Face Mask Detection System using ML

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***Abstract*: According to the World Health Organization, the corona virus COVID-19 pandemic is producing a worldwide health catastrophe, and the most effective protective technique is wearing a face mask in public places (WHO). The COVID-19 epidemic compelled governments all over the world to implement lockdowns in order to limit viral spread. According to reports, wearing a face mask while at work significantly decreases the chance of transmission.An efficient and economic approach of using AI to create a safe environment in a manufacturing setup. A model using deep learning for face mask detection will be presented. A face mask detection dataset consists of with mask and without mask images , we are going to use OpenCV to do real-time face detection from a live stream via our webcam. We will use the dataset to build a COVID-19 face mask detector with deep learning using Python, OpenCV, and Keras. Our goal is to identify whether the person on image/video stream is wearing a face mask or not with the help of deep learning.**

INTRTODUCTION

Detecting a face mask is a difficult process. Because of the expansion of the corona virus illness, it has gotten a lot of attention lately. As a result, several nations have adopted policies such as "No admission without a mask." Face mask detection is a critical issue in Covid-19 prevention and security. In the medical sector, a mask decreases the danger of infection from an infected individual, whether or not they show symptoms. Face mask detection is utilised in a variety of settings, including airports, hospitals, offices, and educational institutions.

The corona virus outbreak has resulted in unprecedented levels of international scientific cooperation. In many ways, artificial intelligence (AI) based on machine learning and deep learning can aid in the fight against Covid-19. Researchers and doctors may use machine learning to analyse large amounts of data to anticipate the spread of COVID-19, act as an early warning system for future pandemics, and identify susceptible groups. To combat and forecast new illnesses, investment for developing technologies such as artificial intelligence and machine learning is required.. The AI's power is being used to combat the Covid-19 epidemic in order to better understand infection rates and to trace and promptly diagnose infections. Many nations have regulations requiring people to wear face masks in public. These guidelines and legislation were created in response to the rapid increase in cases and deaths in several locations. The task of monitoring big groups of individuals, on the other hand, is growing increasingly complex. Anyone who is not wearing a face mask is detected throughout the monitoring procedure.

Face recognition without a mask is simpler, but face recognition with a mask is more difficult because masked face feature extraction is more difficult than regular face feature extraction. Many facial characteristics, such as the nose, lips, and chin, are missing from the covered face. In two phases, a large number of face masks may be detected..

1) Face Recognition 2) Feature Extraction

The first stage is facial recognition, which entails detecting a person's face from a picture. The most common issue is detecting multiple mask and unmasked faces in an image. A traditional object detection method can be used to solve the problem. The technique of extracting parts of faces that are of interest is known as feature extraction..

Feature Extraction is a process of extracting part of faces that are area of interest. Extracted image then matched with mask and no mask images using classifier (model) and then gives us the result.

DEEP LEARNING ARCHITECTURE

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From the provided examples, the deep learning architecture learns a variety of significant nonlinear characteristics. The learnt architecture is then utilised to forecast samples that have never been seen before. We gathered pictures from various sources to train our deep learning architecture. CNN plays a significant role in the learning technique's architecture. The following sections cover every element of deep learning architecture.

Dataset Collection: For training and testing the model, data from two distinct sources is collected. We gathered a total of 1915 photos of people wearing and not wearing masks. For training purposes, 80 percent of the pictures are used for training, while the remaining images are used for testing.

ii) Architecture Development: The learning model is built on a deep learning classifier, which may be used to recognise patterns in pictures. An input layer, multiple hidden layers, and an output layer make up the network. Multiple convolution layers make up the hidden layers, which develop appropriate filters for extracting essential features from the provided data. Multiple dense neural networks employ the characteristics collected by DL to make classification decisions.

