Face Mask Detection with Real-Time Alert System – Project Report

# Introduction

The COVID-19 pandemic emphasized the importance of wearing face masks in public spaces. Manual monitoring is impractical and inefficient. This project presents a real-time face mask detection system using computer vision and deep learning that identifies whether individuals are wearing a face mask and triggers audio alerts if not.

# Abstract

This project implements a real-time face mask detection system that uses a webcam feed to identify people without masks. It employs a trained deep learning model to classify detected faces into "Mask" or "No Mask" categories. If a person is detected without a mask, the system issues a voice warning and plays an alarm sound using text-to-speech and sound playback mechanisms. The primary goal is to promote safety compliance in public areas such as offices, hospitals, or schools.

# Tools Used

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| Tool/Library | Purpose |
| Python | Programming Language |
| OpenCV | Face detection and real-time video feed |
| TensorFlow/Keras | Model training and prediction |
| NumPy | Array and image preprocessing |
| pyttsx3 | Text-to-Speech for voice alerts |
| playsound | Audio alarm playback |
| Jupyter Notebook | Code development and visualization |

# Steps Involved in Building the Project

* Data Collection & Preprocessing - Gathered and processed images of people with and without masks. Converted images to grayscale, resized to a fixed shape (100x100), and normalized pixel values.
* Model Training - A Convolutional Neural Network (CNN) was trained using labeled mask and no-mask images. The model was compiled, trained, and saved for later prediction.
* Face Detection - Used OpenCV’s Haar Cascade Classifier to detect faces in each frame of the webcam stream.
* Real-Time Prediction - Each detected face was preprocessed and passed to the trained model to predict the class.
* Visual Feedback - A rectangle and label ('Mask' or 'No Mask') were displayed on the video feed over each detected face.
* Audio Alert Mechanism - If a 'No Mask' label was detected, the system:  
   - Triggered a voice message ('Please wear a mask') using pyttsx3.  
   - Played an alarm using playsound, both run in separate threads to avoid freezing the webcam.
* Optimization - Added alert interval logic to prevent repetitive alert spam. Used threading to ensure smooth and non-blocking real-time video feed.

# Conclusion

This project successfully demonstrates a practical application of deep learning and computer vision to enforce public safety. The system operates in real-time, accurately detects faces, classifies mask usage, and generates alerts when non-compliance is observed. Such a solution can be deployed in various environments to ensure health protocol adherence with minimal human intervention.