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Proactive Risk Assessment in Cctv Using Hand Gesture Recognition and Geolocation-Based Alerts

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Abstract
The proposed system enhances CCTV surveillance by integrating hand gesture recognition with real-time monitoring to improve security risk assessment. Traditional systems rely on manual monitoring and motion detection, which may fail to identify potential threats linked to human gestures. Using Open Pose for gesture recognition and Media Pipe for feature extraction, the system detects high-risk gestures like clenched fists or aggressive pointing. Upon detection, it triggers instant alerts via SMS, email, and mobile app notifications to nearby police and authorized personnel, utilizing geolocation-based alerts for rapid response. This proactive approach enhances surveillance efficiency, enabling quicker threat detection and intervention, ultimately improving public safety.

Keywords: Python, HTML, CSS, MYSQL, CNN and TCN Algorithm.

Introduction

Traditional CCTV surveillance systems primarily rely on manual monitoring and basic motion detection, which may overlook critical security threats. In particular, they struggle to detect aggressive hand gestures that could indicate potential danger. To enhance security monitoring, this system integrates hand gesture recognition with real-time CCTV surveillance. By utilizing OpenPose for gesture detection and MediaPipe for feature extraction, it identifies threatening gestures like clenched fists or aggressive pointing.
Once a high-risk gesture is detected, the system automatically sends alerts to nearby police stations and authorized personnel via SMS, email, and mobile app notifications. Geolocation-based alerts ensure that notifications reach the appropriate authorities in real-time, enabling a swift response. This proactive approach enhances threat detection and intervention, making CCTV surveillance more intelligent and effective in improving public safety.

LITERATURE REVIEW

CCTV surveillance has been widely used for security monitoring, but traditional systems primarily rely on manual observation and basic motion detection, limiting their ability to identify security threats accurately. Existing methods, such as facial recognition and motion-based alerts, often fail to detect subtle human gestures that may indicate potential danger. Research on hand gesture recognition highlights its

effectiveness in interpreting human actions and enhancing security measures. Technologies like OpenPose and MediaPipe have been successfully applied in gesture recognition for various applications, including human-computer interaction and safety monitoring.

Studies have also explored the integration of AI-driven analytics with CCTV surveillance to improve threat detection. Geolocation-based alert systems have proven effective in ensuring timely responses by notifying the nearest authorities. By combining these advancements, a proactive surveillance approach can significantly enhance security monitoring, allowing for real-time identification of threatening gestures and immediate intervention.

EXISTING SYSTEM

Traditional CCTV surveillance systems primarily depend on manual monitoring and basic motion detection to identify potential security threats. Security personnel must continuously observe multiple video feeds, which can lead to human fatigue and delayed responses. Additionally, conventional systems often rely on facial recognition or simple motion-based alerts, which may not effectively detect aggressive behaviors or subtle hand gestures that could indicate a threat. These limitations make it challenging to identify risks in real-time, leading to delays in threat assessment and response. Furthermore, traditional alert mechanisms are often limited to on-premise alarms, which may not effectively notify law enforcement or relevant authorities in a timely manner.

Another major drawback of existing systems is the lack of intelligence in distinguishing between normal and suspicious activities based on human gestures. While some systems incorporate AI-based motion detection, they generally focus on broad movements rather than specific hand gestures, such as clenched fists or aggressive pointing. This lack of granularity reduces the system's effectiveness in identifying potential conflicts or violent incidents before they escalate. Moreover, traditional surveillance systems typically do not integrate geolocation-based alerts, which means that security breaches may not be reported to the nearest authorities, resulting in delayed interventions. These inefficiencies highlight the need for a more advanced and proactive surveillance system that can accurately assess risks through real-time hand gesture recognition and intelligent alert mechanisms.

