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Automated framework for detection of Face mask and Social distancing

Sandhya M. S.
sandhyasgowda96@gmail.com
RNS Institute of Technology, Bengaluru, Karnataka

Dr. Bhavanishankar K.
bsharsh@gmail.com
RNS Institute of Technology, Bengaluru, Karnataka

ABSTRACT

COVID-19's global pandemic has had a massive effect on global health, impacting over 139 million people worldwide. Wearing face masks and keeping a 2-meter gap between each other will help to avoid the spread. We propose a computer vision-based pathogen for creating a protected environment that contributes to public safety that focuses on real-time automatic surveillance of people in public places in order to recognize face masks, healthy social distance, and normal body temperature. When any of the above conditions are breached, the device sends out an alert to the authorized person. As a result, the proposed method saves time and slows the spread of the corona virus, all of which are beneficial to society. It may be useful in the current case, where the lockout is being eased to allow people to be inspected in public areas, shopping malls and other locations.

Keywords— *Covid-19, Deep Learning, Euclidean Distance, HAAR Cascade, Public Safety*

1. INTRODUCTION

The COVID-19 Pandemic Disease has triggered a major global health epidemic that has changed humanity's perspective of the environment and our daily lives. Before coronavirus was declared a global pandemic, the World Health Organization assigned COVID-19 to the spread of serious acute respiratory syndrome coronavirus 2 (SARS-Cov-2), a new severe infectious respiratory disease that first appeared in Wuhan, China in December 2019 and has infected 7,711 people and caused 170 confirmed deaths in China (coronavirus disease 2019). According to a report published by the World Health Organization (WHO) on April 16, 2021, the new COVID-19 outbreak has infected over 200 countries, with a mortality rate of about 2%.

Although a novel corona virus has triggered person-to-person transmission, the novel coronavirus that triggers coronavirus disease 2019. According to our findings, (COVID-19) may also, be transmitted by an asymptomatic carrier who has no covid symptoms. It has quickly spread across the globe, posing serious health, economic, environmental, and social problems for the entire human population. WHO suggests that people wear face masks to reduce the risk of virus transmission and maintain a social distance of at least 2 meters between individuals to prevent disease transmission from person to person? Furthermore, many public service providers demand that customers wear masks and maintain a safe social distance while using their services. As a result, detecting face masks and maintaining protected social distances has become a critical computer vision challenge for assisting the global community. This proposed system describes a strategy for preventing the virus from spreading by monitoring whether people are maintaining a safe social distance and wearing face masks in public places in real time. We have used haar cascade classifiers to detect face masks and social distancing. It is a machine learning technique that involves training a cascade function from a set of positive and negative images. The model is initially fed a collection of positive and negative images or data in this process. It is then subdivided into features such as line features, edge features and four-rectangle features Cascade of Classifiers is used to do this. If the individual wearing the mask is securely fastened, and whether the people in the frame are keeping a safe distance from one another. The system issues an alarm to the general public when the violation is detected. With the help of an Arduino UNO board a Temperature sensor is used to measure the temperature of each individual, which also removes the security or an external person.

Then, to measure the temperature and also reduces the risk of that person coming in contact with the infected person.

