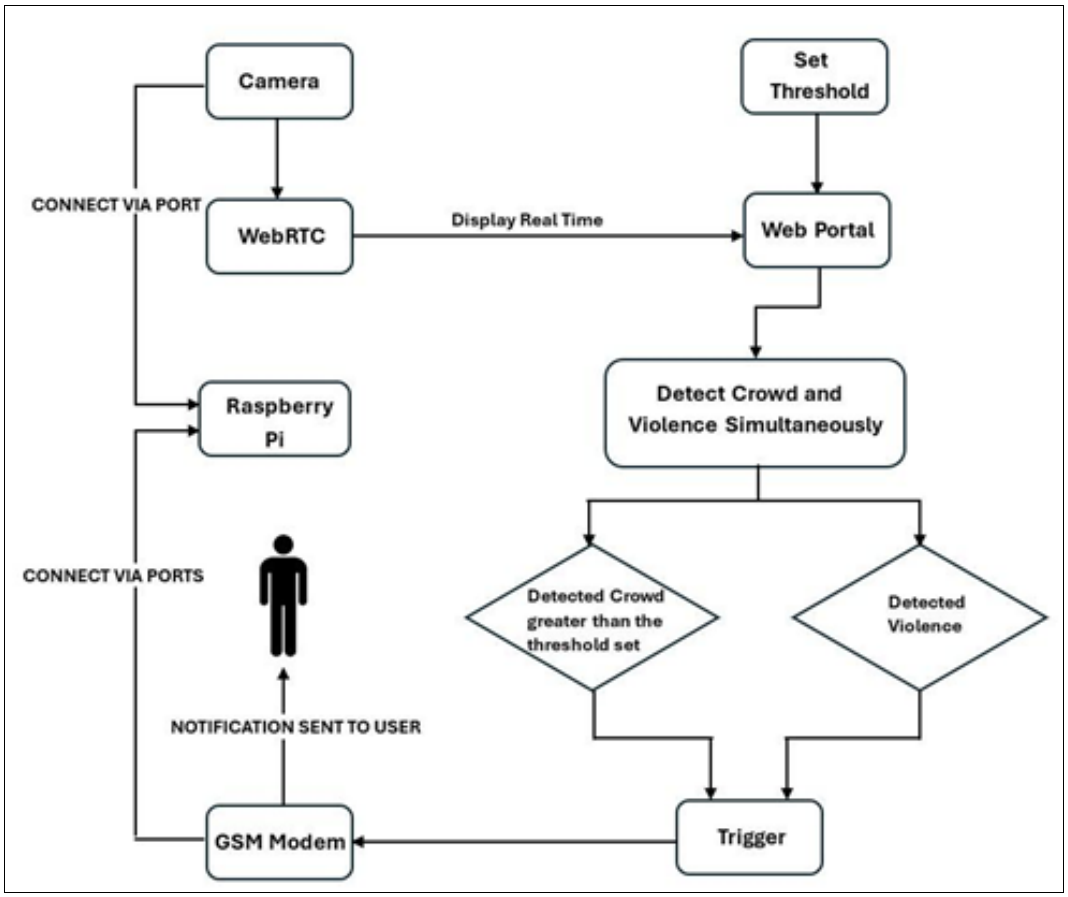
Abstract
The goal of this work is to explain a crowd management system that uses Raspberry Pi technology integrated with GSM and YOLOv8. This system is essential for monitoring and confronting violent behavior inside a group of people. The most recent recognized model, YOLOv8, which has a high degree of accuracy, potentially high detection speed, and low latency, is utilized by the design. Users are provided with a gateway that allows them to set boundaries and view real-time crowd activity monitoring. GSM was used to send warnings for every violent occurrence that was found. Advanced communication technologies and detection are used in the rapid and economical system solutions. The projected crowd administration scheme influences progressive electronics like Raspberry Pi, GSM, and YOLOv8 to monitor and control big crowds, specifically in surroundings place extreme action concede possibility happen. The system aims to discover, path, and put oneself in the place of another occurrence of attitude in certain-opportunity, guaranteeing improved security honestly rooms in the way that stadiums, concerts, or protests. At the center of bureaucracy is the YOLOv8 (You Only Look Once report 8) model, a newfangled object discovery invention famous for allure extreme veracity, speedy discovery speed, and reduced abeyance. YOLOv8 is particularly created to perceive and path things or groups of nation inside a crowd, recognizing severe conduct like fights, hostile gestures, or different campaigns. Its skill to process broadcast feeds from cameras attributed to a Raspberry Pi guarantees honest-period study and operation. Raspberry Pi serves as the alter center, merging accompanying cameras to capture live movie of the crowd. It acts as a cheap, adept resolution to act the difficult computational tasks wanted for object discovery. The system admits controllers to set predefined frontiers or zones inside the crowd, taking alerts when powerful act crosses these limits. Additionally, GSM (Global System for Mobile Communications) electronics is organized to please mechanical warnings to appropriate experts or crew when destructive performance is discovered. These warnings are shipped by way of manual ideas, permissive accelerated reaction to occurrence and guaranteeing unexpected mediation. Combining cheap fittings accompanying progressive discovery and ideas electronics, this crowd administration whole offers an effective, ascendable, and inexpensive answer for asserting public security.

