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Face Mask Detection

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Abstract

"Health is Wealth," as millions of people are being killed by a newly discovered virus known as n-CoV (Corona virus), which is affecting a vast number of people. Because those who have Covid are asymptotically ill, the disease is referred to as mysterious. When an infected person coughs or sneezes, the infectious disease is primarily spread through droplets. Wearing a mask is one of the most important safety measures that everyone needs to take. When they go to crowded areas where there is a high chance of this disease spreading, some people wear masks incorrectly. In order to stop the spread of this virus and encourage people to wear masks in crowded places, we have developed a real-time face mask detector. But in the absence of automated preventative measures on the ground, face mask wearing regulations in colleges and other organizational settings are enforced by humans, buildings, is an extremely expensive and time-consuming action. In order to meet this challenge, it will not be feasible to mitigate highly airborne transmissible diseases, and the time to respond will keep getting bigger.

Keywords: Covid, Mask Detection, CNN, Cascade Classifier, Pre-processing Techniques.

1. Introduction

The term COVID-19 has gained popularity over the past 3 yrs. A viral pneumonia outbreak was caused by this novel infectious virus that first surfaced in Wuhan, China. In addition, a global outbreak contributed to the pandemic that struck in 2019. Symptoms of this virus included fever, dry cough, exhaustion, breathing difficulties, chest pain, pressure, and other symptoms. The fact that some disease carriers were also asymptotic contributed to the illness's lethality, strangeness, and mystery. [4] Covid is spread by droplets that sick individuals cough and sneeze. Wearing a mask is one of several precautions that are recommended to stop or lessen the transmission. However, a lot of people choose not to wear masks when they are in crowded areas. Therefore, developing new systems to automatically identify circumstances in which people neglect to wear face masks is a crucial task for the artificial intelligence and machine learning community. Automated face mask detection systems are in high demand as a result of global health crises and the widespread adoption of protective measures. In public places, wearing face masks to stop the spread of infectious diseases like COVID-19 has become standard procedure. Upholding mask-wearing regulations is essential for preserving public health and safety. Monitoring people by hand in a variety of contexts—from airports to shopping malls—requires a lot of resources and is prone to human error. The incorporation of technology, specifically computer vision and deep learning methodologies, offers a potentially effective approach to tackle this problem. Automated face mask detection systems can monitor in real time, lessen the workload for human observers, and improve public health campaigns overall. This paper presents a thorough investigation into the creation and assessment of a face mask detection system based on deep learning. The main goal is to create a model that can reliably identify people in a variety of dynamic and varied environments who are not wearing masks. Our method seeks to advance the expanding field of computer vision applications in public health and safety by utilizing cutting-edge convolutional neural networks (CNNs) and sophisticated image processing techniques, masks in public areas to slow the spread of pandemics like COVID-19. For the purpose of surveillance, It detect masks worn by people and also alerts if no mask isdetected.

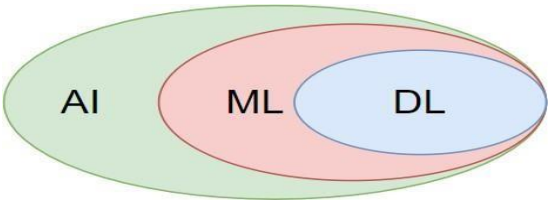


Figure 1: AI VS ML VS DL

As shown in Figure 1, deep learning (DL) is a subset of machine learning (ML) that uses multiple layers to comprehend, analyze, and extract features and characteristics from the input. Large amounts of input data are needed for deep learning, and the model takes longer to train and learn on its own. This aids in improving the accuracy of the results we provide.

Pattern recognition and image processing are the two primary applications of Convolutional Neural Networks (CNNs), which are a key component of deep learning or deep neural networks. CNN layers are composed of neurons that map and produce an output by analyzing and understanding the input using learnable weights and biases.