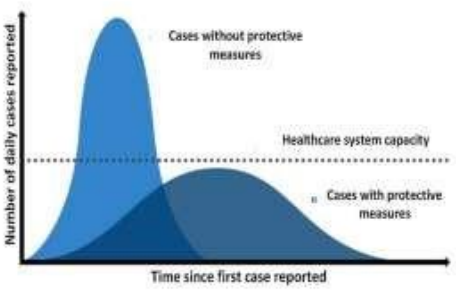

Figure 1: Effect of following proper COVID-19 Guidelines

2. RELATED WORK

According to the World Health Organization, people should keep a distance 3 feet (1 metre) between them. Using real-time video footage and photographs, YOLO object detection can be used to help implement proper social distancing and wearing masks in public [1]. This paper proposes a systematic and efficient method for detecting people, detecting social distancing violations, detecting faces, and classifying face masks. On the labelled video dataset, the device has an accuracy of 91.2 percent and an F1 score of 90.79 percent, with an average prediction time of 7.12 seconds for 78 frames [2]. To contain the spread of the pandemic, multidisciplinary efforts in the emerging world of coronavirus were merged. Those efforts included the AI party. This method is used to scan, evaluate, forecast, and monitor current patients based on their results [3]. COVID-19, a novel coronavirus, caused a viral pneumonia outbreak in China, which turned into a pandemic in March 2020. According to the WHO, the disease will affect 6.2 million people until November 2020. Any proven cure has yet to be found, according to recent updates [4]. COVID-19, the worst-case scenario for mankind, is spreading across more than 180 countries. This research suggests using a deep learning system to automate the monitoring of social distancing in public and crowded places using surveillance video footage and face mask detection [5]. In this work, we aim at detecting the fine-grained wearing condition of face mask. We present a new realistic dataset with 8635 faces in various states of wear, which covers a wide range of conditions. Context-Attention R-CNN is a new detection system for conditions of wearing a face masks that we suggest [6]. The use of a face mask and social distancing acts as an upgraded protection convention that prevents the infection from spreading.

To screen behaviour and acknowledge violation, the method is freely implemented by actualizing the model on an embedded system-based package. As a result, the new system benefits the general public by saving time and assisting in the reduction of the spread [7].

3. EXISTING SYSTEM

In the present scenario, everywhere manual process is carried out to identify whether the people entering or roaming the arena is following COVID guidelines. Here a person has to be appointed to enforce the covid appropriate behaviour strictly in public places and also in other places or work. The main challenge is lack of personnel or volunteers to enforce the guidelines of the government to mitigate the spread of this virus. In order to avoid the risk of covid warriors being infected we have come up with the automated system which will monitor people.

4. PROPOSED SYSTEM

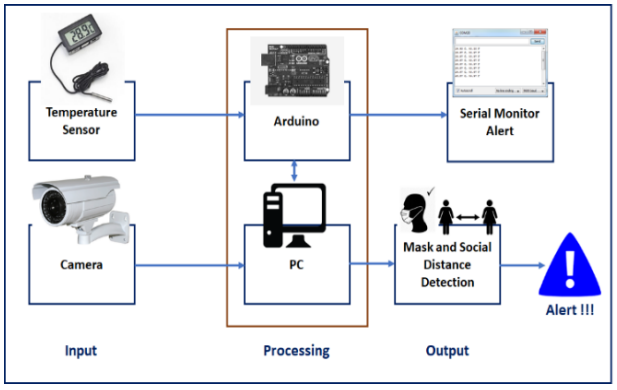

Figure 2: System Architecture

According to our research, following safe social distance and wearing proper mask in public places can avoid the spread of Corona Virus. Here, in this proposed system, we have used object detector cascade to get the features of human faces. Which is further classified into two models, one is used for mask detection and the other is used for the calculation of social distancing. The first model is used for mask detection which also gives the percentage of how properly the person is wearing the mask. The second model is used to calculate the distance between people by using Euclidean distance formula.

It is said that a safe social distancing should have at least 2 meters of distance between people. If any of these two conditions are violated, an alert will be raised to the concerned authorities. According to the medical specialists, a person is said to be infected by Corona Virus if the body temperature is high. In order to alert the people around an infected person, we have used LM317 three pin temperature sensors connected to Arduino controller board. This helps in notifying the authorized person about the sick person who may be a suspect of being infected by Corona Virus.

4.1 Object Detector Cascade (Haar Cascade)

The use case will be carried out using the Haar Cascade classifier. In this paper "Rapid Object Detection using a Boosted Cascade of Simple Features", Paul Viola and Michael ones introduced the Haar Cascade classifier as an effective object detection technique in 2001. A cascade function is trained using a large number of positive and negative images in this machine-learning technique. Based on the preparation, it is then used to detect objects in other images. So, they're big individual.xml files with a lot of features, and each xml file corresponds to a very particular form of use case.

Object detection is the process of identifying a specific object in a photograph or video. Template matching, blob analysis, and the Viola-Jones algorithm are all supported by Computer Vision System Toolbox for object detection. Model matching finds matching regions in a larger picture by using a small image, or template. Blob analysis identifies objects of interest by combining segmentation and blob properties. The Viola Jones algorithm recognises pre-trained artefacts such as faces, noses, eyes, and other body parts using Haar-like features and a cascade of classifiers. A custom classifier can also be trained.

