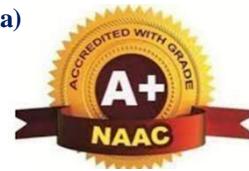


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**DEPARTMENT OF
COMPUTER SCIENCE ENGINEERING AND ARTIFICIAL INTELLIGENCE**

Neural Network and Deep Learning Project Report

**On
“Real-Time-Face-Mask-Detection”**

Submitted By

Keerthi Patil S 3BR22CA024

**Under the Guidance of
Prof. Pavan Kumar and Mr. Vijay Kumar
Dept of CSE-AI, BITM, Ballari**



**Visvesvaraya Technological University
Belagavi, Karnataka
2025-2026**

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CERTIFICATE

Certified that the mini project work entitled "**Real-Time-Face-Mask-Detection**" carried out by **Keerthi Patil S,** [3BR22CA024], Bonafide students of Ballari Institute of Technology and Management in partial fulfillment for the award of Bachelor of Engineering in Computer Science and Artificial Intelligence of the Visvesvaraya Technological University, Belgaum during the year 2025- 2026. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of the project work prescribed for the said Degree.

Signature of Lab Co-Ordinators
Mr. Prof. Pavan Kumar and Mr .Vijay Kumar

Signature of HOD
Dr. Yeresime Suresh

ABSTRACT

The COVID-19 pandemic has emphasized the critical importance of wearing face masks to reduce the spread of infectious diseases. Manual monitoring of mask compliance in public places is inefficient, inconsistent, and impractical for large-scale environments. To address this challenge, this project presents an automated real-time face mask detection system using Convolutional Neural Networks (CNNs) and computer vision techniques. The proposed system first detects human faces from live video streams and then classifies each detected face as either *With Mask* or *Without Mask*. The model is trained on a labeled dataset of masked and unmasked facial images after performing necessary preprocessing and data augmentation. OpenCV is used for real-time video acquisition and visualization. Experimental results demonstrate that the system achieves high accuracy with low latency and performs reliably under varying lighting conditions and face orientations. This solution provides an efficient, scalable, and cost-effective approach for monitoring mask compliance in public areas such as hospitals, educational institutions, transportation hubs, and workplaces, thereby contributing to enhanced public safety and health management.

ACKNOWLEDGEMENT

The satisfaction that accompanies the successful completion of project work on the “**Real-Time-Face-Mask-Detection**” would be incomplete without mentioning those who made it possible. Their noble gestures, affection, guidance, encouragement, and support crowned our efforts with success. It is our privilege to express our gratitude and respect to all those who inspired us in the completion of this project.

I am extremely grateful to our Lab Coordinators Professor and Head of the Department of CSE-AI, BITM, Ballari, for their noble gestures, support, coordination, and valuable suggestions in completing the project work.

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CHAPTER 1

INTRODUCTION

The COVID-19 pandemic emphasized the critical role of face masks in reducing the spread of infectious diseases, particularly in crowded public environments. Mask-wearing became a primary preventive measure recommended by health organizations worldwide to limit human-to-human transmission. However, enforcing mask compliance through manual monitoring is inefficient, time-consuming, and prone to human error, especially in large-scale public settings such as transportation hubs, shopping centers, hospitals, and educational institutions.

To overcome these limitations, this project proposes an automated real-time face mask detection system based on **Convolutional Neural Networks (CNNs)**. The system leverages deep learning and computer vision techniques to identify whether individuals are wearing face masks correctly or not. By automating the detection process, this solution ensures faster, more accurate, and consistent monitoring, thereby supporting public safety measures and reducing the risk of virus transmission. This intelligent system can be effectively deployed in real-world surveillance environments to enhance health safety and regulatory compliance.