2. Literature Survey

S.no	Title	Author Name	General	Summary	Future Scope
1.	Face mask detection methods and techniques	Firas Amer Mohammed Alia , Mohammed S.H. Al-Tamimia	Convolutional Neural Networks, Deep Learning Frameworks, Cloud Services	This architecture is designed to improve the accuracy and robustness of face mask detection by progressively extracting and analyzing features at different levels of complexity. Here's a concise summary of how this architecture works:	Attention Mechanisms, Hierarchical Features, Mask-Type Recognition
2.	Multi-Stage CNN Architecture for Face Mask Detection	Amit Chavda, Jason Dsouza, Sumeet Badgujar, Ankit Damani	Data Augmentation, Image Preprocessing, GPU Acceleration, Web Frameworks, Version Control Tools	The architecture aims to enhance accuracy and robustness by progressively extracting and analyzing features at different levels of complexity. a sophisticated approach that utilizes Convolutional Neural Networks (CNNs) in a series of stages to accurately determine whether an individual in an image is wearing a face mask.	Semi-Supervised Learning, Health Monitoring Applications, Multimodal Fusion, Domain Adaptation
3.	Face mask detection in COVID-19	Vibhuti1 & Neeru Jindal2 & Harpreet Singh3 & Prashant Singh Rana	Computer Vision, Deep Learning and CNNs, Transfer Learning, Data Augmentation, YOLO	ace mask detection technology during the COVID-19 pandemic involves using advanced computer vision and deep learning techniques to automatically identify whether individuals are wearing masks properly in images or videos.	Improved Accuracy and Reliability, Mask-Type Recognition, Real-time Feedback and Alerts, Social Distancing Compliance
4.	The Face Mask Detection For Preventing the Spread of COVID-19	Susanto, Febri Alwan Putra, Riska Analia, Ika Karlina Laila Nur	Behavioral Insights, Public Health Impact, Ethical Considerations, Performance Evaluation	It is designed to automatically identify whether individuals in images or videos are wearing masks properly. This technology serves a critical role in enforcing mask-wearing compliance, contributing to public health measures aimed at mitigating the spread of the virus.	With ongoing advancements, the technology's potential includes improved accuracy, behavioral insights, integration with broader safety measures, and adaptability to different environments.
5.	Detecting Masked Faces in the Wild with LLE-CNNs	Shiming Ge1 , Jia Li2∗ , Qiting Ye1,3 , Zhao Luo1,3	Web APIs and Deployment, GPU Acceleration, Ethical Considerations, Public Health Impact	the Face Mask Detection technology serves as a vital tool in preventing the spread of COVID-19 by automating the monitoring of mask-wearing compliance. It combines computer vision and deep learning to enforce safety measures, thereby supporting	Algorithm Refinement, Mask Type Recognition, Multimodal Fusion, Privacy-Preserving Solutions, Cross-Domain Adaptation

				global public health initiatives during the pandemic.	
6.	A novel Deep Mask Net model for face mask detection and masked facial recognition	Naeem Ullah a , Ali Javed b,⇑ , Mustansar Ali Ghazanfar c , Abdulmajeed Alsufyani d , Sami Bourouis	GPU Acceleration, Performance Evaluation Metrics, Privacy and Ethical Considerations, Web Frameworks, Facial Recognition Algorithms	The "Deep Mask Net" model represents a novel approach that combines face mask detection and masked facial recognition using advanced deep learning techniques. While the specifics of this model may vary, the general concept involves leveraging convolutional neural networks (CNNs) to achieve accurate results in identifying both the presence of masks on faces and recognizing individuals even when they are wearing masks.	Multimodal Integration, Mask Type Classification, Large-Scale Deployment, Robustness to Variations, Enhanced Accuracy
7.	A Deep Learning Approach for Face Mask Detection to Prevent the COVID-19 Pandemic	Shay E. Snyder and Ghaith Husari	Ethical Considerations, Performance Evaluation Libraries, Cloud Services, Web APIs and Deployment, Real-time Image Processing Libraries, Object Detection Techniques	A Deep Learning Approach for Face Mask Detection to Prevent the COVID-19 Pandemic involves using advanced techniques from the field of deep learning and computer vision to automatically identify whether individuals are wearing masks properly in images or videos. This technology serves as a crucial tool in enforcing mask-wearing compliance and contributing to public health efforts during the COVID-19 pandemic.	Multimodal Fusion, Multilingual Support, Privacy-Preserving Solutions, Mask Type Classification, Enhanced Accuracy and Robustness

