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Vision-Based Women Safety System: Detecting High-Risk Situations Using Deep Learning

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Abstract – Women's safety is a major concern, especially in crowded public places. This project introduces a smart surveillance system that uses Artificial Intelligence (AI) to help detect potentially unsafe situations for women in real time. The system uses a camera feed and combines object detection (to find people in the frame) with a gender classification model (to identify if a person is male or female). It then checks if a female is surrounded by four or more males. If such a situation is found, the system draws a red box around the female and triggers an alert to notify authorities or take action. This tool can be used in public places like colleges, bus stations, parks, or offices to monitor surroundings and act early to prevent possible threats. By using technologies like computer vision and deep learning, the system helps improve safety and provide faster responses in risky situations. By combining computer vision, deep learning, and real-time analysis, this project offers a proactive tool for improving public safety. The solution can be deployed in universities, transport hubs, workplaces, and other sensitive areas, enhancing monitoring capabilities and supporting preventive action against potential harassment or assault scenarios.

Keywords- Women's Safety,Smart Surveillance System,Artificial Intelligence (AI)Computer Vision,Deep Learning,Real-Time Monitoring

I. INTRODUCTION

Women's safety is a major concern, especially in crowded public places like parks, streets, and transport stations. Most current security systems depend on human monitoring, which can sometimes miss signs of danger or respond too slowly. To solve this problem, we have built an intelligent system that uses artificial intelligence to keep women safer in public spaces. This system uses a camera to watch real-time video and can detect people, identify their gender, and check the surroundings. If it finds that a woman is surrounded by four or more men, it marks her with a red box on the screen and immediately triggers an alert. This helps security teams respond faster and possibly prevent harmful situations. With the help of technologies like object detection, gender classification, and automatic alerts, our project aims to make public areas safer for women and reduce the risk of harassment or harm.

II. LITERATURE SURVEY

Women's safety has been a critical area of concern globally, especially in urban environments where the chances of encountering unsafe situations are higher due to population density and public mobility. Over the years, researchers and technologists have explored various approaches to enhance public safety, ranging from manual surveillance systems to modern AI-powered solutions. Traditional security

methods often rely on CCTV cameras monitored by human personnel. However, such systems are prone to human error, fatigue, and delayed response times, which can compromise the effectiveness of real-time threat detection. Recent advancements in computer vision and machine learning have opened new possibilities in automating safety monitoring tasks. Technologies like object detection and face recognition have been extensively researched and applied in fields such as surveillance, smart city infrastructure, and crowd monitoring.

These methods allow systems to automatically detect individuals, track their movement, and identify specific traits or behaviors. However, most existing surveillance systems still lack the ability to intelligently analyze crowd composition or assess the context in which a person, especially a woman, might be at risk. Several studies have proposed gender classification models that utilize facial features or body structure to distinguish between males and females. These models often use convolutional neural networks (CNNs) for accurate classification. While these techniques have shown promise, their application in real-time safety monitoring systems has been limited. Moreover, existing women safety apps mostly focus on reactive measures such as panic buttons, location sharing, or emergency calls. Although these tools are useful, they depend heavily on the victim's ability to trigger them, which may not always be possible during a dangerous situation.

There is a need for proactive systems that can detect potentially risky scenarios automatically and alert authorities or nearby individuals without any user input. Literature also explores the use of YOLO (You Only Look Once) models for real-time object detection, which provide fast and accurate detection of people in video feeds. When combined with gender classification algorithms, these systems can not only detect individuals in a frame but also analyze their gender distribution. This forms the basis of a more intelligent safety system that can recognize when a female is in a vulnerable situation—such as being surrounded by a group of males—and take appropriate action like triggering alerts or drawing attention through visual signals. Another important aspect highlighted in current research is the use of bounding boxes and visual indicators for ease of monitoring. Studies show that marking individuals in video frames using colored boxes (e.g., red for danger, green for safe) improves both automatic and manual monitoring efficiency. Our proposed system fills this gap by integrating all these components into one framework that works in real-time and provides immediate feedback in potential risk situations.

