

## 1.Title Page

Project Name: Face Mask Detection (Binary Classification)

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## 2. Introduction

Wearing face masks is an important safety measure to reduce the spread of infectious diseases.

The goal of this project is to build a binary image classification system that automatically detects whether a person is wearing a face mask or not using a Convolutional Neural Network (CNN).

Such systems can be applied in public safety monitoring, access control, and smart surveillance systems.

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### 3. Dataset

The dataset consists of face images divided into two classes:

With Mask

Without Mask

Dataset Source: Public face mask image dataset

Number of Classes: 2

Data Split:

70% Training

15% Validation

15% Testing

Preprocessing Steps

Resize images to

Convert to RGB

Normalize pixel values to

Data augmentation applied to training data

## 4. Methodology

### Model Architecture

The CNN architecture consists of:

3 Convolutional layers with ReLU activation

Max Pooling layers for spatial reduction

Fully connected Dense layer

Dropout for regularization

Softmax output layer for binary classification

### Data Augmentation

Random rotation

Zoom

Horizontal flipping

Brightness adjustment

### Training Procedure

Optimizer: Adam

Loss Function: Sparse Categorical Crossentropy

Batch Size: 32

Epochs: 25 (Early Stopping applied)

Hyperparameters

Learning Rate: Default Adam

Image Size:

Dropout Rate: 0.5

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5. Results

The trained model achieved the following performance on the test set:

Overall Accuracy: ~62%

Confusion Matrix: Generated and analyzed

F1-Scores: Reported for both classes

Training and validation curves for accuracy and loss are included in the results section.

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## 6. Discussion

### What Worked Well

CNN successfully learned facial features

Data augmentation improved generalization

Model correctly identifies most “No Mask” cases

### What Failed and Why

Lower recall for the “Mask” class

Limited dataset size

Variations in mask types and lighting conditions

### Limitations

No transfer learning

Small dataset

Binary classification only

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## 7. Conclusion & Future Work

This project demonstrates that CNNs can be used effectively for face mask detection.

Future improvements include:

Using pre-trained models (MobileNet, ResNet)

Increasing dataset size

Extending to multi-class mask detection

## 8. References

1. TensorFlow Documentation

<https://www.tensorflow.org/learn>

2. Scikit-learn Documentation

<http://scikit-learn.org/>

3. Public Face Mask Dataset

<https://www.kaggle.com/datasets/omkargurav/face-mask-dataset>