[8]. Face mask detection using transfer learning optimizes the process of creating accurate mask detection models by building upon the knowledge captured by pre-trained neural network models. This approach is efficient, effective, and contributes to efforts to prevent the spread of COVID-19 by enforcing mask-wearing compliance.[9] The concept of "Wear Mask: Fast In-browser Face Mask Detection with Serverless Edge Computing for COVID-19" refers to a specific technology that involves performing real-time face mask detection directly in web browsers using serverless edge computing. While I don't have direct knowledge of this specific technology as of my last update in September 2021.

[10] The primary objective of the "Rapid Real Time Face Mask Detection System" is to provide a real-time solution for monitoring and enforcing mask-wearing compliance as an effective measure to control the spread of COVID-19.

[11] Coronavirus 2019 has made a significant impact on the world. One effective strategy to prevent infection for people is to wear masks in public places. Certain public service providers require clients to use their services only if they properly wear masks. There are, however, only a few research studies on automatic face mask detection. In this paper, we proposed Retina Face Mask, the first high-performance single stage face mask detector. [12] Covid-19 Face Mask Detection Using TensorFlow, Keras, and OpenCV" refers to a project or approach that combines these popular libraries and tools to develop a system capable of detecting whether individuals in images or video streams are wearing face masks or not, thus aiding in enforcing mask-wearing guidelines during the COVID-19 pandemic.[13] Corona mask is a system developed to detect the presence or absence of face masks in real-time data, such as images or video streams. The primary goal is to assist in enforcing mask-wearing guidelines during the COVID-19 pandemic and similar scenarios where wearing face masks is essential for public health.[14] Real-time multi-scale facial mask detection is an advanced technology designed to accurately identify whether individuals are wearing face masks in real-time settings, accounting for varying sizes and distances.[15] Corona mask is a system developed to detect the presence or absence of face masks in real-time data, such as images or video streams. The primary goal is to assist in enforcing mask-wearing guidelines during the COVID-19 pandemic and similar scenarios where wearing face masks is essential for public health.[16] a face mask detector is a technology that utilizes machine learning and image analysis techniques to accurately determine whether individuals are wearing face masks. It plays a crucial role in promoting public health measures, especially during situations requiring widespread mask usage to prevent the spread of illnesses like COVID-19.[17] an AI-based face mask detection system combines artificial intelligence, computer vision, and deep learning techniques to accurately determine whether individuals are wearing face masks. It plays a crucial role in enforcing public health measures, especially during situations requiring widespread mask usage