III.PROPOSED WORK

The proposed system is designed to enhance women's safety in public and crowded environments by leveraging real-time video surveillance with artificial intelligence. The system uses advanced object detection and gender classification techniques to monitor the surroundings and identify situations where a woman may be at risk. The key components and features of the proposed system are:

- Real-Time Object Detection: Utilizes the YOLO (You Only Look Once) model to detect people in a video frame quickly and accurately. This enables continuous monitoring of public spaces.
- Gender Classification: A deep learning model is used to classify the gender of detected individuals. Each person in the frame is analyzed to determine whether they are male or female.
- Surrounding Analysis: The system continuously checks whether any female is surrounded by four or more males within the same frame. This condition is used as a potential risk indicator.
- Visual Alert Mechanism: When the system detects a female being surrounded by four or more males, her bounding box changes color from green to red, indicating potential danger.
- Automated Alert Triggering: Once a red bounding box is activated, the system can be configured to automatically send alerts to security personnel, trigger audio alarms, or notify nearby help centers depending on deployment.
- User-Friendly Interface for Monitoring: The entire system is designed with ease of monitoring in mind. It can be deployed with CCTV cameras in public places, buses, colleges, or workplaces and integrated with existing security systems.

IV.PROPOSED METHODOLOGY

1. Requirement Analysis and Planning

- Problem Definition: Understand and define real-world scenarios that could pose a safety risk to women, especially in crowded or isolated environments.
- Technology Stack Planning: Decide on hardware (camera input, processing unit like GPU/CPU) and software frameworks (YOLO for object detection, ResNet-18 for gender classification).

2. Object Detection with YOLO

- YOLO Integration: Use a pre-trained YOLO (You Only Look Once) model to detect all persons in a video frame. YOLO provides bounding boxes and confidence scores for detected humans.
- Real-time Detection: Continuously process live video input to extract frames and detect persons dynamically.

3. Gender Classification using ResNet-18

- Model Selection: A custom ResNet-18 architecture is used for binary gender classification. ResNet-18 is a deep convolutional neural network known for its residual learning capability and high accuracy in image tasks.
- Training: The ResNet-18 model is fine-tuned on a labeled dataset (UTKFace) with appropriate transformations and data augmentations.
- Implementation: For each person detected by YOLO, the corresponding image region is cropped, preprocessed, and passed to the ResNet-18 model to classify the person as male or female.

4. Surrounding Analysis and Risk Detection

- Proximity Analysis: Calculate spatial relationships between the detected persons to check if any female is surrounded by four or more males.
- Bounding Box Coloring: If such a scenario is detected, the female's bounding box turns red as a warning indicator. Safe conditions are shown with a green box.

5. Alert Mechanism

- Visual Alerts: Red bounding boxes visually indicate possible danger.
- System Trigger: Optionally, the system can trigger additional alerts (e.g., sound alarms) when a red bounding box is drawn.

6. Testing and Evaluation

- Modular Testing: Each component — YOLO detection, gender classification (ResNet-18), and risk logic — is tested individually.
- System Integration Testing: The complete pipeline is tested using both video files and live webcam streams to ensure real-time performance.
- Performance Metrics: Evaluate system accuracy using metrics like precision, recall, and F1-score for detection and classification tasks.
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7. Deployment and Future Scope

The system can be installed on surveillance setups such as CCTV control systems or deployed on mobile units (e.g., Raspberry Pi).

- Add emotion recognition or suspicious activity detection using pose estimation.
- Integrate alerting systems with emergency response services.
- Expand the classifier to be more inclusive or robust across diverse lighting and angle conditions.

V. EXPERIMENTAL RESULTS AND OBSERVATIONS

The Women Safety Monitoring System was evaluated through various model configurations and datasets to analyze performance and accuracy. The system integrates object detection, gender classification, and contextual safety alerts based on crowd composition.

Model Performance Evaluation:

1 ResNet18 (Trained on UTKFace Dataset):

• Large Dataset: Accuracy: 75.92%

2.Small Sample Dataset with Extended Training (More Epochs):

