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AI-Powered Crowd Safety Monitoring with Real Time Mask Compliance Detection

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ABSTRACT: AI-Powered Crowd Safety Monitoring with Real-Time Mask Compliance Detection is an intelligent system designed to improve public health and safety by automatically monitoring mask usage in crowded environments. Manual supervision in places such as schools, offices, hospitals, malls, airports, and transport stations is difficult and time-consuming, creating the need for an automated real-time solution. The proposed system uses computer vision and deep learning techniques to detect whether a person is wearing a mask or not through live camera video streams. OpenCV is used for face detection, while a hybrid deep learning model combining MobileNetV2 and CNN is used for accurate mask classification. TensorFlow Lite is used to optimize the trained model for faster speed, lightweight performance, and efficient deployment on low-resource devices. When a face is detected, the system preprocesses the image and classifies it as “Mask” or “No Mask.” The result is displayed on the screen with a bounding box and label for easy monitoring. The proposed system offers high accuracy, fast processing, and reliable real-time performance. It can be effectively used for crowd safety monitoring and compliance checking in various public areas.

KEYWORDS: Artificial Intelligence, Face Mask Detection, Computer Vision, Deep Learning, MobileNetV2, Convolutional Neural Network (CNN), OpenCV, TensorFlow Lite, Real-Time Monitoring, and Crowd Safety Monitoring are the key technologies and concepts used in the proposed system for accurate and efficient real-time mask compliance detection.

I.INTRODUCTION

AI-Powered Crowd Safety Monitoring with Real-Time Mask Compliance Detection is a smart system developed to improve safety in crowded places. It helps monitor mask usage and reduce the spread of airborne diseases. Manual checking is difficult and time-consuming, so an automated solution is needed. The system uses Artificial Intelligence, Computer Vision, and Deep Learning for real-time detection. OpenCV is used for face detection, while a hybrid model combining MobileNetV2 and CNN is used for classification. TensorFlow Lite improves speed and lightweight performance. The system displays results as Mask or No Mask with bounding boxes. It is suitable for schools, offices, hospitals, malls, airports, and other public areas.

II. LITERATURE SURVEY

1. Wang, Y., Liu, X., & Zhang, J. (2022)

This paper explores deep learning techniques for real-time face mask detection using models such as MobileNetV2, VGG-16, and ResNet-50. The study demonstrates that CNN-based approaches provide higher accuracy and better efficiency compared to traditional machine learning methods under different lighting conditions and facial orientations.

2. Patel, R., Kumar, S., & Verma, P. (2021)

This research presents a lightweight face mask detection system using MobileNetV2 for real-time applications. The study integrates OpenCV's DNN module for face detection and highlights the importance of data augmentation and model fine-tuning to improve detection accuracy in noisy and low-resolution environments.

3. Ahmed, M., Gupta, N., & Sharma, A. (2022)

This paper proposes a hybrid approach combining YOLO for face detection and MobileNetV2 for mask classification. The system is tested on surveillance footage and achieves robust performance in crowded environments, multiple face detection scenarios, and varying mask conditions.

4. Lee, H., Kim, J., & Park, S. (2021)

This study focuses on AI-based face mask monitoring in public places such as hospitals, malls, and transportation hubs. The research discusses the integration of deep learning models with IoT-enabled smart surveillance systems and edge computing for real-time processing and reduced latency.

5. Das, R., Singh, P., & Roy, A. (2023)

This paper compares traditional machine learning techniques with deep learning models such as MobileNetV2, ResNet-50, and EfficientNet for face mask detection. The results show that deep learning approaches achieve better accuracy, speed, and scalability, especially in real-time applications using transfer learning techniques.

By 2023, research focused on fairness and bias reduction in AI-driven lending systems to ensure transparent.

