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Guardmask: Tensorflow Based Mask Compliance System

G. Vidya Sagar, M. Kavya Varshitha, M.Keerthi, V. Sai Pavan, M. Charan, D.Sai Venkat.

Assistant Professor, Department of AI&DS, Sree Venkateswara College of Engineering, Rajupalem, Nellore, India

U.G. Student, Department of AI&DS, Sree Venkateswara College of Engineering, Rajupalem, Nellore, India

U.G. Student, Department of AI&DS, Sree Venkateswara College of Engineering, Rajupalem, Nellore, India

U.G. Student, Department of AI&DS, Sree Venkateswara College of Engineering, Rajupalem, Nellore, India

U.G. Student, Department of AI&DS, Sree Venkateswara College of Engineering, Rajupalem, Nellore, India

ABSTRACT: The The Guard Mask Detection System is an AI-powered application designed to detect whether individuals are wearing face masks using deep learning and computer vision techniques. The system is built using TensorFlow and OpenCV, leveraging Convolutional Neural Networks (CNNs) for accurate and efficient mask detection. By analyzing real-time video feeds from CCTV cameras or webcams, this system can identify mask compliance and alert authorities if violations occur.

Guard Mask integrates with live video streams, making it suitable for deployment in crowded public spaces such as shopping malls, workplaces, and transportation hubs. The system ensures high accuracy and efficiency, offering an automated solution for monitoring compliance and potentially issuing alerts for violations. By combining AI-driven image processing with TensorFlow's robust framework, Guard Mask contributes to enhancing public health measures with minimal human intervention. The TensorFlow-based mask compliance system effectively identifies and ensures adherence to mask-wearing policies, promoting public health and safety in various environments.

KEYWORDS: Face Mask Detection, Mask Compliance Monitoring, Deep Learning, TensorFlow, Convolutional neural network(CNN), Real-time Surveillance, Computer vision, COVID-19 safety, Automated Compliance System , Smart Surveillance System.

I. INTRODUCTION

The outbreak of COVID-19 brought about a critical need for preventive health measures, with face masks emerging as a key line of defense against viral transmission. Despite mandates in public spaces, ensuring widespread and consistent mask usage remains a challenge, especially in areas with high foot traffic.

To address this issue, we propose GuardMask, a TensorFlow-based mask compliance system that uses computer vision and deep learning techniques to detect whether individuals are wearing face masks in real time. The system employs Convolutional Neural Networks (CNNs) to process live video streams and accurately classify individuals as either "masked" or "unmasked."

By integrating TensorFlow's powerful deep learning capabilities with tools like OpenCV for image processing, GuardMask provides a reliable and scalable solution for automated mask monitoring. The system is well-suited for deployment in locations such as schools, offices, hospitals, and transportation hubs, reducing the need for manual supervision while improving compliance rates.

This project highlights the potential of AI-driven surveillance systems in promoting public health and safety, offering a practical response to pandemic-related challenges using modern machine learning techniques.

II. LITERATURE SURVEY

In recent years, the emergence of global pandemics, particularly COVID-19, has underscored the importance of preventive measures such as wearing face masks in public spaces. Consequently, numerous studies have explored automated face mask detection systems to support compliance monitoring. Early approaches employed classical computer vision techniques using Haar cascades and HOG (Histogram of Oriented Gradients) features for face detection, which, while effective to some extent, lacked robustness in complex environments. With the advancement of deep learning, Convolutional Neural Networks (CNNs) have become the preferred method for image classification and object detection tasks, offering significant improvements in accuracy and real-time performance. Research by Loey et al. (2021) introduced a hybrid model combining ResNet50 with traditional classifiers for mask detection, while others have utilized MobileNetV2 and InceptionV3 for lightweight, real-time implementations. TensorFlow, as an open-source deep learning framework, has facilitated rapid development and deployment of such models. Studies show that integrating face detection algorithms with mask classification models significantly enhances system efficiency. Moreover, real-time deployment using OpenCV and TensorFlow Lite enables edge-based inference suitable for surveillance systems. The existing literature collectively highlights the growing potential of deep learning models in public health applications, forming a solid foundation for the development of GuardMask — a robust, TensorFlow-based mask compliance system designed for real-time monitoring in various environments.