- Validation Loss: 0.1823
- Validation Accuracy: 92.66%

- Training Loss: 0.2661
- Training Accuracy: 88.07%

3. VGG16 (Trained on UTKFace Dataset):

- Validation Loss: 0.3927
- Validation Accuracy: 81.33%
- Training Loss: 0.4040
- Training Accuracy: 80.92%
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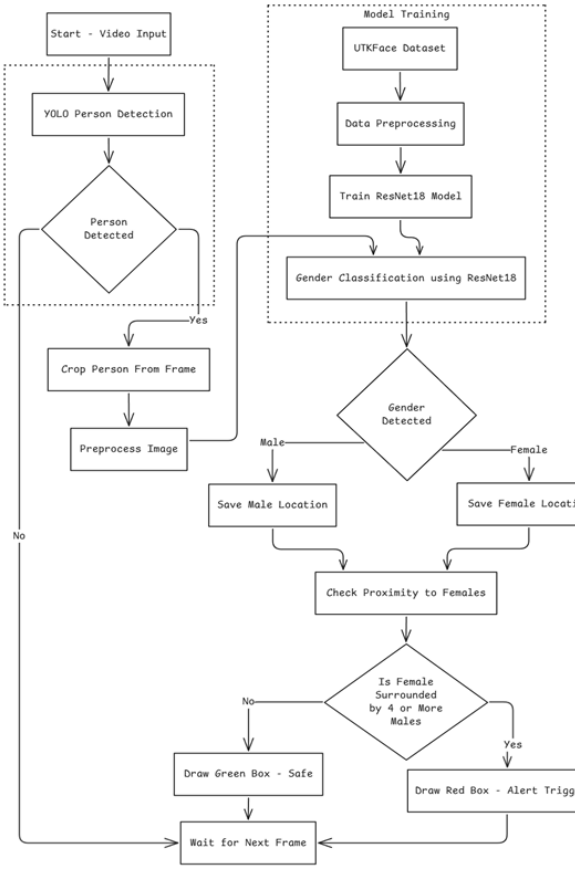
System Observations:

- Real-time Detection: YOLO-based person detection performed effectively in real-time environments, accurately identifying individuals within video frames.
- Gender Classification: ResNet18 outperformed VGG16 in gender prediction tasks, especially in smaller datasets with longer training cycles.

VI. SYSTEM ARCHITECTURE



VII .CONCLUSION

This research presents an AI-powered Women Safety Monitoring System that leverages computer vision and deep learning to identify potentially unsafe situations in real-time. The system combines object detection (YOLO) and gender classification (ResNet18/VGG16) to monitor live video feeds, detect individuals, determine their gender, and assess whether a female is surrounded by four or more males—triggering a visual alert when necessary.

Through experiments with models trained on the UTKFace dataset, the system achieved high accuracy, especially with ResNet18, which recorded a validation accuracy of 92.66% on a small dataset and longer training. The safety logic was successfully implemented, marking females in red bounding boxes when surrounded, and green when in a relatively safer context.

This solution offers a proactive surveillance tool that can be integrated into public safety systems, campuses, or transportation hubs to improve women's security. By automatically detecting suspicious crowding patterns, it minimizes the need for constant human monitoring.

In future work, this system can be enhanced by:

- Incorporating facial recognition for identity verification
- Using distance estimation to better understand proximity
- Improving alert systems through sound or mobile notifications
- Deploying as a mobile or embedded smart CCTV module

The proposed system demonstrates that AI and deep learning can be effectively used for real-time public safety, especially for vulnerable individuals in crowded environments.

REFERENCES

1. Musaddik Moulavi,Anuprita Barge,Rajan Vishwakarma, Bhushan Dhengle, Anisaara Nadaph, A. Ospanova, " Object Detection and Recognition and Age-Gender Prediction using YOLO and OpenCV" May 2022International Journal of Special

Education (IJSE) 11(44):3251-3253,DOI:10.15680/IJIRSET.2022.11041336

2. He,K.,Zhang,X.,Ren,S.,&Sun,J.(2016). Deep residual learning for image recognition. In Proceedings of the IEEE conference on computer vision & pattern recognition (pp. 770-778).

3. T. D., Nguyen, V. H., & Kim, H. (2019). Real-time and robust multiple-view gender classification using gait features in video surveillance. Pattern Analysis and Applications, 23(1), 399–413. doi:10.1007/s10044-019-00802-6.

4. Juan Du 2018 J. Phys.: Conf. Ser. 1004 012029, "Understanding of Object Detection Based on CNN Family and YOLO"

5. Mr. Timothy D Paul , Ms. A. Kalaiselvi, Ms. S. Nagarathinam, "Experimental Analysis Of Women Safety Management System By Using Iot Enabled Machine Learning Strategies ", https://www.researchgate.net/publication/352786018

6. Abhishek Nazare and Sunita Padamannavar, "An Implicit Approach on Classification of Gender using CNN Methods with Crowd Analysis".

7. Shrikant Jagannath Patro and Prof. Nisha V M, "Real Time Video Analytics for Object Detection and Face Identification using Deep Learning".