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Face Mask Detection and Alert System

Using Computer Vision and Deep Learning

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Abstract : The COVID-19 pandemic is causing a worldwide emergency in healthcare. This virus mainly spreads through droplets which emerge from a person infected with coronavirus and poses a risk to others. The risk of transmission is highest in public places. One of the best ways to stay safe from getting infected is wearing a face mask in open territories as indicated by the World Health Organization (WHO). In this project, we propose a method which employs TensorFlow and OpenCV to detect face masks on people. A bounding box drawn over the face of the person describes whether the person is wearing a mask or not. If a person's face is stored in the database, it detects the name of the person who is not wearing a face mask and an email will be sent to that person warning them that they are not wearing a mask so that they can take precautions.

IndexTerms **– Covid-19, face mask, TensorFlow, OpenCV, database.**

I. INTRODUCTION

COVID-19 had a massive impact on human lives. The pandemic lead to the loss of millions and affected the lives of billions of people. Its negative impact was felt by almost all commercial establishments, education, economy, religion, transport, tourism, employment, entertainment, food security and other industries. According to WHO(World Health Organization), 55.6 million people were infected with Coronavirus and 1.34 million people died because of it as of November 2020. This stands next to black death which almost took the lives of 60 percent of the population in Europe in the 14th century. After the person gets infected, it takes almost fourteen days for the virus to grow in the body of its host and affect them and in the meantime, it spreads to almost everyone who is in contact with that person. So, it is extremely hard to keep track of the spread of COVID-19. COVID-19 mainly spreads through droplets produced as a result of coughing or sneezing by an infected person. This transfers the virus to any person who is in direct close contact (within one-meter distance) with the person suffering from coronavirus. Because of this, the virus spreads rapidly among the masses. With the nationwide lockdowns being lifted, it has become even harder to track and control the virus.

Face masks are an effective method to control the spread of viruses. It has been found that wearing face masks is 96% effective to stop the spread of viruses. The governments, all over the world, have imposed strict rules that everyone should wear masks while they go out. But still, some people may not wear masks and it is hard to check whether everyone is wearing a mask or not. In such cases, computer vision will be of great help. There are no efficient face mask detection applications to detect whether the person is wearing a face mask or not. This increases the demand for an efficient system for detecting face masks on people for transportation means, densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety. This proposed method uses machine learning classification using OpenCV and Tensorflow to detect face masks on people.

II. RESEARCH METHODOLOGY

Dataset Collection:

The dataset was collected from Kaggle Repository and was split into training and testing data after its analysis. The data consists of three classes – With mask, Without mask and Improper mask. For training purposes, 80% images of each class are used and the rest of the images are utilized for testing purposes.

Machine Learning Classifiers

These are used to predict the class/target/labels/categories of a given data point. Classification belongs to the category of supervised learning in which the targets are provided with input data. They are used in many applications like medical diagnosis, spam detection, target marketing etc. They use a mapping function (f) from input variables (X) to discrete output variables(Y).

1. **OPENCV:**

OpenCV is an open-source library which is primarily used for Computer Vision Applications. This contains many functions and algorithms for Motion tracking, Facial recognition, Object Detection, Segmentation and recognition and many other applications. Images and real time video streams can be manipulated to suit different needs using this library.

2. **TENSORFLOW:**

It is an open-source machine learning framework to build and train neural networks. It has a collection of tools, libraries and community resources which helps in easy building of deployment of ML powered applications. This is developed and maintained by Google and was released in 2015.

3. **KERAS:**

Keras is a high-level neural network library that runs on top of TensorFlow. Both provide high level APIs used for easily building and training models but Keras is more user-friendly because it is built-in Python.

Image Processing

A default OpenCV module is used to obtain faces followed by training a Keras model to identify the mask. Haar Cascade Classifier is used to detect input from the cam. The images captured are pre-processed before going to the next step. In the preprocessing step, the image is transformed into a grayscale image because the RGB color image contains so much redundant information that is not necessary for face mask detection. RGB color image stored 24 bit for each pixel of the image. On the other hand, the grayscale image stored 8 bit for each pixel and it contained sufficient information for classification. Then, we reshaped the images into (64×64) shape to maintain uniformity of the input images to the architecture. The images are resized to maintain uniformity.