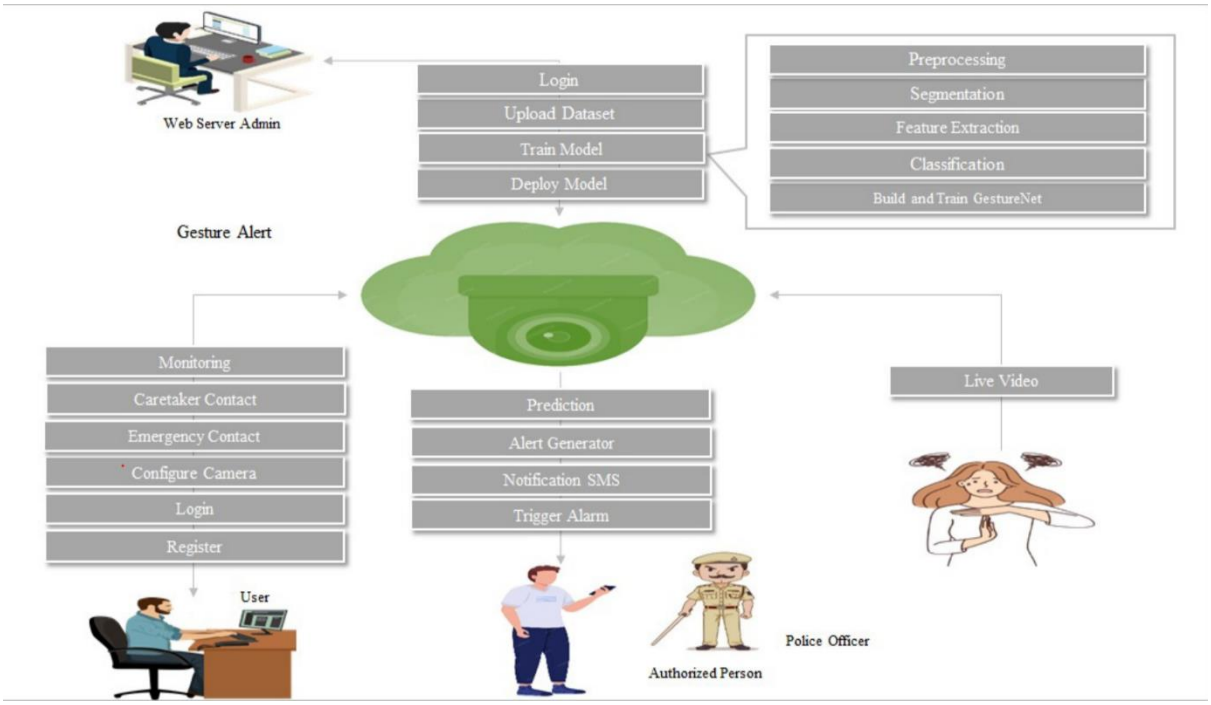
PROPOSED SYSTEM.

The proposed system enhances traditional CCTV surveillance by integrating hand gesture recognition and geolocation-based alerts to improve proactive risk assessment. Using OpenPose for gesture recognition and MediaPipe for feature extraction, the system detects specific hand gestures that indicate potential security threats, such as clenched fists or aggressive pointing. Upon recognizing a high-risk gesture, the system instantly triggers an alert, reducing reliance on manual monitoring and increasing the accuracy of threat detection. The system is designed to function in real-time, ensuring continuous surveillance and rapid identification of suspicious activities.

In addition to gesture recognition, the system incorporates geolocation-based alert mechanisms to ensure that notifications reach the relevant authorities based on the incident's location. Alerts are sent via SMS, email, and mobile app notifications to both law enforcement and authorized personnel, allowing for a swift response. By combining real-time surveillance with intelligent risk detection and automated alerts, the proposed system enhances public safety, reduces the time to intervention, and offers a more responsive alternative to conventional CCTV monitoring.

Methodology

The proposed system enhances CCTV surveillance by integrating hand gesture recognition and geolocation-based alerts to improve security risk assessment. Using OpenPose for gesture recognition and MediaPipe for feature extraction, the system detects specific high-risk gestures, such as clenched fists or aggressive pointing, that may indicate potential threats. When such gestures are identified, real-time alerts are automatically sent to nearby police stations and authorized personnel via SMS, email, and mobile app notifications. Additionally, geolocation-based notifications ensure that alerts are directed to the appropriate authorities in the affected area. This proactive methodology enables quicker threat detection and intervention, making surveillance systems more intelligent and responsive in mitigating security risks.



Feature extraction

The proposed system enhances CCTV surveillance by integrating hand gesture recognition and geolocation-based alerts for proactive risk assessment. Utilizing OpenPose for gesture recognition and MediaPipe for feature extraction, the system identifies high-risk gestures, such as clenched fists or aggressive pointing, that may indicate potential threats. Upon detection, automated alerts are sent to nearby police stations and authorized personnel via SMS, email, and mobile notifications, ensuring a swift response. The incorporation of geolocation-based alerts enhances situational awareness, enabling precise intervention. This approach improves traditional CCTV systems by reducing response time and increasing the accuracy of threat detection, ultimately enhancing public safety.

Future Scope

The future scope of this project includes enhancing gesture recognition accuracy using deep learning models trained on larger datasets to improve the detection of complex hand movements. Integration with AI-powered behavioral analysis can further refine threat assessment by considering additional contextual factors, such as body posture and movement patterns. Additionally, expanding the system to support multilingual voice commands and real-time audio analysis could enhance its ability to detect verbal threats alongside gestures. The incorporation of edge computing can reduce latency, enabling faster response

times and improved real-time processing. Future developments may also explore the integration of blockchain technology to ensure secure storage and transmission of surveillance data, strengthening data integrity and privacy. Moreover, expanding the system for use in smart cities, airports, and critical infrastructure security can broaden its applications, making it a vital tool in modern surveillance and threat prevention

Conclusion

In conclusion, the proposed system enhances traditional CCTV surveillance by integrating hand gesture recognition and geolocation-based alerts to proactively assess security risks. By utilizing OpenPose for gesture recognition and MediaPipe for feature extraction, the system identifies potentially threatening gestures, such as clenched fists or aggressive pointing, and promptly notifies relevant authorities through SMS, email, and mobile app notifications. The incorporation of geolocation-based alerts ensures that responses are directed to the nearest law enforcement or security personnel, enabling swift intervention. This innovative approach improves the efficiency of threat detection, reduces response times, and enhances overall public safety, making CCTV monitoring more intelligent and effective.

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