III. METHADODOLOGY

The GuardMask system aims to automate the detection of individuals wearing or not wearing face masks using real-time video streams. The core of the system is a Convolutional Neural Network (CNN) trained on image datasets to classify whether a person is compliant (wearing a mask) or non-compliant (not wearing a mask).

Data Collection :

- Dataset Used: The project uses publicly available datasets such as:
- MAFA Dataset (Masked Faces)
- RMFD (Real-World Masked Face Dataset)
- Synthetic datasets from Kaggle

Classes :

- With Mask
- Without Mask
- (Optional) Improperly Worn Mask

Each image was annotated with a corresponding label indicating the mask-wearing status of the individual.

Data Preprocessing :

- Image Resizing: All images are resized to a standard dimension (e.g., 224×224) for uniformity.
- Normalization: Pixel values are normalized to a range of 0–1.
- Data Augmentation: Techniques such as rotation, flipping, zooming, and brightness variation are applied to increase dataset diversity and prevent overfitting.
- Label Encoding: Class labels are converted to categorical format for compatibility with TensorFlow models.

Real-Time Detection Integration

Face Detection: OpenCV's Haar Cascade or Dlib is used to detect faces in live video streams.

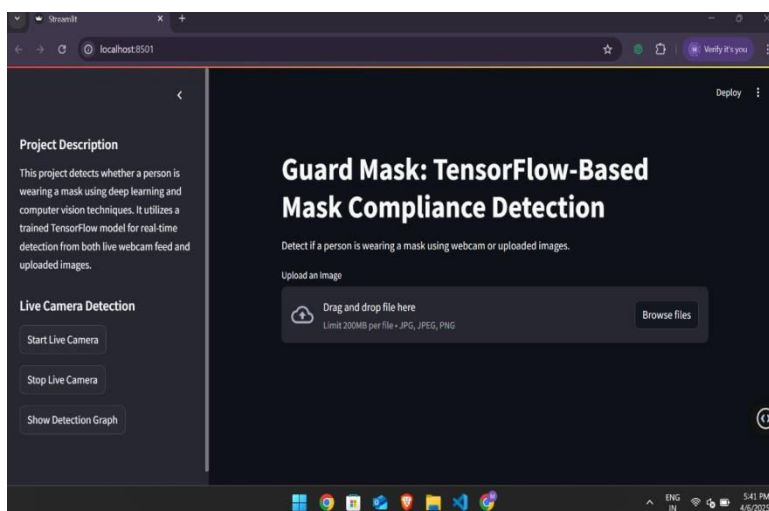
Mask Classification: Each detected face is passed through the trained model for classification.

Visualization: Bounding boxes and labels are drawn on video frames indicating mask status in real time.

IV. IMPLEMENTATION

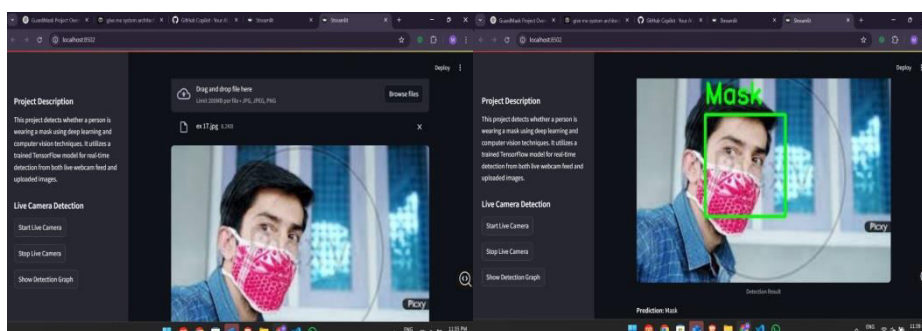
Fig.A. The implementation of the GuardMask: TensorFlow-Based Mask Compliance System was carried out in a structured manner using Python and TensorFlow as the core technologies. The first step involved collecting and preparing a labeled dataset consisting of images of people with and without face masks. These images were preprocessed through resizing, normalization, and data augmentation techniques to enhance the diversity and

