MASK DETECTION AND ALERT SYSTEM FOR SOCIAL DISTANCING

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Abstract—T A novel coronavirus has resulted in person-to-person transmission but as far as we know, the transmission of the novel coronavirus causing coronavirus disease 2019 (COVID-19) can also be from an asymptomatic carrier with no covid symptoms. COVID-19 spreads mainly from person to person through respiratory droplets. Respiratory droplets travel into the air when you cough, sneeze, talk, shout, or sing. These droplets can then land in the mouths or noses of people who are near you or they may breathe these droplets in. When you wear a mask, you protect others as well as yourself. Masks work best when everyone wears one. They are a simple barrier to help prevent your respiratory droplets from reaching others. Studies show that masks reduce the spray of droplets when worn over the nose and mouth. Masks can also reduce the inequitable impact of the pandemic, particularly for those who live in crowded environments where physical distancing is difficult, and for those who work in frontline roles where there is a greater risk of exposure to the virus. At the moment, WHO recommends that people should wear face masks to avoid the risk of virus transmission and also recommends that a social distance of at least 2m be maintained between individuals to prevent person-to person spread of disease. Furthermore, many public service providers require customers to use the service only if they wear masks and follow safe social distancing. Therefore, face mask detection and safe social distance monitoring has become a crucial computer vision task to help the global society. This project describes approach to prevent the spread of the virus by monitoring in real time if person is following safe social distancing and wearing face masks in public places.

Keywords—COVID-19, machine learning, mask, face detection

I. INTRODUCTION (*HEADING 1*)

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them.

It is among rapidly growing technologies today, with its applications in various aspects of a business. Image Processing forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps.
Importing the image with optical scanner or by digital photography.
Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.

Output is the last stage in which result can be altered image or report that is based on image analysis.

Purpose of Image processing

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image.
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

Classification

The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing.

Machine Learning

"Optimizing a performance criterion using example data and past experience", said by E. Alpaydin, gives an easy but faithful description about machine learning. In machine learning, data plays an indispensable role, and the learning algorithm is used to discover and learn knowledge or properties from the data. The quality or quantity of the dataset

will affect the learning and prediction performance. The textbook (have not been published yet) written by Professor Hsuan-Tien Lin, the machine learning course instructor in National Taiwan University (NTU), is also titled as "Learning from Data", which emphasizes the importance of data in machine learning. Fig. 1 shows an example of two-class dataset.

Training Set and Test Set in machine learning, an unknown universal dataset is assumed to exist, which contains all the possible data pairs as well as their probability distribution of appearance in the real world. While in real applications, what we observed is only a subset of the universal dataset due to the lack of memory or some other unavoidable reasons. This acquired dataset is called the training set (training data) and used to learn the properties and knowledge of the universal dataset. In general, vectors in the training set are assumed independently and identically sampled (i.i.d) from the universal dataset. In machine learning, what we desire is that these learned properties can not only explain the training set, but also be used to predict unseen samples or future events.

In order to examine the performance of learning, another dataset may be reserved for testing, called the test set or test data. For example, before final exams, the teacher may give students several questions for practice (training set), and the way he judges the performances of students is to examine them with another problem set (test set).

II. LITERATURE SURVEY

In 2017, Dr. S Syed Ameer Abbas and his co-authors proposed a system for human tracking and crowd management using raspberry pi and Open-CV. A cascade classifier was trained for head detection from the scene is trained using Haarfeatures through OpenCV. The whole concept of their idea was to record the crowded scene using a camera and Raspberry pi3 that has a quad core ARMv8 central processing unit which processes the video frame by frame. The head count is measured and the crowd is managed by comparing the value with the threshold and if it surpasses the threshold the prevention can be done accordingly.

2018, Joel Joseph Joy and his co-authors proposed a system of traffic density identification which was based on image processing. The queue length and the traffic densities were recorded from the images taken from the camera. The video input was taken and fuzzy logic was applied to handle the concept of partial truth. The outcome of partial truth concept could range anywhere between completely true and completely false.

In 2020, Adrian Rosebrock published an article on social distancing detector which is based on OpenCV, Computer Vision and Deep Learning concept. The article throws a light on social distancing during the pandemic period and it focuses on social distance monitoring through CCTV cameras installed across streets. The camera records the distance between people in pixels and compares it with the standard measurement and thus behave as a social distancing detector. This social distance detector application logic resides in the file.py script and this file is responsible for looping over frame of a video stream and ensuring that people are maintaining a healthy distance from one another. It is compatible with both video files and webcam streams.