Keywords: Crowd management system, raspberry pi technology, yolov8 object detection, GSM communication, violent behavior detection

Introduction
The rapid advancement of technology necessitates the need for innovative concepts that can improve public safety in situations where there are many instances of traffic and violence, such as public spaces, bus stops,
The rapid advancement of technology necessitates the need for innovative concepts that can improve public safety in situations where there are many instances of traffic and violence, such as public spaces, bus stops, schools, and non-prohibited zones [14]. This particular project uses YOLOv8 object detection, Google Edge TPU, Raspberry Pi, and GSM to create a real-time crowd and disturbance management system [2, 3]. Cameras are physically positioned above crowded places, and video analytics are used to track aggressive behavior and crowd density over time. As a sophisticated algorithm, YOLOv8 will supply the resources needed for a real-time population count at a specific maximum occupancy rate that has been established on a website [1]. The appropriate authorities use a GSM module to communicate with the system when aggressive behavior or crowd density is observed [7]. For sensitive and high-risk regions, these emerging technologies offer a practical, economical, and effective security solution. This tool's goal is to improve security infrastructure by lowering the severity and frequency of incidents that could result in property damage or fatalities by efficiently addressing emerging threats.

Architecture



Literature Survey

1. Estimating human poses is a challenging job in the realm of computer vision, frequently limited by a scarcity of training samples and numerous difficulties faced during target detection, such as intricate backgrounds, object obstruction, crowded settings, and differing viewpoints. Gu, Kaiming, along with Boyu Su. "An Analysis of Human Pose Detection in Low-Light Conditions for the Year 2024 Using the YOLOv8 Model"
2. In the past few age, concerning details progress has considerably affected many surfaces of our Sanket Kshirsagar, Rushikesh Matele, Atharva https://doi. org/10.542 54/2755- 2721/32/20 230200 Crowd Monitoring and Alert System https://ww w.jetir.org/ documents/JET IR2404515. pdf 2024
3. According to the report written apiece World Health Organization (WHO) [1], it has happened disclosed that the coronavirus affliction (COVID-19) has polluted heaps of family everywhere and precipitated end of life considerably Gündüz, M.Ş., Işık, G. "A new YOLO-located pattern real-period crowd discovery from program and accomplishment reasoning of YOLO models https://link. springlike.co m/item/1 0.1007/s11 554-023- 01276-w 2023
4. Human Pose Estimation (HPE) is a task in calculating concept that aims to find corpse cheap hangouts, in the way that the head, knees, wrists, and elbows, in a representation or broadcast frame Esraa Samkari, Muhammad Arif, Manal Alghamdi, Mohammed A. Al Ghamdi. Human Pose Estimation Using Deep Learning: A Systematic Literature Review" https://ww w.mdpi.com/2504- 4990/5/4/8 1 2023
5. Object detection is applied in various perspectives, for instance, automated vehicle structures, development affirmation, an individual by walking acknowledgment, apply self-governance, robotized CCTV, object checking, and so forth. R. Sai Sree, P. Chandu, B. Pranavi Real-Time Object Detection Using Raspberry Pi" (2023).Raspberry Pi. 1R. Sai Sree, 2P. Chandu, 3B. Pranavi. https://ijcrt. org/papers/ IJCRT2308 153.pdf 2023

Existing Work

Overseeing crowds in public areas is an important field of study, as excessive crowding can result in problems like stampedes, disorientation, and the swift transmission of contagious illnesses. Multiple systems have been created to efficiently monitor and manage crowds, with many depending on computer vision methods. One example of such a system utilizes a three-tier architecture: the sensor tier, the management tier, and the interface tier. The sensor layer gathers information on how many individuals are entering a specified zone, whereas the management layer oversees if the occupancy threshold has been met. When the limit is surpassed, the interface layer activates an alert, like a buzzer, to inform security staff. This kind of system is especially useful for confined areas such as stores, meeting rooms, spaces, and lifts.