to prevent the spread of illnesses like COVID-19.
[18] the real-time implementation of an AI-based face mask detection and social distancing measuring system leverages AI, computer vision, real-time processing, and user interfaces to enhance public safety during the pandemic.
[19] an AI-based face mask detection system combines artificial intelligence, computer vision, and deep learning techniques to accurately determine whether individuals are wearing face masks. It plays a crucial role in enforcing public health measures, especially during situations requiring widespread mask usage to prevent the spread of illnesses like COVID-19.[20] a face mask detector is a technology that utilizes machine learning and image analysis techniques to accurately determine whether individuals are wearing face masks. It plays a crucial role in promoting public health measures, especially during situations requiring widespread mask usage to prevent the spread of illnesses like COVID-19.[21] an AI-based face mask detection system combines artificial intelligence, computer vision, and deep learning techniques to accurately determine whether individuals are wearing face masks. It plays a crucial role in enforcing public health measures, especially during situations requiring widespread mask usage to prevent the spread of illnesses like COVID-19.[22] A deep learning approach for face mask detection, aimed at preventing the spread of the COVID-19 pandemic, employs advanced neural network architectures and large datasets to accurately identify whether individuals are wearing face masks in images or videos. This approach combines convolutional neural networks (CNNs), data preprocessing, transfer learning, and real-time inference to create effective models.[23] Face mask detection using transfer learning is a technique that harnesses the capabilities of pre-trained deep learning models to accurately identify individuals wearing face masks. This approach involves repurposing existing models that have learned features from vast image datasets and adapting them for the specific task of mask detection.[24] To help control the COVID-19 pandemic, technology has played a crucial role in innovations such as face mask detection using transfer learning. This involves repurposing pre-trained neural network models, usually Convolutional Neural Networks (CNNs), to identify whether individuals are wearing face masks. [25] Real-time mask detection on Google Edge TPU offers a sophisticated solution for applications like access control, healthcare, and public safety, demonstrating the power of edge computing and AI in addressing critical challenges such as mask-wearing compliance.

3. Methodology

3.1 Proposed System

3.2 Building of this Face Mask Detector consists of several phases/modules.

Data Collection
Model Creation
Pre-processing of Data
Training Model
Testing Model

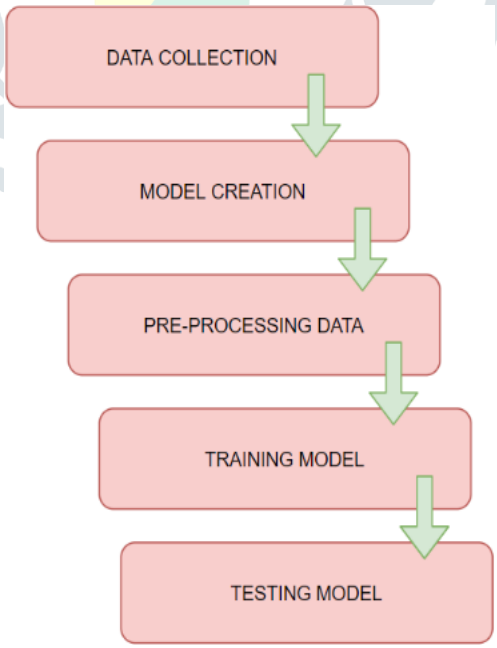


Figure 2: Building of this Face Mask Detector

Data Collection

The face mask detector required data set consisting of many images of people's faces with and without masks. For the modelto give more precise and accurate results irrespective of whatevermay be the input, we have collected data set consisting of imagesof people having faces with and without masks: zoomed images,inverted images, horizontally flipped, vertically flipped, faces with transparent masks, faces with face shields, no masks and faces with different coloured masks.

Inclusive of shielded faces and transparent masks images, our dataset contains 4624 images of people wearing with masks (2312 images) and without masks (2312 images).

Model Creation

The next phase after data collection is the Model creation/Modelling of the face mask detector. We have used Convolutional Neural Network, a branch of Deep Learning to model our system. The algorithm for the model creation is as follow:

