A Social Distancing Violation Monitoring and Alert System

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Abstract–**The increase in the Virus outbreak has caused a great deal of damage not only to the people around the world but also to the economy and the way we look at small things around us. From the year 2019, the world has seen different types of viruses. COVID 19, a horrific virus that put the entire world to an absolute stop. It caused widespread damage to the businesses, people, education, technology, medical and various other sectors. The Omicron which was a version of the SARS-COV-19 destroyed the immunity in most of the people. Recently the newer virus the H3N2 has also started its spread across India. When the cases were going sky-rocketing, the WHO came up with the idea that, when people stood at about 1-1.5meters it turned out to be safer for people. This process was coined as social distancing. Even though it is a very simple rule, a lot of people are not able to follow it because of the increased crowd around them. It has become very difficult to maintain it in places such as malls, markets, transportation stations etc. Using machine learning techniques, we have been able to monitor whether a proper distance is maintained between people.**

Keywords - SARS-CoV-2, Omicron, H3N2, Social Distancing, YOLOv3, Violation, Monitoring.

I. INTRODUCTION

The SARS-COV-2 surge started in December 2019. By March 2023 there had been 681,827,072cases in total and 6,813,670 deaths. The most effective method suggested by WHO (World Health Organization) is socialdistancing, which has become very difficult for people to follow. Manually people used to draw lines and circles on the roads, malls, worship places, which marked the territory for the people to stand and not cross it and as would violate the social distancing norm. We can never always blame the people for not following it as most of us were not prepared to face a situation beforehand. Human beings due to their mob-mentality often tend to roam to places with a large crowd.Placessuch as very narrow streets, malls, markets, eateries where the daily crowd is enormous,alwaysmaintaining social distancing is difficult. And especially during times such as the festivals like Christmas, Diwali, New year, the number of people who throng on the roads is humungous. Due to this there will be lot of people who might get infected, and here by, to maintain hygiene in such places by the health care workers would be difficult. The other viruses also demands such a selective isolation of the people in crowd to prevent the spread of the deadly virus, but physically monitoring all the time is a tiring process.

We considered the health care workers who would be on the field monitoring social distancing the whole time. Asthey are very near to the public the chances of their health getting deteriorated is very high. Our main goal was to terminate this problem. Thus, a technology that would monitor this at a remote location could be helpful to them.

Keeping all this in mind we have come up with a very simple system where the proximity of the people is determined using the deep learning mechanisms. We monitor the live video streaming camera, or even a recorded video or photo and detect the proximity of people and alert immediately if there was a breach.The system that we have made not only displays efficiently the number of people who are not following the social distancing but also helps to safely control the spread of the SARS-COV-2 virus.

II. LITERATURE SURVEY

With the Indian population over 1.3 billion, it is becoming very difficult to monitor social distancing with minimal technologies. The works done by those researchers has helped the government to maintain social distancing to a bit. Technologies such as machine learning, deep learning and artificial intelligence are used by many tech-enthusiasts and they have easedout the process. In this section we will analyze different projects undertaken by different researchers.

Initially we had investigated [1] which was monitoring the social distancing using artificial intelligence. The camera would capture the images or the live stream. Then using R-CNN methodologies, it would detect the images present in the image or the video after which the distance is calculated using the distance matrix. Then the people are highlighted and shown is the distance is violated or not.

[2] [3] used image processing methods. Edge detection where, the edge of each object on the image is considered and if the edge of the two people cross the threshold level, we say that it was a breach of social distancing. Even though edge detection is a very efficient methodology, it is not very accurate while giving out the results. Another approach that we saw was [4] training the datasets using the Microsoft Common Object in Context (MS-COCO) for the image segmentation. This proposal also gave a proper measurement of the distance between them. [5] also followed a similar method. But instead, it identified the triggered areas where the spread of virus could be higher and instantly gave a warning that the following place was at risk. By this people could restrain themselves from going there.[6]used the centroid to find out the distance between the people and detect the social distancing.

[7] uses UAV(unmanned Ariel Vehicle) which is similar to a drone which captures the real time images and searches for the pedestrians. They are marked on a map and the distance is checked. [8] similarlyused Artificial Intelligence for the monitoring Social Distance where, CNN and Convolution Long Short-term memory ConvLSTM was used. [9] used CNN methodologies which proved to have 98.5% accuracy. [10] took a different approach for this and used the IoT (Internet of Things) for detection. VidMask was used by few projects like [11] for training and detecting people with masked faces and then detect social distance. [12][13] used the deep learning concept. [14] had a special feature of identifying the people in the low light as well. [15] gave us the inspiration to work on this project. It explained the importance of social distancing and the various effects it has if not followed properly.