The purpose of this paper is to inspect whether the people in a public place maintain social distancing. It also checks whether every individual is wearing face mask. If If both are not done, the drone sends alarm signal to nearby police station and also give alarm to the public. In addition, it also carries masks and drop them to the needed people. Nearby, traffic police will also be identified and deliver water packet and mask to them if needed.

This survey paper emphasizes on a surveillance method which uses Open-CV, Computer vision and Deep learning to keep a track on the pedestrians and avoid overcrowding. The implementation can be done using closed circuit television (CCTV) and Drones where the camera will detect the crowd with the help of object detection and compute the distance between them. The Euclidean distance between two people will be calculated in pixels and is compared with given standard distance and if it is observed to be less than the standard distance the local authorities or local police authorities will be notified.

Rapid worldwide spread of Coronavirus Disease 2019 (COVID 19) has resulted in a global pandemic. Correct facemask wearing is valuable in infectious disease control, but the effectiveness of facemasks has been diminished mostly due to improper wearing. However, there have not been any published reports on the automatic identification of facemask wearing conditions. In this study, we developed a new facemask wearing condition identification method in combination with image super resolution with classification network (SRCNet) SRCNet), which quantified a three categories classification problem based on unconstrained 2D facial image images. The proposed algorithm contained four main steps: image pre-processing, face detection and crop, image super resolution, and face mask wearing conditions identification.

III. PROPOSED SYSTEM

In this proposed project study, we have planned to develop a hybrid model integrating social distancing and mask detection from real inputs using system webcam. First video to frame conversion happens, then image processing and machine learning techniques are applied. Using the machine learning technique, the model is been generated and whenever inputs comes it compares with the trained model and social distancing, mask are predicted. The system would

automatically detect the social distancing and mask detection which are a critical factor for prevention for covid 19. The human might subject to forget these new lifestyle, thus automatic detection and alerting the human race with regard to social distancing and mask detection is important until vaccine is been discovered. For effective machine learning based classification, we use convolutional neural network (CNN).

Biomedical Imaging techniques

For medical diagnosis, different types of imaging tools such as X- ray, Ultrasound, computer aided tomography (CT) etc are used. The diagrams of X- ray, MRI, and computer aided tomography (CT) are given below.

Some of the applications of Biomedical imaging applications are as follows:

- Heart disease identification– The important diagnostic features such as size of the heart and its shape are required to know in order to classify the heart diseases. To improve the diagnosis of heart diseases, image analysis techniques are employed to radiographic images.

- Lung disease identification – In X- rays, the regions that appear dark contain air while region that appears lighter are solid tissues. Bones are more radio opaque than tissues. The ribs, the heart, thoracic spine, and the diaphragm that separates the chest cavity from the abdominal cavity are clearly seen on the X-ray film.

- Digital mammograms – This is used to detect the breast tumour. Mammograms can be analyzed using Image processing techniques such as segmentation, shape analysis, contrast enhancement, feature extraction, etc.

Automatic Visual Inspection System

This application improves the quality and productivity of the product in the industries.

Automatic inspection of incandescent lamp filaments – This involves examination of the bulb manufacturing process. Due to no uniformity in the pitch of the wiring in the lamp, the filament of the bulb gets fused within a short duration. In this application, a binary image slice of the filament is created from which the silhouette of the filament is fabricated. Silhouettes are analyzed to recognize the non uniformity in the pitch of the wiring in the lamp. This system is being used by the General Electric Corporation.

Automatic surface inspection systems – In metal industries it is essential to detect the flaws on the surfaces. For instance, it is essential to detect any kind of aberration on the rolled metal surface in the hot or cold rolling mills in a steel plant. Image processing techniques such as texture identification, edge detection, fractal analysis etc are used for the detection.

Faulty component identification – This application identifies the faulty components in electronic or electromechanical systems. Higher amount of thermal energy is generated by these faulty components. The Infra-red images are produced from the distribution of thermal energies in the assembly. The faulty components can be identified by analyzing the Infra-red images.