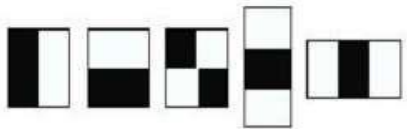

Figure 3: HAAR-Features

To create a single value for each element, subtract the number of pixels under the white rectangle from the number of pixels under the black rectangle. The Haar features, which are rectangle features for rapid human face detection, are shown in Figure 3.

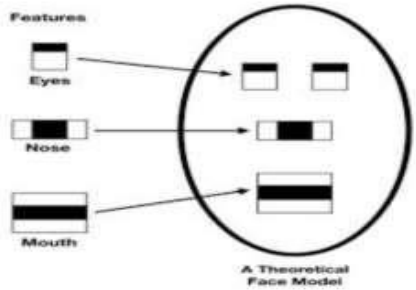

Figure 4: HAAR-Feature resembling face

Human faces are detected by scanning characteristics similar to the Haar feature image, which begins in the upper left corner and ends in the lower right corner of the image (Figure 5). Scanning is repeated many times to identify human faces in a photograph.

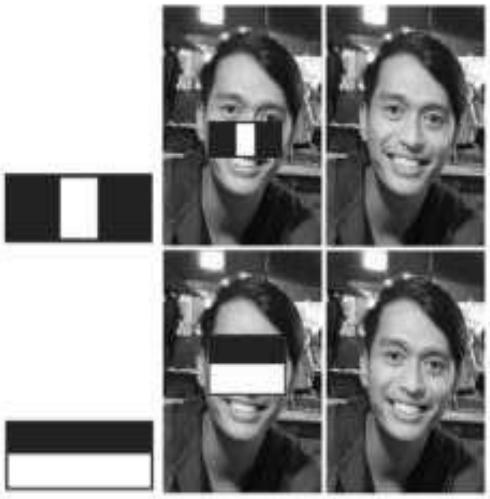

Figure 5: Haar features scan in image

Integral images are used to calculate rectangular features more easily. Four values in the rectangular corners are needed to determine the number of pixels in a given rectangle. The meaning in pixels (x, y) in the integral image is the number of pixels above and to the left (x, y). The Viol-Jones algorithm begins by evaluating these features in the given image with a base window size of 24x24. If we consider all possible Haar feature parameters including shape, position, and scale, we will need to count 160,000 features in this window. This, on the other hand, is almost impossible. As a consequence, the AdaBoost algorithm has been proposed as a solution to this problem. AdaBoost is a machine learning algorithm capable of selecting the best features from a sample of 160,000. These traits are ineffective classifiers. AdaBoost builds strong classifiers by linearly integrating weak classifiers.

4.2 Euclidean distance

The distance between people protected by the camera was calculated using Euclidean distance. The Euclidean distance is used to measure the pairwise distances of people observed in the bounding box centroid. To estimate social distance violations between people, we used an approximation of physical distance to pixel and set a threshold. A violation threshold is established to decide whether the distance value exceeds the minimum social distance threshold.

$$\boldsymbol{d(p,q) = \sqrt{\sum_{i=1}^{n}(q_i - p_i)^2}} \qquad \textit{Equation (1)}$$

Where **p, q** are points
d is distance metric.

4.3 Flow Chart

The corona virus has been spread across the world in an uncontrollable way. In order to avoid the spread of this virus the safety measures like wearing face masks and maintaining a proper social distancing should be practiced. The proposed system works in such a way that when human beings are captured in a live video streaming, it will detect whether the person in the frame is properly wearing the face mask and maintaining a safe distance of 2 meters between one another. At the same time, the temperature sensor detects the body temperature. If any of the mentioned conditions are violated, an alert is raised to notify the authorized person of the organization.