The major implication that we noticed from all the above projects was that none of them had a proper alert system. The above proposed methodologies just display on the screen of a recorded video the number of violations that have occurred. Due to this the security officer or the person who is governing the system might know that the social distance is violated, but the people who are standing there will not be knowing. Thus, we have inculcated the knowledge from the previous projects and the idea that we had come up with. They are

- Instant sound alert
- Instant WhatsApp message alert

Instant Sound alert is a feature that gives out a beep sound for about 2 seconds whenever there is a security breach in real time. As soon as the people in the given locality cross the threshold distance, a wide awakening sound is heard that could help people adjust themselves from where they are standing immediately.

Sometimes when the security officers are not viewing the camera from the security room, it would be difficult to keep a track if there has been a breach or not. Hence, sending a WhatsApp message to the group in which the security officers or the health care workers are present would make them attentive and help them clear out the crowd that is present. It can also be combined with the help of camera to see the exact person who violated the social distancing norms and take necessary actions on them.

III. PROPOSED METHODOLOGY

The proposed method makes use of image-processing techniques to track social distance in public spaces and workplaces. Cameras are placed in strategic locations, and video streaming is used to monitor the social distance. We can combine this solution with the security camera systems at workplaces, factories, and retail locations so that we can monitor whether individuals are maintaining a safe distance from one another. Utilizing the YOLO (You Only Look Once) Object detection technique that accurately identifies a person's class as input. Here is a stream of video. We track the objects in accordance with their movement by utilizing Object Tracking. The individual who disobeys the social distance rule is depicted by the RED bounding box elsewhere with a GREEN box's perimeter.

Majorly there are 3 main steps in doing this:

Person Identification: The initial step of identifying a person in the given camera or a video stream was done with the help of the YOLOv3. It is an object detection algorithm, whose purpose is to identify unique objects with help of training. The weights that were used had distinctive ability to filter out rest of the parts in the image and correctly mark the human beings in the video. The imutils library does the basic image processing. Using CNN or R-CNN could have slowed down the process of training as it would have very less frame rate for comparison as contradictory to the YOLOv3 that has been used. In order to make sure that same person is not detected twice and the exact person is detected throughout the video, we give out a class id to each of the person in the video individually. Thus, it will be their identification and even if the person moves out of the frame and comes again, it will again track him as the same person and not a different person. The box that is drawn around the person using the coordinates X, Y. As the person moves inside the frame, the coordinates keep getting updated and the box around the person also will change accordingly.

Detection of Social Distancing Violation: Once the detection of people is done, the next step would be to accurately check the social distance between each people. We then initiate by setting the minimum confidence and the minimum threshold values. The confidence level indicated how accurate does the system detect the person. Minimum distance (MIN_DIST) is given as 50. The MIN_DIST is calculated with the focal length(F) multiplied with the width(W) whole divided by the pixels occupied(P).A dot is drawn inside each of the box exactly at the centroid. When the centroids of two people's boxes reaches below the MIN_DIST, we then say that the social distance is violated.

The centroid is first identified by using the width, of the height of the box that is detected around the person. Then the non-maxima suppression is applied, which makes sure even though two boxes overlap each other, they are not losing their unique identity. After which, we check if the centroids of two boxes are greater than or lesser than the MIN_DIST. Then we detect if there is a breach in the protocol.

OpenCV2 is used for the camera input. It also works similarly to the video feed. Where the camera opens and we can then detect the person. The video feed could have two different camera angles:

Checking the protocol from close distance: This surveillance camera provides a very zoomed-in view of persons around from a very close distance. We recognize the individual from the video monitor and ensure that they are far enough away to be safe.

Checking the protocol from a bird's eye view:From a very far away distance, each person's distance from the other is calculated.

*Violation Alert System:*The major part of the project is providing the right alert to the people and the health care workers. This will ensure that the people will immediately change their positions and stay at a safer distance, that makes this project standout from rest of the projects. The alerts are given in 3 different ways.

*Alerts in the Video Feed:*Once the people are detected on the video feed or on the camera, a specific-colored light

box would be displayed around them. Initially it would be green. If the centroids of the boxes cross the minimum distance, the color of the box will immediately change to red around the two people who are very close by. There will also be a section in the video labeled as "Social Distancing Violations" which will show the real time count of number of violations.

Sound based Alert: Video based alert would be helpful if the number of people is very limited and the space is very little. Example a video-based alert will be helpful in a queue of people standing at the billing counter or students sitting in the class. But when this combined with an alert sound such as a beep when there is a violation detected will immediately bring in a sense of tension amongst the people and help them stand in their appropriate positions. We had installed the "Winsound" library and an alert at a frequency of 400 will be played.