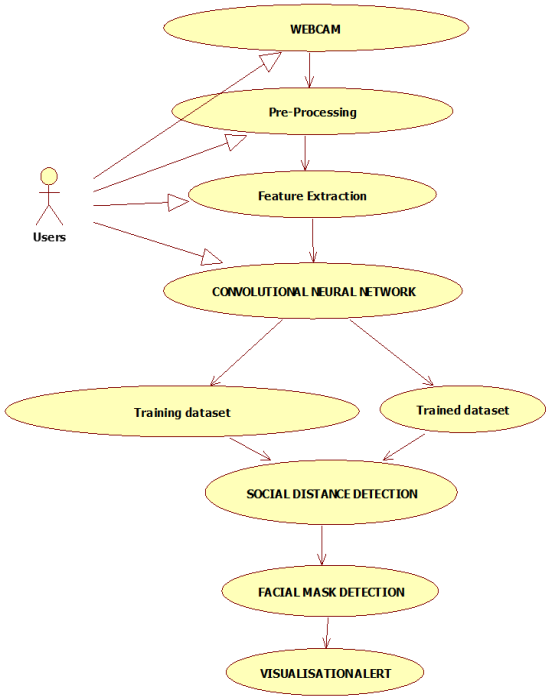

Fig. 1. Use case diagram

Image Acquisition:

As the input video may be taken from an arbitrary perspective view, the first step is to transform perspective of view of webcam view. As the input frames are monocular (taken from a single camera), the simplest transformation method involves selecting four points in the perspective view which define ROI where we want to monitor social distancing and mapping them to the corners of a rectangle in the webcam view.

Pre-Processing:

This assumes that every person is standing on the same flat ground plane. This webcam converts the video to frame which has the property that points are distributed uniformly horizontally and vertically (scale for horizontal and vertical direction will be different). From this mapping, we

can derive a transformation that can be applied to the entire perspective image.

Above image shows how we can select Region of Interest (ROI). The ROI is detected using **Gabor filter algorithm**. We draw certain points on the image. This will define ROI where we want to monitor social distancing. Certain ROI points will define 180 cm(unit length) distance in horizontal and vertical direction and those should form parallel lines with ROI. In above image we can certain points defining 180 cm in real life in horizontal direction. As we can see ROI formed by certain points which has different length in horizontal and vertical direction.

Detection

The third step to detect audience and draw a bounding box around each person. To clean up the output bounding boxes, we apply minimal post-processing such as non-max suppression (NMS) and various rule-based heuristics, so as to minimize the risk of over fitting.

Distance Calculation

Now we have bounding box for each person in the frame. We need to estimate person location in frame. i.e we can take bottom center point of bounding box as person location in frame. Then we estimate (x,y) location between each persons by applying transformation to the bottom center point of each person's bounding box, resulting in their position in the webcam view. Last step is to compute the obtained image view distance between every pair of people and scale the distances by the scaling factor in horizontal and vertical direction estimated from calibration.

Social distancing should be practiced in combination with other everyday preventive actions to reduce the spread of COVID-19, including wearing masks, avoiding touching your face with unwashed hands, Wash your hands frequently with soap and water for at least 20 seconds (or use hand sanitizer containing at least 60% alcohol) Get tested if you have signs or symptoms of COVID-19, or if you think you may have been exposed to someone with COVID-19

4.5.2 FACE MASK DETECTION:

Data Collection and Pre-processing

The proposed system uses face images with different types of faces which are labeled and used for the training of our models. We use the existing background subtraction algorithm in a pre-processing step. The real-time automated detection of verification of persons wearing masks or not are performed by the **SSD algorithm** (Single Shot MultiBox Detector). Before the custom face mask image dataset is labelled, the data set is divided into the training data set and the testing data set. The images in the training data collection are classified into two categories: mask and no mask

Model building and Training

Our proposed framework uses the machine learning approach such as webcam to detect people in real time. The custom data set is loaded into the project directory and the algorithm is trained on the basis of the labeled images. In pre-processing steps, the image is resized, converted to numpy array format and the corresponding labels are added to the images in the dataset before using our SSD model as input to build our custom model and train our model using the TensorFlow Object Detection API. The face mask recognition system uses AI technology to detect the person with or without a mask. It can be connected with any surveillance system installed at your premise. The authorities or admin can check the person through the system to confirm their identity. The system sends an alert message to the authorized person if someone has entered the premise without a face mask. The accuracy rate of detecting a person with a face mask is 95-97% depending on the digital capabilities. The data has been transferred and stored automatically in the system to enable reports whenever you want.