CHAPTER 2

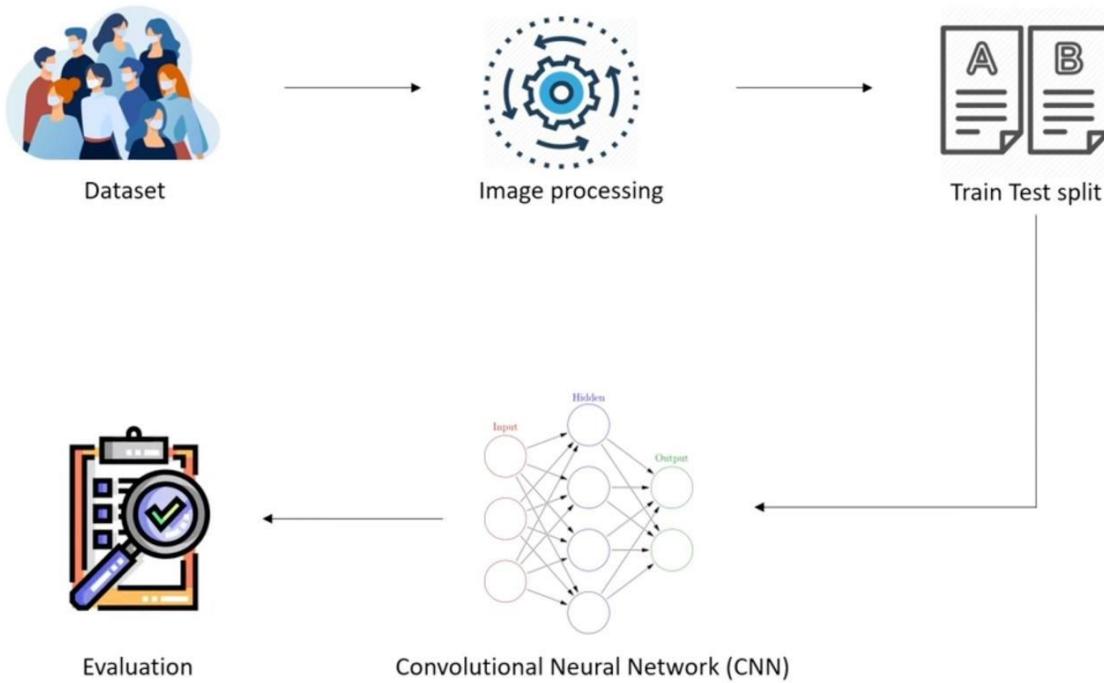
OBJECTIVES

1. **Data Collection and Preprocessing:** To collect a dataset of masked and unmasked human faces and perform necessary preprocessing steps such as resizing, normalization, labeling, and data splitting to prepare it for effective model training.
2. **Model Development:** To design and implement a Convolutional Neural Network (CNN) using deep learning frameworks to accurately classify whether a person is wearing a face mask or not.
3. **Training and Performance Evaluation:** To train the CNN model on labeled image data and evaluate its performance using metrics such as accuracy, precision, recall, F1-score, and confusion matrix.
4. **Real-Time Detection and Visualization:** To integrate the trained model with a real-time video stream using OpenCV for live face mask detection and to visually display results with bounding boxes and labels.
5. **Automation and Public Safety:** To develop an automated and reliable monitoring system that reduces human effort, ensures consistent mask detection, and supports public safety in crowded and sensitive environments.

CHAPTER 3

PROBLEM STATEMENT

To design and develop an automated system that can accurately detect whether a person is wearing a face mask in real time, addressing the limitations of manual monitoring which is slow, inconsistent, and prone to human error. In crowded public environments, it becomes difficult to ensure mask compliance using traditional methods, leading to safety risks and non-adherence to health guidelines. Therefore, an intelligent, efficient, and reliable face mask detection system is required to support continuous monitoring and enhance public safety.

CHAPTER 4**METHODOLOGY****4.1 Block Diagram**

This block diagram represents the workflow of a Flower Classification System. A flower image is given as input, which is then processed and converted into numerical features (x_1, x_2, x_3, x_4). These features are passed through a trained CNN or MLP model, where hidden layers (h_1, h_2, h_3) learn important patterns from the image. The model outputs predicted class values ($\hat{y}_1, \hat{y}_2, \hat{y}_3, \hat{y}_4$), identifying which flower category the image belongs to. Finally, the system displays the classified flower species along with the confidence level of the prediction.

CHAPTER 5

REQUIREMENT ANALYSIS

FUNCTIONAL REQUIREMENTS

1. **Image and Video Input Handling:** The system shall accept input from live camera feed as well as pre-recorded images and videos for mask detection.
2. **Face Detection:** The system shall detect human faces accurately from each frame using a robust face detection algorithm.
3. **Mask Classification:** The system shall classify each detected face as *Mask* or *No Mask* using the trained CNN model.
4. **Real-Time Processing:** The system shall perform detection and classification in real time with minimal delay.
5. **Visual Output Display:** The system shall display bounding boxes around detected faces along with corresponding labels and confidence scores.

