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Using CNN and YOLO Detect Face Mask and Social Distance Along With Temperature

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Abstract
The COVID-19 is an unparalleled crisis leading to huge number of problems. To reduce the spread of corona virus people are advised to wear masks when surrounded by people to protect themselves. This makes face recognition very difficult since certain parts of face are hidden. Many new algorithms are devised using convolutional architecture to make face recognition accurate as possible. This convolutional architecture has made it possible to extract even pixel details.

Designed a binary face classifier which can detect any face present in the frame irrespective of its alignment beginning from RGB image of any size.The method involves training through fully convolutional networks it detects multiple facial images in a single frame and also proposes a model to detect social distance using visualisation deep learning network. CNN and YOLO algorithms are used to detect face mask and social distance between persons respectively. Arduino controller and LM35 sensor is used to detect body temperature which alerts if temperature is above predefined value.
Keywords: LM-35 temperature sensor, face detection, social distance, image processing, bounding box.

1.INTRODUCTION

The spread of COVID-19 virus and the ensuring large-scale lockdowns across the globe has given rise to an alarming situation [1]. The resumption of production in manufacturing setups across all sectors was a key pre-requisite for kick starting economic activity of a nation [2]. While there is an urgent need to resume operations, the safety of people cannot be compromised. Accordingly, processes are being put in place to educate the workforce regarding new safety regulations at the workplace which helps reduce the risk of virus transmission[3].

COVID-19 is a disease that spread from human to human which can be controlled by ensuring proper use of a facial mask and maintains social distance as per guidelines of WHO. Fever, dry cough, tiredness, diarrhoea, loss of taste, and smell are the major symptoms of corona virus which is declared by the World Health Organization (WHO) [4].Therefore in this paper hardware sensors are used to detect temperature. The spread of COVID-19 can be limited if people strictly maintain social distancing and use a facial mask. Very sadly, people are not obeying these rules properly which is speeding the spread of this virus. Detecting the people not obeying the rules and informing the corresponding authorities can be a solution in red-ucing the spread of corona virus.

Face mask detection is a technique to find out whether someone is wearing a mask or not. It is similar to detect any object from a scene. Many systems have been introduced for object detection. Deep learning techniques are highly used in medic-al applications [5], [6]. Recently, deep learning architectures [7] have shown a remarkable role in object detection. These architectures can be incorp-orated in detecting the mask on a face.

An existing system of CCTV installations is there todo the task of face detection but it is practically impossible to monitor manually. This paper a syst-em is designed which uses neural network concept. Here an architecture called mobile net v2 used in CNN Algorithm to predict the Desired mask Class-ification. The Dataset is collection of human faces which is divided into two parts with mask and without Mask [8]. Once it's trained by the network it will capable of detection. Now our sample inputs are passed through camera to Identifies. For the social distance we applied YOLO algorithm, its type of deep learning, identify humans and calcul-ate distance between them in the space of video visualisation [9]. In this paper the body temperatu-re is measured using an arduino connected to

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LM35 Temperature sensor and displaying it on 16x2 LCD display which alarms us using a buzzer connected to arduino when given temperature limit is excee-ded.

2. RELATED WORK

This section covers the work of scientists in many fields, such as Image Segmentation, Face detection, social distancing and body temperature measure-ement. The study indicated that the masks that are adequately fit effectively interrupt the spread of droplets expelled when coughing or sneezing. Masks those are not perfectly fitted, also capable of retaining airborne particles and viruses. Allam and Jones [11] proposed a framework on smart city networks focusing on how data sharing should be performed during the outbreak of COVID-19. The proposed system discussed the prospects of Urban Health Data regarding the safety issues of the economy and national security [10]. In the system, the data is collected from various points of the city using sensors, trackers, and from laboratories. A face mask detecting model named Retina Facemask combining with a cross-class object removal algorithm is proposed by Jiang et al. [12]. The developed model includes one stage detector consisting feature pyramid network that results in slightly higher precision and recall than the baseline result. For reducing the shortage of datasets, they have applied transfer learning, a well-known deep learning technique. Gupta et al. [13] proposed a model to enforce the social distance using smart city and Intelligent Transportation System (ITS) during COVID-19 pandemic. Their model described the deploying sensors in different places of the city to monitor the real-time movement of objects and offered a data-sharing platform. A noticeable contri-bution of a smart city in controlling the spread of corona virus in South Korea is explained by Won Sonn and Lee [14]. A time-space cartographer speeded up the contact tracking in the city including patient movement, purchase history, cell phone usages, and cell phone location. Real-time monitor-ring has been carried out on CCTV cameras in the hallways of residential buildings.

