# Face Mask Detection with Live Alert System Report

## 🔹 Introduction

The COVID-19 pandemic has made wearing face masks essential in public spaces. However, manual enforcement is not scalable. This project automates mask detection using deep learning and computer vision, enabling real-time detection through a webcam and alerting when someone is not wearing a mask.

## 🔹 Abstract

This project implements a Convolutional Neural Network (CNN) to classify face images as “Mask” or “No Mask.” The trained model is integrated with OpenCV for real-time mask detection through webcam video. The system issues alerts when individuals are not wearing masks, making it suitable for public surveillance and safety enforcement.

## 🔹 Tools Used

- **Language**: Python
- **Libraries**: TensorFlow/Keras, OpenCV, NumPy
- **Model**: CNN with image classification
- **Dataset**: Kaggle Face Mask Dataset or custom-prepared labeled images
- **Hardware**: Webcam

## 🔹 Model Architecture

The CNN architecture used in this project is composed of three convolutional blocks followed by fully connected layers:

Input: (128, 128, 3) RGB image

Conv2D(32, 3x3) → ReLU
MaxPooling2D(2x2)
BatchNormalization
||
Conv2D(64, 3x3) → ReLU
MaxPooling2D(2x2)
BatchNormalization
||

```
Conv2D(128, 3x3) → ReLU
MaxPooling2D(2x2)
BatchNormalization
        ||
  Flatten
 Dense(128) → ReLU
Dropout(0.5)
Dense(2) → Softmax
```

- **Optimizer**: Adam
- **Loss Function**: Categorical Crossentropy
- **Output**: Probability distribution over classes [Mask, No Mask]

## 🔹 Project Workflow

1. **Data Preparation**
    - Resize, normalize images
    - One-hot encode labels
    - Train-test split
2. **Model Training**
    - Trained CNN for 10 epochs
    - Achieved ~96% test accuracy
3. **Real-Time Integration**
    - OpenCV captures webcam stream
    - Frames are resized and passed to the model
    - Predictions displayed with bounding box and label
4. **Alert System**
    - When "No Mask" is detected:
        - Show red warning on screen
        - Can be extended to include buzzer or sound alert

## 🔹 Conclusion

This project demonstrates a working prototype of a real-time face mask detection system using deep learning and computer vision. The trained CNN model performs with high accuracy and can be integrated into safety monitoring systems in public spaces. Future work can include multi-face detection, edge-device deployment, and integration with access control mechanisms.