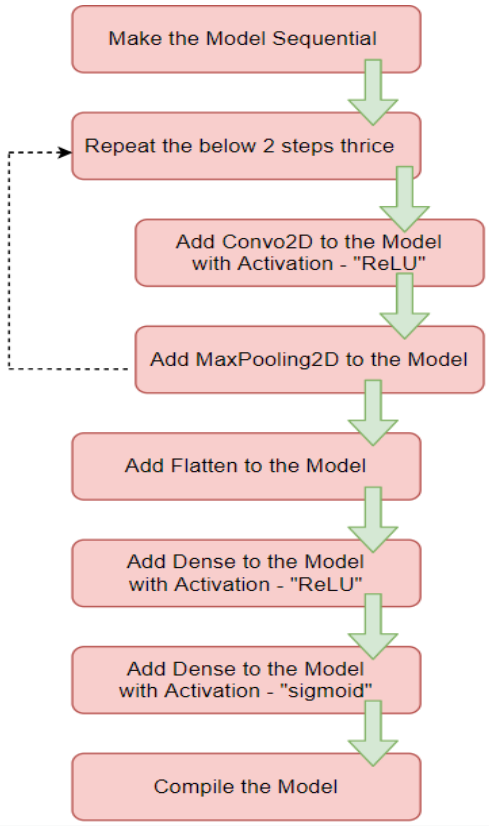


Figure 3: Model Creation

Pre-processing of data

Before input data is fed into a machine learning model, it must first undergo a number of preparation and cleaning steps in the face mask detection preprocessing process. Improving both the model's performance and the quality of the data is the aim.

Here are some common preprocessing steps for face mask detection:

. Data collection

. Image resizing

. Normalization

. Data Augmentation

. Label Encoding

. Data Splitting

. Face Detection

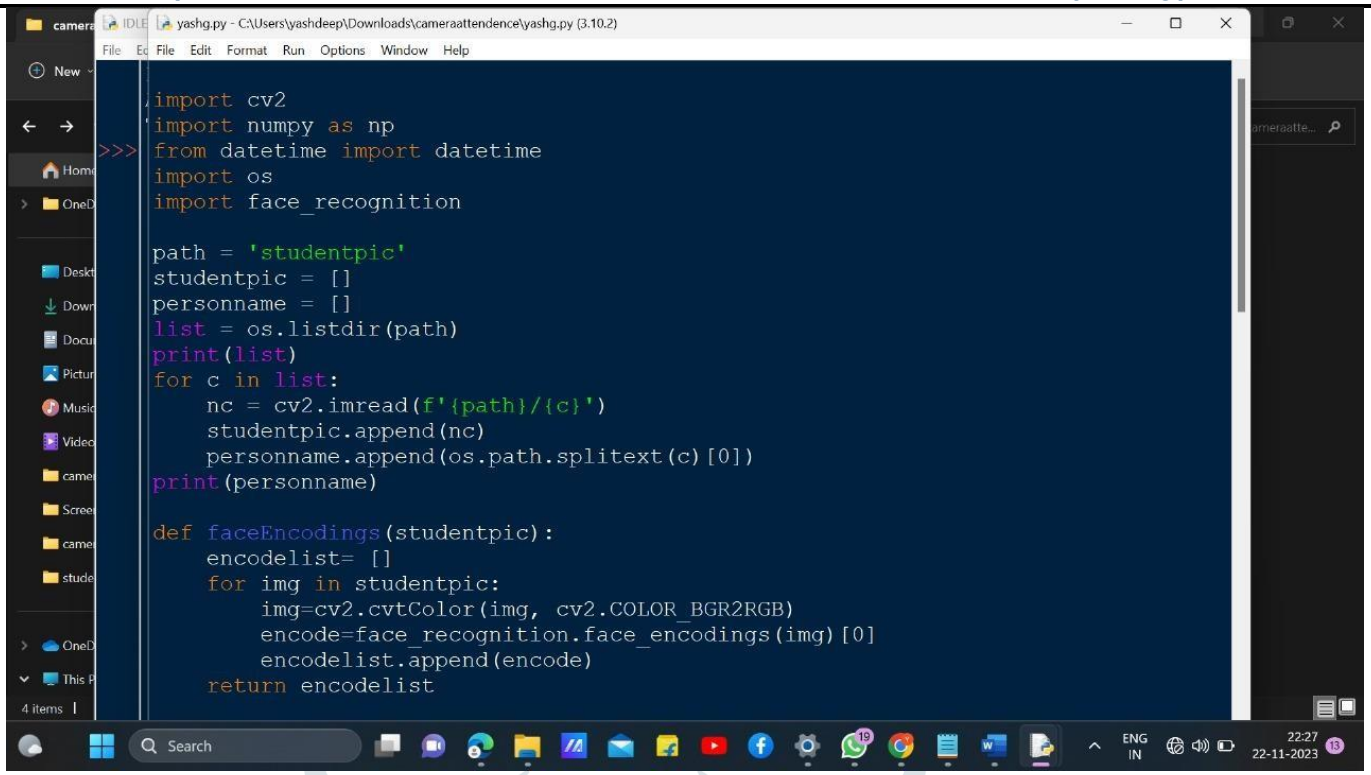
These preprocessing steps can vary depending on the specific requirements of the face mask detection task and the characteristics of the dataset being used.