One of the main and most effective measures to contain the recent viral outbreak is the maintenance of the so-called Social Distancing (SD). To comply with this constraint, governments are adopting restrictions over the minimum inter-personal dista-nce between people [24].

To rectify any monocular image by computing a homography matrix that transforms it to a geometrically correct bird's eye (overhead) view. We make the following contributions: (i) we show that the homography matrix can be parameterised with only four geometric parameters that specify the horizon line and the vertical vanishing point, or only two if the field of view or focal length is known; (ii) We introduce a novel representation for the geometry of a line or point (which can be at infinity) that is suitable for regression with a convolutional neural network (CNN)[25].Sensor for Body Temp-erature Measurement and Monitoring in time of Pandemic [26].

3. SYSTEM METHODOLOGY

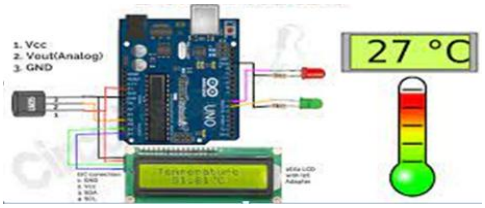

Fig 1: LM35 Arduino board setup

In this paper hardware setup is used as shown in Fig 1arduino board connected to LM35 tempe-rature sensor, 16*2 LCD display and a buzzer. When our hand is placed on the sensor it detects temperature if it exceeds 27degree Celsius buzzer sound occurs.Thus temperature detection is made using the above hardware setup.

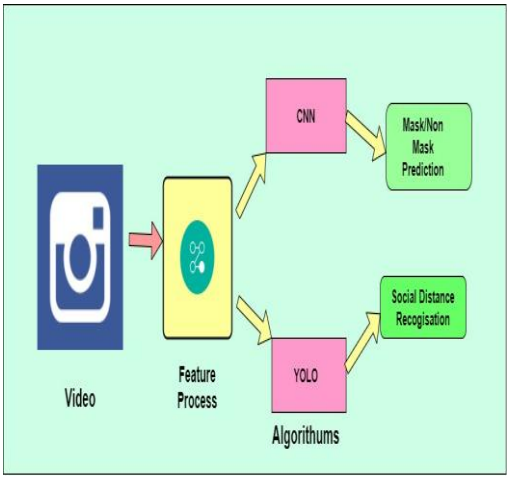

Fig 2: System Architecture

Here one of the Architecture Mobile Net v2 used in CNN Algorithm as shown in Fig 3b to predict the Desired mask Classification is used. The Dataset is collection of human faces with divide into two parts: with mask and without Mask[15]. Once it's trained by the network it will capable of detection. Now our

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sample inputs are passed through camera to Identifies[16].

For the social distance YOLO algorithm is applied, its type of deep learning, identify humans and calculate distance between them in the space of video visualisation and also checks the temperature for using hardware components as mentioned in Fig 1

3.1 ALGORITHMS USED

a) CNN:

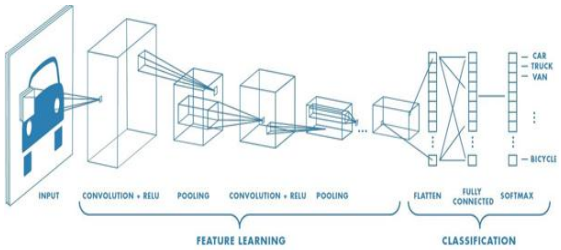

Fig 3: CNN Architecture

A convolutional neural network is a feed-forward neural network as shown in Fig 3 [24] that is generally used to analyse visual images by processing data with grid-like topology also known as ConvNet.ConvNet is used to detect and classify objects in an image.