NON-FUNCTIONAL REQUIREMENTS

1. **Accuracy:** The model should achieve at least 95% accuracy on test data to ensure reliability in tumor classification.
2. **Efficiency:** The system should train and predict results within reasonable computational time and resource limits.
3. **Scalability:** The system should allow retraining with new or larger datasets without major code modifications.
4. **Usability:** The interface and output should be clear and easily interpretable by both developers and non-technical users.
5. **Maintainability:** The code should be modular and well-documented for easy updates or future enhancements.

CHAPTER 6

DESIGN

FLOW CHART

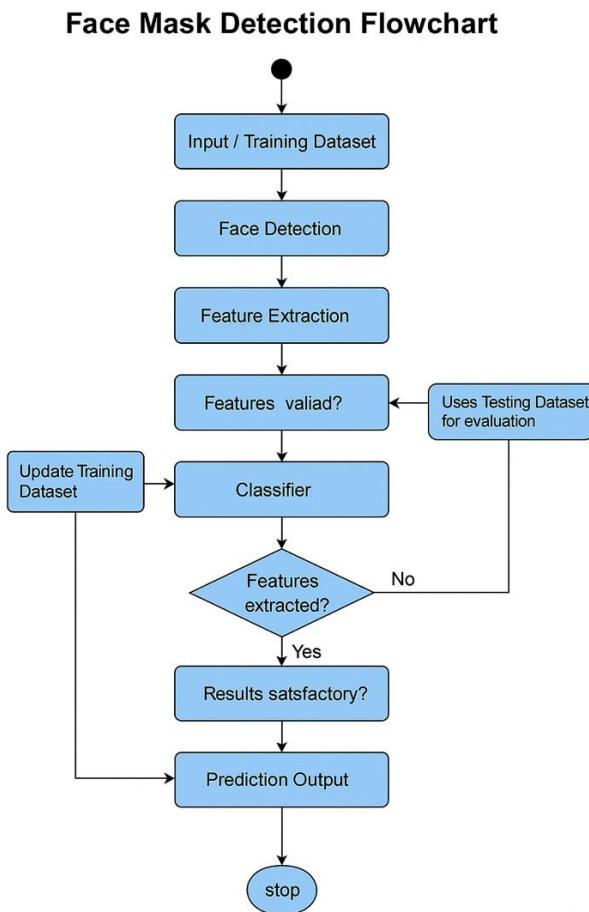


Fig 6.1 Flow Chart

USE CASE DIAGRAM

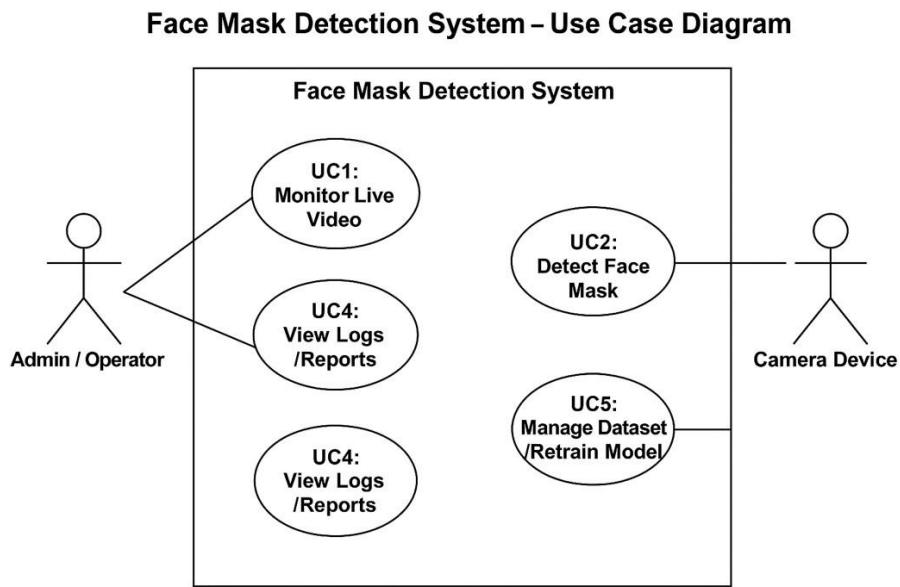


Fig 6.2 Use Case Diagram

SEQUENCE DIAGRAM

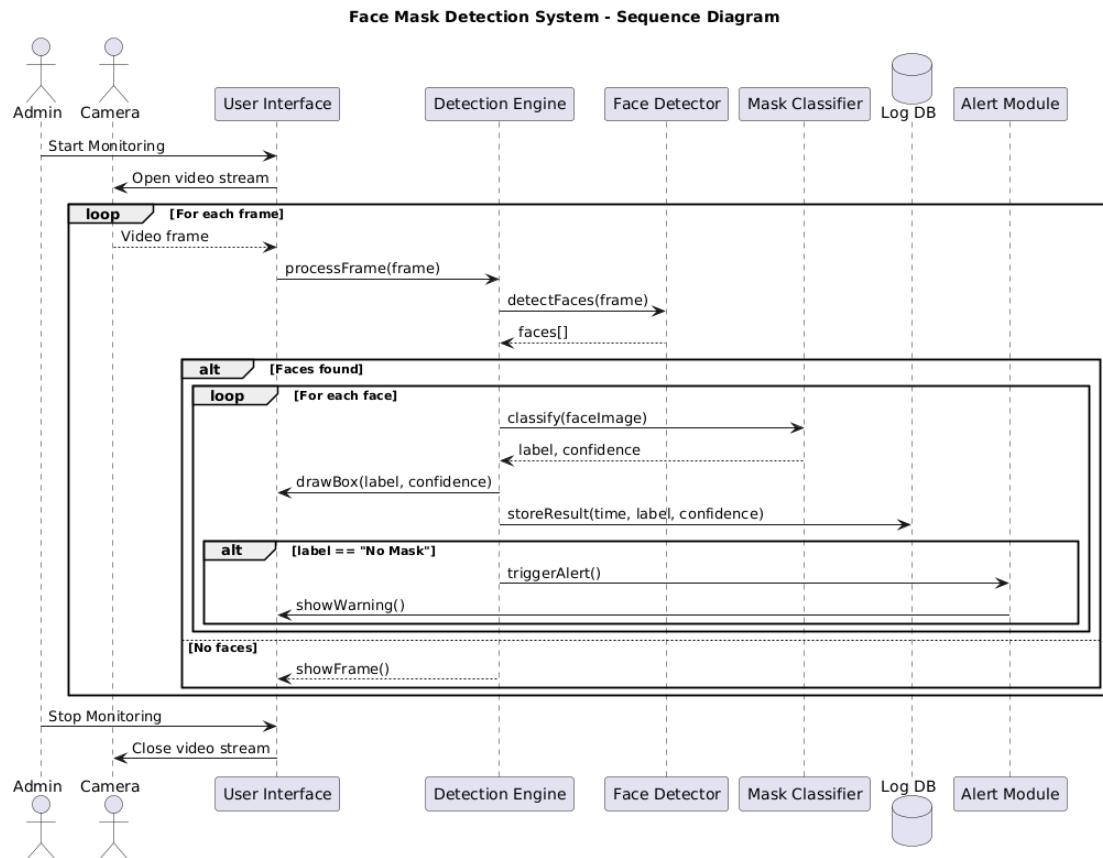


Fig 6.3 Sequence Diagram

CHAPTER 7

IMPLEMENTATION

Phase 1:

Data Preprocessing

The dataset is loaded and analysed to understand feature distributions, correlations, and class balance. Necessary cleaning, normalisation, and data splitting are performed to prepare the data for training.

Phase 2:

Preprocessing

A neural network model is implemented using PyTorch along with custom Dataset and DataLoader classes. The model is trained using labelled data and optimised using the Adam algorithm.

Phase 3:

Model Development

Different model configurations such as number of layers, hidden units, dropout rate, and learning rate are tested. The best model is selected based on validation performance.

Phase 4:

Training

The best-trained model is evaluated on the test set using accuracy, precision, recall, F1-score, confusion matrix, and ROC curve to measure overall performance.

Phase 5:

Evaluation

The final model is saved along with training details. An inference script is prepared for prediction, and full documentation is provided for future use.