- **Training Model**
  In order to train a face mask detection model, features and patterns from a labeled dataset are extracted by a machine learning algorithm. An outline of the procedures needed to train a face mask detection model is provided below**:**
  Data Preparation
  Model Selection
  Model Definition
  Model Compilation
  Model Training

- **Testing Model**
  In order to test a face mask detection model, one must evaluate its performance using a different dataset from the one it was trained on**.** Here are the key steps involved in testing a face mask detection model:
  Loading the Model
  Model Prediction
  Performance Metrices
  Visual Inspection

4. Result

The face mask detection results pertain to the efficacy and precision of the trained model in relation to novel, unseen data. Usually, a variety of metrics are used to analyze these outcomes in order to determine how effective the model is.
some key terms and metrics used to describe the results in face mask detection:
True positive:
Instances where the model correctly predicts that a person is wearing a face mask.
True negative:
Instances where the model correctly predicts that a person is not wearing a face mask.
False positive:
Instances where the model incorrectly predicts that a person is wearing a face mask when they are not.
False negative:
Instances where the model incorrectly predicts that a person is not wearing a face mask when they are.
Accuracy:
The ratio of correctly predicted instances (TP + TN) to the total instances. It provides an overall measure of the model's correctness.
Precision
The ratio pf true prediction to the total actual positives. It measures the ability of the model to capture instances.


