

Project Report

# Department of Computer Science

## Course Title: Digital Image Processing

## Section: 6B

## Project Title:

Real-Time Face Mask Detection Using CNN and OpenCV

## Team Members:

|  |  |
| --- | --- |
| Name | Roll Number |
| Motasim Ejaz | CSC-22F-094 |
| Hamzauddin | CSC-22F-071 |

## Submitted To: Sir Ameen Chahjroo

# Abstract

This project focuses on detecting whether a person is wearing a face mask in real-time using a webcam. With the help of Deep Learning (CNN), OpenCV, and TensorFlow, we trained a model to distinguish between masked and unmasked faces. The trained model is then integrated with a real-time video stream using OpenCV, providing instant visual feedback with bounding boxes and classification labels.

# Objective

- To classify people as 'With Mask' or 'Without Mask' using a real-time webcam feed.  
- To implement a practical application of Convolutional Neural Networks (CNN) in Digital Image Processing.

# Tools & Libraries Used

Python - Main programming language  
TensorFlow / Keras - Deep learning model training and loading  
OpenCV (cv2) - Real-time webcam, image processing, face detection  
NumPy - Matrix and array operations  
Matplotlib - Visualizing accuracy and loss during training  
Haar Cascade Classifier - Face detection using pre-trained classifier

# Project Structure

Mask Detection Project/  
├── dataset/  
│ └── image/  
│ ├── with\_mask/  
│ └── without\_mask/  
├── mask\_detector.py  
├── mask\_detection\_model.h5  
├── mask\_detection\_realtime.py

# Methodology

## 1. Data Preparation

Two folders: with\_mask/ and without\_mask/.  
Used ImageDataGenerator to normalize images and apply validation split (20%).

## 2. Model Training (mask\_detector.py)

Built a Sequential CNN model with:  
- 2 Conv2D layers  
- MaxPooling  
- Flatten + Dropout  
- Dense layers for classification  
Trained on 80% of the data for 10 epochs and validated on 20%.  
Model saved as mask\_detection\_model.h5.

## 3. Real-Time Detection (mask\_detection\_realtime.py)

Loaded the trained model.  
Used Haar cascade classifier to detect faces.  
For each face:  
- Extracted, resized, and normalized the region.  
- Made prediction (With or Without Mask).  
- Drew bounding box and label.

# Results

✅ Green box = Person with Mask  
❌ Red box = Person without Mask

# Limitations

- Depends on lighting and camera quality  
- May misclassify if mask is improperly worn  
- Requires a well-balanced dataset for better accuracy

# Conclusion

This project demonstrates how CNNs and OpenCV can be effectively combined for real-time classification tasks. The solution is a practical application of digital image processing in the health and safety domain. It shows how technology can help monitor public compliance in sensitive environments like hospitals or public transport.

Date of Submission: June 2025