CHAPTER 8

RESULTS AND DISCUSSION

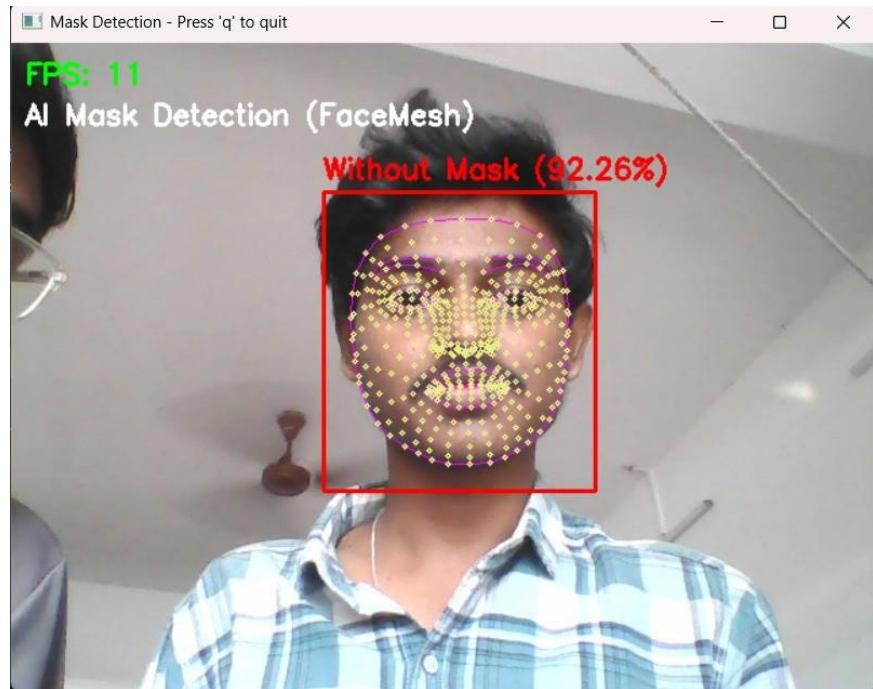


Fig 8.1: Real-Time Face Mask Detection Output Showing “Without Mask”

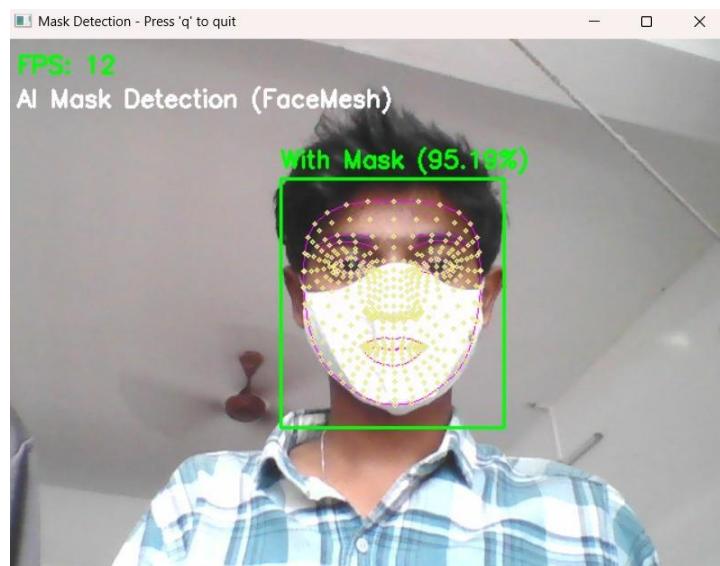


Fig 8.1: Real-Time Face Mask Detection Output Showing “With Mask”

CHAPTER 9

CONCLUSION

This project successfully demonstrates the design and implementation of an intelligent real-time face mask detection system using Convolutional Neural Networks (CNNs) and computer vision techniques. The proposed system effectively detects human faces and accurately classifies them as *With Mask* or *Without Mask* from live video streams. By automating the mask detection process, the system eliminates the limitations of manual monitoring, such as human error, inconsistency, and inefficiency in crowded environments.

Experimental results show that the developed model achieves high accuracy and performs reliably under various lighting conditions and face orientations. The integration of OpenCV for real-time video processing enhances system usability and responsiveness. This project highlights the practical application of artificial intelligence in public health and safety, especially during pandemic situations.

CHAPTER 10

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