yashg.py - C:\Users\yashdeep\Downloads\cameraattendence\yashg.py (3.10.2)
File Edit Format Run Options Window Help
import cv2
import numpy as np
from datetime import datetime
import os
import face_recognition
path = 'studentpic'
studentpic = []
personname = []
list = os.listdir(path)
print(list)
for c in list:
nc = cv2.imread(f'{path}/{c}')
studentpic.append(nc)
personname.append(os.path.splitext(c)[0])
print(personname)
def faceEncodings(studentpic):
encodelist= []
for img in studentpic:
img=cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
encode=face_recognition.face_encodings(img)[0]
encodelist.append(encode)
return encodelist
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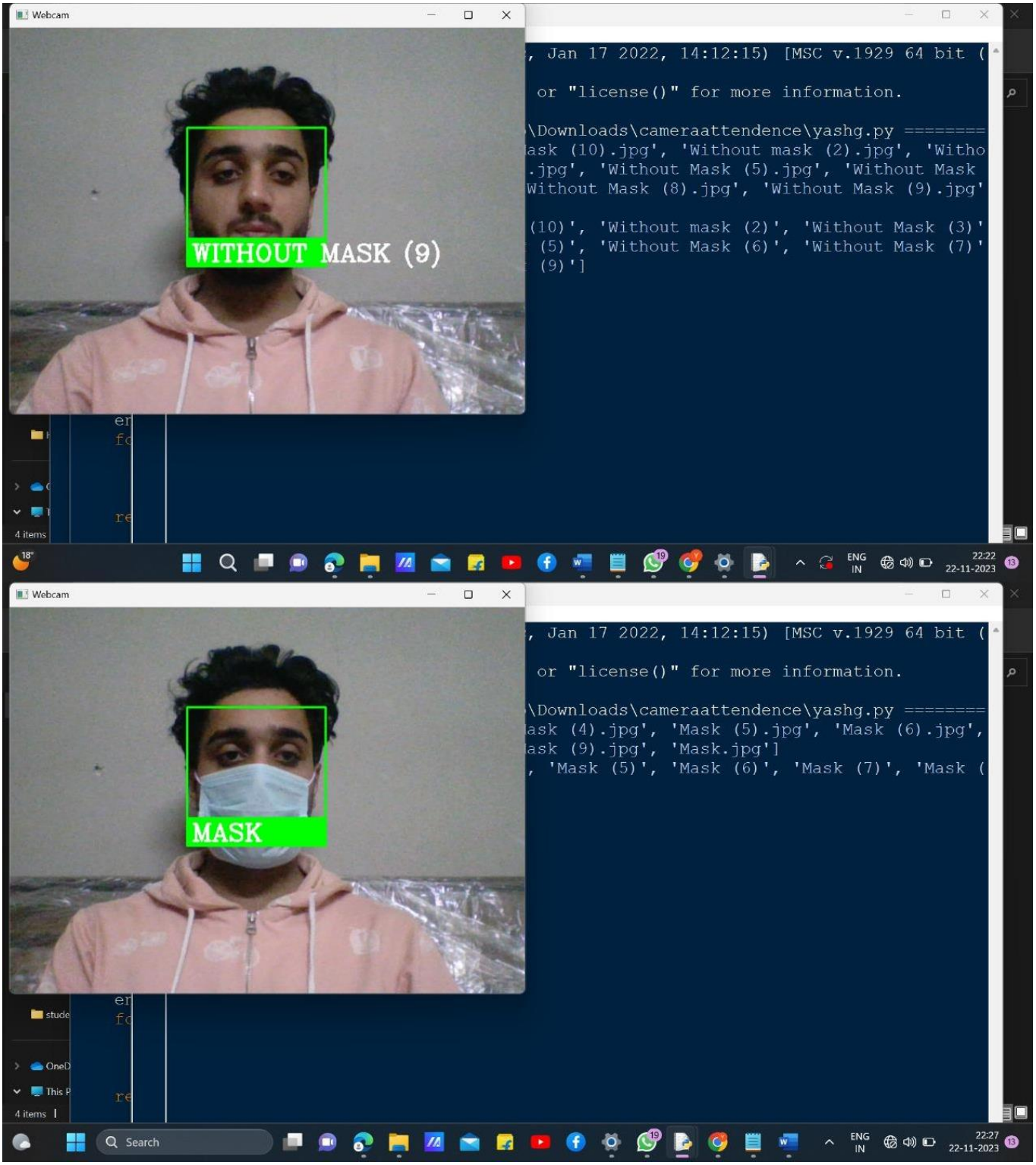

4.1 Conclusion

This paper focuses on and discusses a Convolutional Neural Network and OpenCV-built Real-Time Face Mask Detector. After evaluating and training the model using the obtained data set, we found that its accuracy was approximately accurate. This detector can be installed at the entrances to densely populated areas to aid in the detection of individuals not wearing masks. Whenever the system notices someone entering without a mask, it sounds an alarm (beep). The constant surveillance can make the area and the people around it cautious. The technology significantly lowers the spread of COVID.

4.2 Future Scope

Despite the fact that we have created a robust face mask detector with lots of features, our model has some drawbacks. The model requires adequate lighting to function properly. It is incapable of detecting faces at night or in low light. Furthermore, the model functions well against a plain backdrop. It occasionally misbehaves in bad backgrounds. To make this a fully functional model, anyone who takes up the project can work on the areas mentioned, fix these bugs, and improve the system. Additionally, only those wearing masks will be permitted entry into locations when this system is integrated with automatic doors at the entrances. All of these can lessen the spread of COVID and prevent contamination of the surrounding areas and people.
Following are the future uses:
Testing on Real-world Scenarios
Model Deployment
Reporting and Documentation
Visual Inspection
Model prediction
Loading the model

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