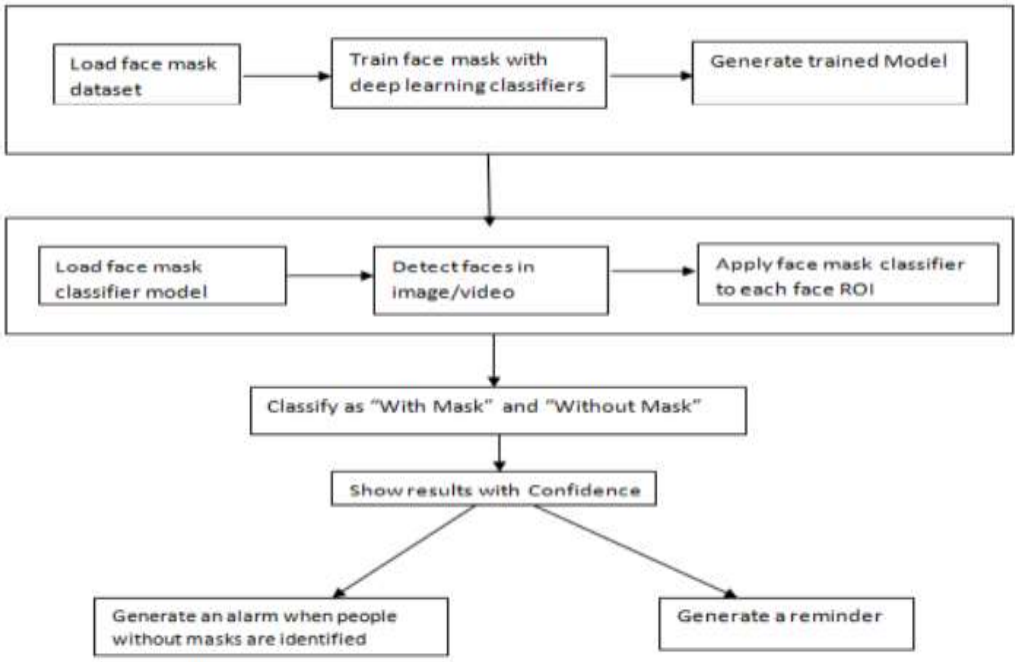

Fig 3: Architecture of Proposed Face mask detection system.

Deep Learning Frameworks

To implement this deep learning network we have the following options.
1. Tensor Flow
2.Keras
3.PyTorch

TensorFlow is a free and open-source software framework for dataflow and differentiable programming that may be used to solve a variety of problems. It's a symbolic math library that's also utilised in neural networks and other machine learning applications. TensorFlow is Google Brain's second-generation system, which is used for both research and production.

Keras is a human-centered API rather than a machine-centered one. Keras adheres to best practises for reducing cognitive load by providing consistent and simple APIs, reducing the number of user actions required for common use cases, and providing clear and actionable error messages.Keras includes numerous implementations of commonly used neural-network building blocks such as layers, objectives, activation functions, optimizers, and a host of tools to make working with neural networks easier.

PyTorch is an open source machine learning framework based on the Torch library that is used for applications such as computer vision and natural language processing. It was created largely by Facebook's AI Research team (FAIR).

Images without mask

Images with mask

Applications

Airports: The proposed method might be highly beneficial in recognising people who aren't wearing masks when travelling through airports. Traveller data can be gathered as videos in the system at the entry. If a traveller is found without a face mask, the airport authorities are notified, allowing them to respond promptly.

Hospitals: The recommended technique may be used in conjunction with CCTV cameras to identify whether or not their personnel are wearing masks. If a health practitioner is found without a mask, they may be reminded to wear one.

Offices : The approach described might help maintain safety standards and prevent the spread of Covid-19 or any other airborne infection. If an employee is not wearing a mask, a reminder message may be sent to them. When choosing a system, the best performance must be taken into account. As a consequence, the aforementioned performance indicators may be taken into account while designing the best system that can be implemented on a large scale..

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Face Mask Detection in webcam stream

The flow to determine whether or not the person in the webcam is wearing a face mask. There are two steps to the procedure.
1. Recognize the people in the webcam
2.Organize the faces into groups based on their masks. A pre-trained model from the OpenCV framework was used to recognise the faces.

To identify the faces a pre-trained model provided by the OpenCV framework was used. The model was trained using web images.

Limitations

Because it nearly seems like the individual is wearing a mask, the created system has trouble identifying faces covered by hands. It is quite difficult to differentiate each person's face in a highly crowded place. Identifying persons without a face mask in this circumstance would be extremely challenging for our suggested method. To obtain the greatest results from this system, the city needs a huge number of CCTV cameras to watch the whole city, as well as committed staff to enforcing the rules against violators.

RESULT

. The dataset is partitioned into training and testing sets by preserving a reasonable proportion of different classes. The dataset contains a total of 1915 samples, with 80% of them being utilised in the training phase and 20% in the testing phase. There are 1532 and 383 pictures in the training and testing datasets, respectively. Because more training leads in overfitting on the training data, the resulting architecture is trained for 100 epochs. When a model learns the undesirable patterns of the training data, this is known as overfitting. As a result, training accuracy improves but test accuracy declines.

FUTURE SCOPE

Different classifiers are used to evaluate the present system. In the near future, the best system, as well as interface with alarm and alerting systems, may be developed.
This system might be combined with a system that implements social distance, resulting in a healthy system that has a significant influence on the spread. Masks are becoming the new normal, and we're headed for a world without faces. Experts warn that this may be a major security risk." - Luke McGee (Luke McGee) Though wearing face masks has been proven to be the most effective way to prevent the transmission of airborne viruses such as Corona, it poses a significant security risk to the country since it might provide possibilities for those who hide their faces for malicious purposes. Experts warn that when face recognition becomes a more essential component of monitoring criminals, mass mask-wearing might hinder crime investigations in the coming days.

CONCLUSION

We utilised OpenCV, tensor flow, keras, Pytorch, and Deep learning to determine whether individuals were wearing face masks or not as technology is blooming with growing trends and availability. Images and real-time video feeds were used to evaluate the models. The model's correctness has been attained, and model optimization is a continual process in which we are developing a very precise answer by fine-tuning the hyper parameters.. This model might be used as an example of edge analytics in action. Furthermore, using a public face mask.dataset, the suggested approach delivers state-of-the-art results. The development of face mask detection technology that can identify if someone is wearing a mask and allow them entrance would be extremely beneficial to society.

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