In CNN every image is represented in the form of an array of pixel values (0's or 1's) as shown in Fig 4 [24]. Image Dimensions = 5 (Height) x 5 (Breadth) x 1 (Number of channels, eg. RGB)

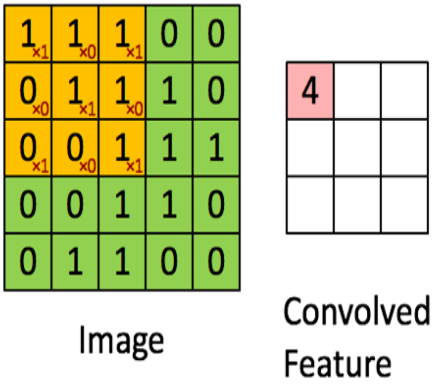

Fig 4: Image representation and convolved feature

The convolution operation forms the basis of any convolution neural network. The four important layers in CNN are convolution layer, ReLUlayer, pooling layer and fully connected layer.

1. *Convolutionallayer*: It has several filters that perform the convolution operation every image is considered as matrix of pixel values from which feature maps are extracted.

2. *ReLU layer*: Rectified linear unit performs element wise operation and sets all the negative pixels to 0.It introduce non-linearity to the network and the generated output is a rectified feature map.

3. *Pooling layer*: It is a down sampling operation that reduces the dimensionality of the feature map. The rectified feature map now goes through a pooling layer to generate a pooled feature map.

The next step is flattening which is used to convert all the resultant 2D arrays from the pooled feature maps into a single long continuous linear vector.

4. Fully connected layer: The flattened matrix is fed as input to the fully connected layer to classify the image as shown in Fig 5 [24]

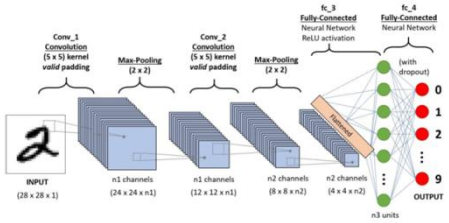

Fig 5: CNN

b) YOLO:

You Only Look Once Input is an effective real-time object recognition algorithm, it uses the regression based techniques. It detects and performs operatio-ns in a single run with the application of artificial intelligence and deep learning.

Each bounding box in a YOLO algorithm as four descriptions:

1. Center of bounding box (bx,by).
2. Width (bw).
3. Height (bh).
4. Class of object(c).

The probability that there is an object in the bounding box is indicated by Pc.

4. IMPLEMENTATION

In this project a hardware setup using the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.LM35 sensor is connected to the Arduino board to detect the temperature and the buzzer which is connected to the board alarms us if the temperature exceeds the prescribed limit, thustemperature is detected.

Social Distancing and Face Mask Detection Platform utilizes Artificial Network to perceive if a person walk

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with maintain social distance and does/doesn't wear a mask as well. The application can be associated with any current or new IP cameras to identify individuals maintaining social distance with/without a mask.

There are 3 steps mainly in this project

4.1 Dataset Collection

4.2 Implement Algorithm for train

4.2 Camera Module

***4.1. Dataset Collection*:** Data set is collection of face images that is taken from the internet resource. Data from two different sources [19], [20] are collected for training and testing the model. That separate with mask and Non mask folder. The mask folder contain collection of Masked faces images and Non mask folder contain without Masked faces images. For social distances we used pertained weights. For training purposes, 80% images of each class are used and the rest of the images are utilized for testing purposes as shown in Fig 6 [24].