generalizability of the model. A Convolutional Neural Network (CNN) was then designed and trained using TensorFlow and Keras, focusing on high accuracy and efficient computation. The trained model was evaluated using standard performance metrics such as accuracy, precision, recall, and F1-score to ensure reliability. For real-time application, the model was integrated with OpenCV to capture live video feed from a webcam, where each detected face is classified as either “Mask” or “No Mask.” Based on the prediction, the system highlights faces with green or red bounding boxes to indicate compliance or non-compliance, respectively. Optionally, an alert system can be integrated to notify authorities when a mask violation is detected. The entire system was tested under various lighting conditions and angles to verify its robustness and efficiency in practical environments.



(A)

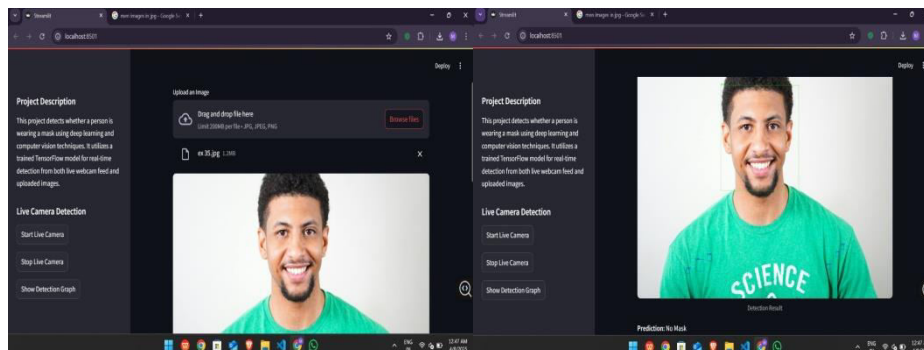
Fig(B,C); The images depict a web application designed for mask detection using deep learning and computer vision techniques. It leverages a TensorFlow-based model to analyze live webcam feeds or uploaded images, identifying whether a person is wearing a mask. The interface includes features like starting or stopping live camera detection and displaying detection graphs. The background of the detection image shows an indoor setting with windows, adding a realistic environment for testing the system's functionality.



(B)

(C)

Fig(C,D):This image shows a web application interface, likely built with Streamlit, running on localhost. The project described detects whether a person is wearing a mask using deep learning and computer vision, leveraging a TensorFlow model for real-time detection. An image of a smiling man in a green shirt has been uploaded for analysis. The interface also offers options for live camera detection and viewing detection graphs.



(C)

(D)

V. CONCLUSION

In conclusion, the **GuardMask: TensorFlow-Based Mask Compliance System** successfully demonstrates the potential of deep learning and computer vision technologies in promoting public health and safety. By leveraging Convolutional Neural Networks (CNNs) and real-time video processing, the system accurately detects whether individuals are wearing face masks, making it a valuable tool for environments where mask compliance is essential. The integration with TensorFlow ensured efficient training and deployment, while the system's scalability allows it to be adapted to various settings, including hospitals, transportation hubs, and workplaces. Overall, the project highlights how AI-driven solutions can be effectively applied to address real-world challenges, contributing to safer communities and aiding in pandemic response efforts.

The GuardMask project illustrates the effective use of artificial intelligence in enhancing health monitoring systems. By employing TensorFlow and CNN-based models, the system achieves high accuracy in detecting mask compliance in real-time, showcasing its practicality for deployment in public surveillance infrastructures. The modular design and adaptability of the system make it suitable for a range of applications, from small businesses to large public venues. This project not only reinforces the importance of AI in public health initiatives but also sets the foundation for further advancements in automated safety monitoring systems, including detecting other safety protocols or integrating with broader smart city solutions.

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