Model Testing

The proposed system operates in an automated way and helps to automatically perform the social distance inspection process. Once the model is trained with the custom data set and the pre-trained weights given, we check the accuracy of the model on the test dataset by showing the bounding box with the name of the tag and the confidence score at the top of the box. If the mask is not visible in the faces, the system generates a warning . Face recognition is a simple way to identify faces, including facial features through technology, especially hardware, like video cameras. The face recognition app or software uses biometrics to map the facial features from any image or video, by comparing it with a database of known faces.

Convolutional Neural Network (CNN):

The size of the training dataset for the face mask and social distancing detection is limited to background and light intensity. Since the face mask and social distancing detection model is a complex network, the scarce data would result in an overfitted model. Transfer learning is a common technique in machine learning when the dataset is limited and the training process is computationally possible. Deep learning uses the weights of a pre-trained model on a big dataset in a similar network as the starting point in training. In this research, we used the weights of the TensorFlow based object detection models for the model training. CNN using deep learning technique outperformed the existing method due to its effectiveness in analyzing and also it required minimal preprocessing stages as compared with other image-processing techniques. CNN has a wide variety of applications in various fields. The first layer is the convolution layer. Convolutional layer is the primary building block of CNN. It extracts the high-level features from the input signal. The pooling layer is

followed after the convolution layer. The pooling operations are fixed according to the applications. The different pooling operation includes max-pooling, min-pooling, and the average pooling.

IV. RESULTS

In following figures, green window shows the presence of mask and red window shows the absences of mask

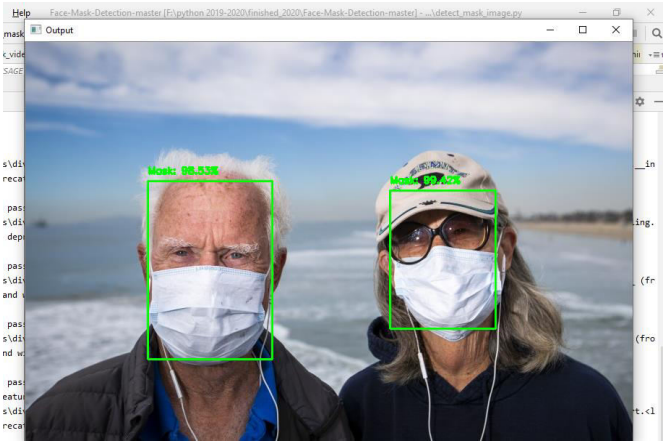

Fig. 2. Mask detection

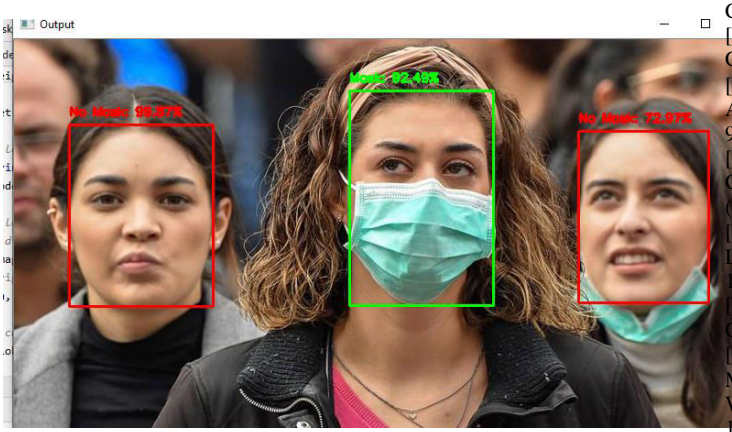

Fig. 3. Mask detection

V. CONCLUSION

The approach that uses computer vision and machine learning techniques to help maintain a secure environment and ensure individuals protection by automatically monitoring public places to avoid the spread of the COVID-19 virus and assist police by minimizing their physical surveillance work in containment zones and public areas. In this project, we have used webcam to analyze face mask and social distancing. We have addressed in depth the tracking of social distancing and the identification of face masks that help to ensure human health. The implementation of this solution was successfully tested in pycharm tool using python scripts

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