In more expansive, open areas, current methods employ Open CV and Python to measure the distance between people. By examining pixel-based locations in a video stream, these systems can identify when individuals are in

close proximity and provide alerts as needed. This approach aids in maintaining social distancing and enhances overall crowd safety.

Our initiative builds upon these current solutions by integrating advanced detection models, real-time notification systems, and enhanced hardware. Our system seeks to improve accuracy and efficiency in crowd detection and notification by employing Raspberry Pi, YOLOv8, a GSM module, and Google Edge TPU.

Methodologies

Developing a real-time surveillance system with a Raspberry Pi that tracks and evaluates live video feeds from a CCTV camera or any other type of video source is the goal of this project [9]. In addition to detecting violent activity, this system will count the number of people in a given location. First, we utilize HTML and CSS to create a web site that lets users define a threshold value. The largest crowd size permitted at various decision points is represented by the threshold value [1]. YOLOv8 Nano, a lightweight pre-trained model optimized for crowded scene identification, is used to further handle real-time feeds from CCTV/video sources [4]. In order to make real-time crowd surveillance effective, YOLOv8 Nano is in charge of identifying, following, and counting people in video streams. In order to detect violent activity among individuals, we are employing a different model that was trained on a violence database that gathers data on pose patterns, dynamics changes, and other factors [13]. Following the Raspberry Pi's processing of the video feed, the user's threshold is compared with the detected crowd size. A potential instant notification is generated if it surpasses or information regarding violence is identified. A GSM module that can be set up as an SMS sender or call maker is used to deliver these alerts to the user [16, 17]. Real-time video stream monitoring utilizing YOLOv8 Nano for crowd identification and data transmission from the violent model to the GSM module is made simple by the Raspberry Pi appliance running Raspbian OS [5, 9]. The primary goal of the developed system is to process sequential scenes from the monitored environment loop that is built into the system in order to provide on-time notice [2].

Working

The suggested Crowd Detection and Alerting System aims to track and assess crowd density in real time, employing YOLOv8 for precise object recognition. The system utilizes a Raspberry Pi as its main processing unit and is fitted with a camera module to continuously record live video footage. Every frame is analyzed with a trained YOLOv8 model to identify and tally the number of individuals present in the scene. The system subsequently assesses crowd density according to these detections.

In order to improve crowd control, a limit is established to determine the highest allowable number of people in a specific location. When the count of identified individuals surpasses this threshold, an alert system is activated. The system includes a GSM module to automatically dispatch SMS notifications to pertinent authorities, allowing for quick action to mitigate risks associated with overcrowding. This function is especially important for promoting safety in communal areas like markets, transport hubs, sports stadiums, and event locations.

The Roboflow platform is crucial for improving model accuracy by enabling dataset preprocessing, annotation, and augmentation. It also facilitates training the YOLOv8 model on various datasets, enhancing detection in different lighting and environmental situations. The trained model is subsequently fine-tuned for efficient operation on Raspberry Pi, guaranteeing smooth performance with low power usage. In conclusion, this system offers a compact, affordable, and scalable method for real-time crowd monitoring and administration. Through the combination of computer vision, edge computing, and wireless communication, it enhances public safety, streamlines resource distribution, and reduces risks linked to large gatherings.

Conclusion

This paper attempts to offer a comprehensive solution for responding to violence or overcrowding in these specific locations, in addition to measuring the crowd density in the areas of interest. It makes use of cutting-edge technologies like GSM modules, YOLOv8, single board computers, and specialized web interfaces. All of these factors work together to create a timely, cost-effective, and practical modern surveillance system that can identify violent and overshoot incidents and then send out alarms to authorities. The community's overall safety in high-risk areas, such as schools, is improved by this proactive approach to security planning.

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