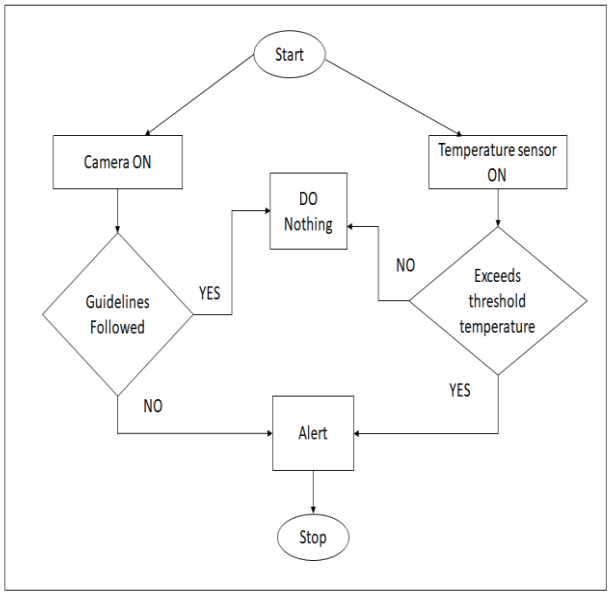

Figure 6: Flow of the process

5. EXPERIMENTAL RESULTS

The live video is captured by the Web camera, and the image frames are captured from the live video. The frames from the live video are then analysed for face recognition. The qualified Haar classifier will function according to the algorithm to detect unusual behaviour, and if any unusual activity is found, it will be detected.

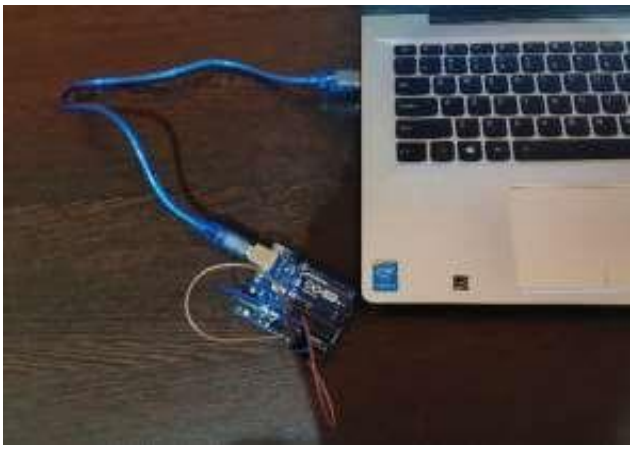

Figure 7: Hardware setup

Figure 7 shows the hardware setup with the components Arduino UNO controller board and LM317 Temperature sensor.

Figure 8 Temperature sensor output

Figure 8 shows the output of the LM317 temperature sensor.

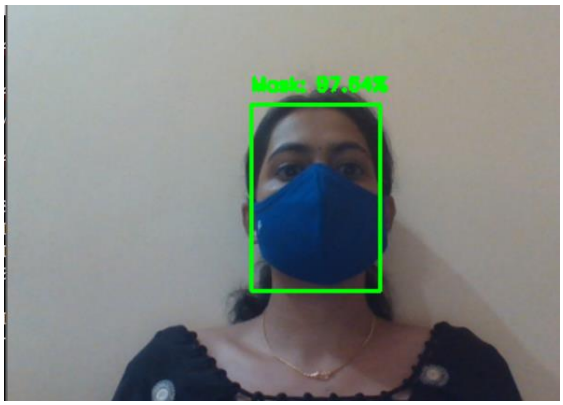

Figure 9a: With Mask

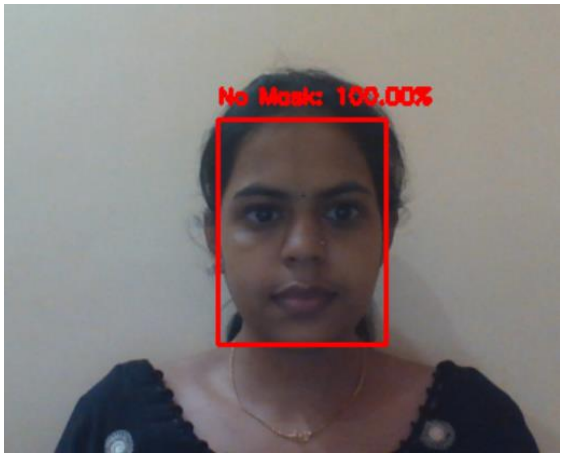

Figure 9b: Without Mask

Figure 9a shows the result of a person wearing face mask and Figure 9b shows the result of a person not wearing mask.