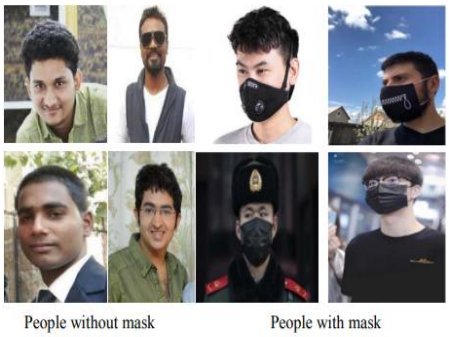

Fig 6: Sample images used for data set.

4.2. Implement Algorithm for train:

In CNN algorithm Images from image dataset is the input which is used for feature extraction of images and classifies the images into twocategories that is masked and unmasked images as shown in Fig 3 Thus training of model is done.

In YOLO algorithm the entire image is taken in a single instance and predicts the bounding box coordinates and class probabilities for these boxes. After detection, the bounding box information, mainly Centroid information, is used to compute each bounding box Centroid distance [17]. Euclidean distance is used to calculate the distance between each detected bounding box of peoples. Following computing centroid distance, a predefined threshold is used to check either the distance among any two bounding box centroids is less than the configured number of pixels or not[18]. If two people are close to each other and the distance value violates the minimum social distance threshold. The bounding box information is stored in a violation set, as seen in Fig. 1, and the colour of the bounding box is updated/changed to red[21]. A centroid tracking algorithm is adopted for tracking so that it helps in tracking of those people who violate/breach the social distancing threshold.

At the output, the model displays the information about the total number of social distancing violations along with detected people bounding boxes and centroids.

4.3. Camera module

Camera module processes video with the trained Model, Here we use OpenCV for processing. OpenCV (Open Source Computer Vision Library) are an open source computer vision and machine learning software library [24]. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.

When an input image or video is parsed through camera if the images are with mask a green box surrounded by the images and red box if images are without mask is displayed as output. If the distance between the images violates the social distancing threshold the colour of bounding box is changed to red.

5. RESULT

In this paper, first the body temperature is detected using sensors if temperature is above the threshold buzzer makes a sound and message stating temperature not normal is displayed on the LCD display after the implementation of the project model.

Images with mask and without mask are detected and also the social distance between images is detected using CNN and YOLO respectively as shown in the below figures.

Fig 7: Results of images with mask and without mask

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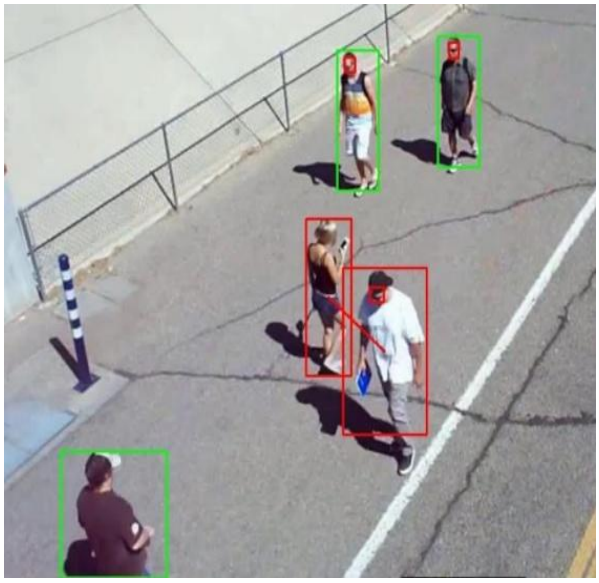

Fig 8: Social distance between the images

As seen in Fig 7 [5] the images with mask are shown with green border box and without mask are shown with red border box .If the images are within the given threshold social distance the images are shown in green border box and if distance are less than the threshold distance images are indicated using red border boxes as shown in Fig 8 [17] after the implementation of the project.

6. CONCLUSION

As per the project Arduino device is connected to temperature sensor to detect the person's body temperature. Machine Learning technology is used for detecting social distance and face mask detection. Yolo algorithm and CNN algorithm is used for detecting social distance and face mask respectively.

6.1 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 travelling 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 mask 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.

But this manual scenario can be automated by using drones and robot technology [22], [23] 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 violators face in a LED screen to maintain a safe distance from the person would be a further study.

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