III. METHODOLOGY

The proposed system uses Artificial Intelligence, Computer Vision, and Deep Learning techniques for real-time face mask detection. A dataset containing images of people with and without masks is collected and preprocessed using resizing, normalization, and augmentation techniques to improve model accuracy. OpenCV is used to detect human faces from live video streams captured through a webcam or CCTV camera. The detected face images are then passed to a hybrid deep learning model combining MobileNetV2 and CNN for mask classification. MobileNetV2 provides lightweight and fast processing, while CNN improves feature extraction and classification accuracy. TensorFlow Lite is used to optimize the trained model for efficient real-time performance. Finally, the system displays the output as Mask or No Mask with bounding boxes and labels for easy monitoring.

IV. RESULTS

The result pages display both the live camera input and the processed output with bounding boxes highlighting detected faces. Each detected face is labelled as Mask or No Mask along with prediction confidence scores. The hybrid deep learning model is specifically trained for face mask detection, ensuring accurate and efficient real-time monitoring in crowded environments.

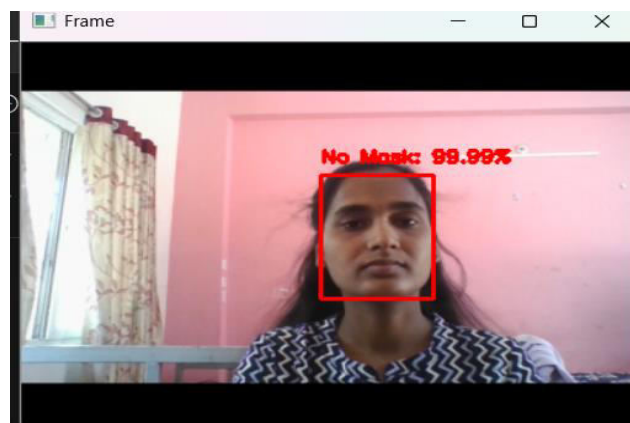


Fig. 1: No Mask Detection

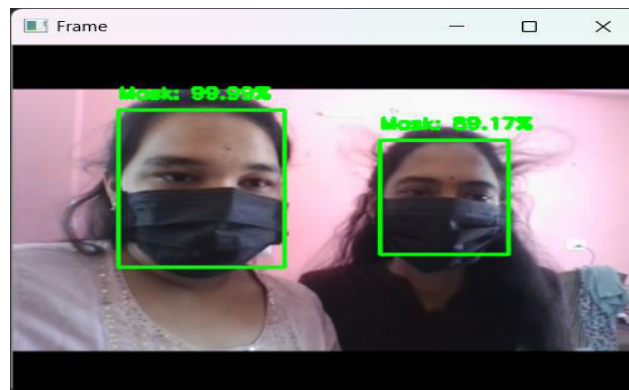


Fig. 2: Mask Detection

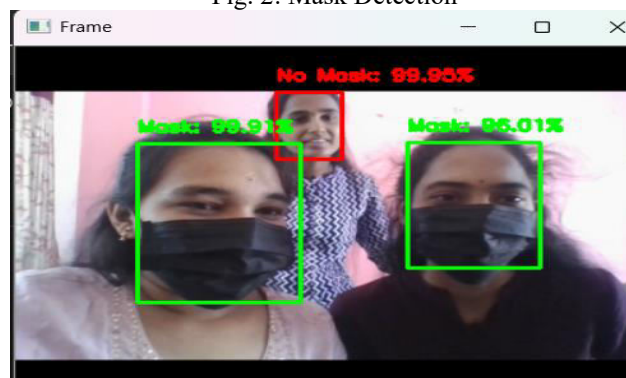


Fig. 3: Multiple faces Detection

V. CONCLUSION

The proposed system successfully performs real-time face mask detection using Artificial Intelligence and Computer Vision techniques. The hybrid model combining MobileNetV2 and CNN provides accurate and fast classification of masked and unmasked faces. OpenCV is used for efficient face detection from live video streams. TensorFlow Lite improves the speed and lightweight performance of the system for real-time applications. Overall, the system helps improve public safety and reduces manual monitoring effort in crowded environments.

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