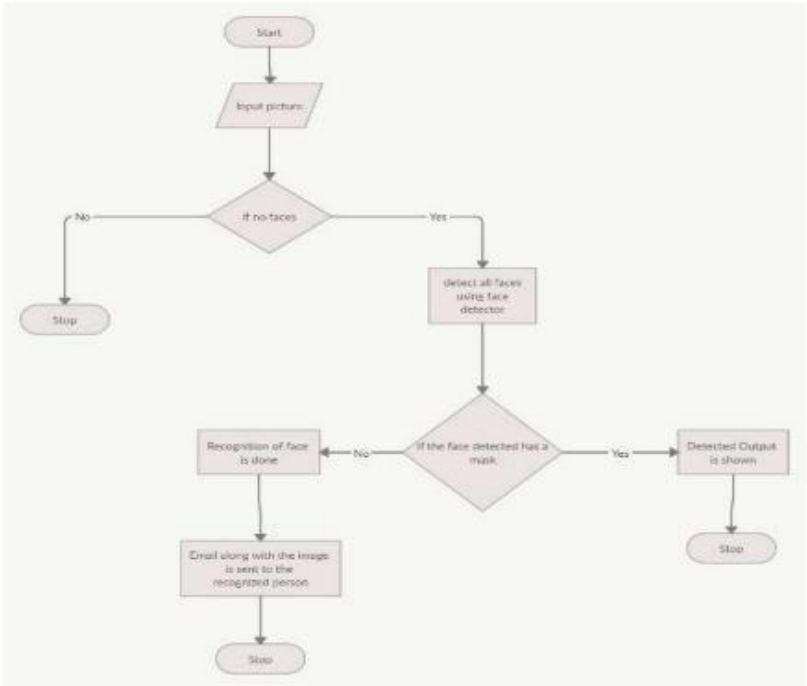
Architecture Development

The learning model is based on CNN which is very useful for pattern recognition from images. It sees data from all the classes. The network comprises an input layer, several hidden layers and an output layer. The hidden layers consist of multiple convolution layers that learn suitable filters for important feature extraction from the given samples. The features from CNN are used for multiple dense neural networks for classification.

Alert Generation

The main goal of our proposed system is screening persons who are not following guidelines of using a facial mask. The learning architecture identifies whether any input image contains persons without a face mask. If such a person is detected, then it sends an alert to the authorities in the form of email or a message about the mask not being worn by the person.

Flow Chart of the Model



III. LIMITATIONS AND FUTURE WORKS

The developed system faces difficulties in classifying faces covered by hands since it almost looks like the person wearing a mask. While any person without a face mask is traveling on any vehicle, the system cannot locate that person correctly. For a very densely populated area, distinguishing the face of each person is very difficult. For this type of scenario, identifying people without face masks would be very difficult for our proposed system. In order to get the best result out of this system, the city must have a large number of CCTV cameras to monitor the whole city as well as dedicated manpower to enforce proper laws on the violators. Since the information about the violator is sent via SMS, the system fails when there is a problem in the network.

The proposed system mainly detects the face mask and informs the corresponding authority with the location of a person not wearing a mask. Based on this, the authority has to send their personnel to find out the person and take necessary actions. But this manual scenario can be automated by using drones and robot technology to take action instantly. Furthermore, people near to the person not wearing a mask may be alerted by an alarm signal on that location, and displaying the violator's face in a LED screen to maintain a safe distance from the person would be a further study.

IV. RESULTS AND DISCUSSION

With the increasing number of COVID cases all over the world, a system to replace humans to check masks on the faces of people is greatly needed. This system satisfies that need. This system can be employed in public places like railway stations and malls. It will be of great help in companies and huge establishments where there will be a lot of workers. This system will be of a great help because it is easy to obtain and store the data of the employees working in that Company and will very easily find the people who are not wearing the mask and a mail will be sent to that respective person to take Precautions not wearing a mask.

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