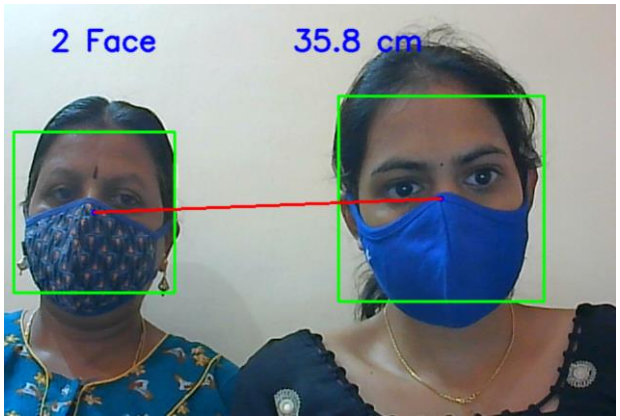

Figure 10a: Safe social distance

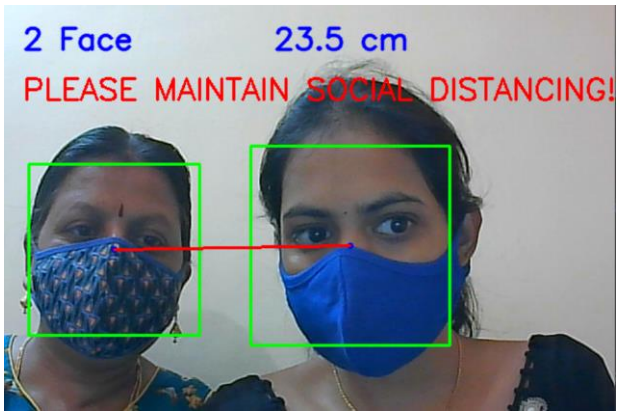

Figure 10b: No social distancing

Figure 10a shows the result of maintaining a proper social distancing and Figure 10b shows the result of not maintaining a proper social distancing.

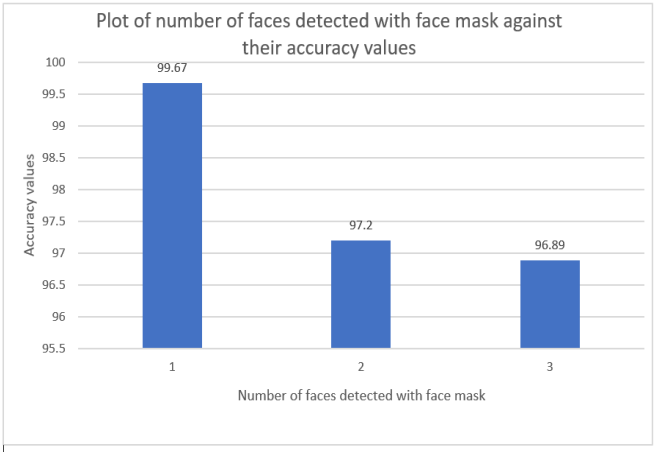

Figure 11: Accuracy result

Figure 11 shows accuracy of Number of faces detected with face mask versus accuracy values.

Table 1: Comparative study

Sl No	Authors	Approach	Remarks
1	Krisha Bhambani et.al [1]	YOLO	Identifies Face Mask, social distancing.
2	Alok Negi et.al [3]	CNN, Haar Cascade Classifier	Identifies Face Mask.
3	B. Sathyabama et.al [5]	YOLO, CNN	Identifies Face Mask, Social Distancing.
4	This Paper	Haar Cascade Classifier, Euclidean Distance with IOT.	Identifies Face Mask, Social Distancing and Body Temperature.

The above table 1 highlights the comprehensive comparative study of the proposed approach with others in the literature.

6. CONCLUSION AND FUTURE SCOPE

In this paper, we are suggesting an approach which can automatically monitor to follow all the safety measures to be taken to avoid the spread of corona virus. We have used Haar Cascade and Euclidean distance algorithms in this system to detect face masks and distance between people. Which reduces the physical surveillance and also reduces the risk of monitoring person getting in contact with the infected person. As a consequence, in the current situation, this new system will work successfully, allowing for the automated monitoring of people.

We have gone over social distancing monitoring and the detection of face masks that aid human health in great detail. The proposed system would enhance public safety by saving time and assisting in the reduction of coronavirus spread because real-time interventions have the potential to significantly reduce violations.

In future this system can be used in Temples, Shopping malls, Public events, Metro stations and airports among other places. And also, frequently washing hands with alcohol-based

sanitizers is also considered to avoid the spread of Corona Virus. This system can be enhanced to detect whether the person's hands are sanitized.

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