*Alert in form of WhatsAppmessage:*Consider a situation where the health care workers are not present inside the security room and the number of staffs are limited or the system is installed inside a SARS-COV-2 contaminated ward in a hospital. In such circumstances, a video feed alert might not be very effective. A sound alert could work but not perfectly. Therefore, we have introduced personalized WhatsApp message that would be sent to the person in the ward that violation has occurred. If all the health care workers are in a WhatsApp group, a message saying violated would help them regulate the people and make them stand in a safe position. For this we have used the library pywhatkit. Instant message would be sent in real time if the system detects that there was a violation.

The combination of Video based alert, sound alert and a WhatsApp message would also benefit the specially abled people to maintain the social distancing.

Fig 1: Flowchart of the project

IV. BENEFITS

The following are the benefits of using our project:

*Help the health careworkers:*Our project's main motive was to help the public health workers. Usually in crowded places, it is the job of the workers or mark each space with dotted lines as to mark the distance for social distancing. But it eventually becomes difficult as when the crowd increases it becomes for the people to handle so many people. Thus, we have used the monitoring using the surveillance camera to ease out their process and take care of the health of the people.

*Lower the spread of SARS-COV-2:*The major purpose the WHO or The World Health Organization started the concept of social distancing was to govern the escalations of the deadly virus. As it was widely accepted by the people, but very poorly followed, the model we have made can help to effectively follow it.

*Increase the economy:*Due to SARS-COV-2 India as a country lost its entire economy. The project helps to remove the lockdown present in the country. Due to this, even though there is SARS-COV-2, people tend to go to crowded places like restaurants, malls, offices, and educational institutions.

Timely Alerts: The system maintains a proper record of the number violations that occurred to make sure that the institution can keep track of the progress. Whenever a WhatsApp message is sent in the group, it notes it down in its database.

V. DISCUSSIONS

The major discussions while making this project was done to see, how much helpful the project was going to be for the health care workers. We had spoken to many Health care workers and then we had decided that something had to be done to remove their plight. Thus, we devised this project. There were discussions as to this project using Deep learning or image processing. Image processing becomes easier to do as it consists of less complex mechanisms. As the complexity is less, we can easily perform more integrated components to the project. We can add many datasets to it and check the accuracy of the project. Yolov3 was used in place of the traditional CNN and R-CNN. This is because, R-CNN and CNN are comparatively slow when each frame must be detected frame by frame. Yolov3 is around 8 times faster compared to them. The major difficult that could arise while making the project was how to connect it to a camera and lively capture the movement of the people in the crowded place. OpenCV2 library came handy for us to effectively view the camera mode and capture the live feed. Later the introduction of the messaging feature that was guided by our guide was added. All the feature makes the project very seamless and was done with the motive of making the people around us feel safe.

Specially abled people find it difficult to adapt to the new norms that is being laid by the WHO (World Health Organization). Thus, alerts based on personalized experience will help everyone be safe from the deadly virus safely.
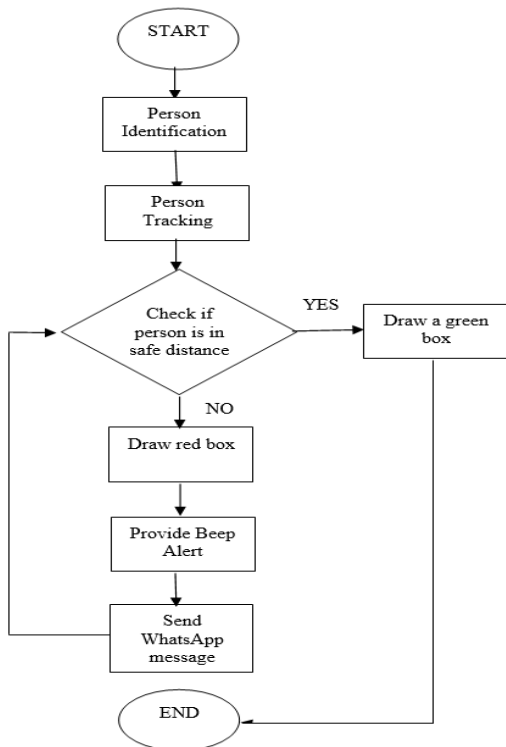
As the WhatsApp is used to provide mobile alerts, we have made sure that the system is highly secured and there will not be any invasion of privacy or leakage of mobile numbers to third party and will be safe to be used by everyone.

VI. RESULT

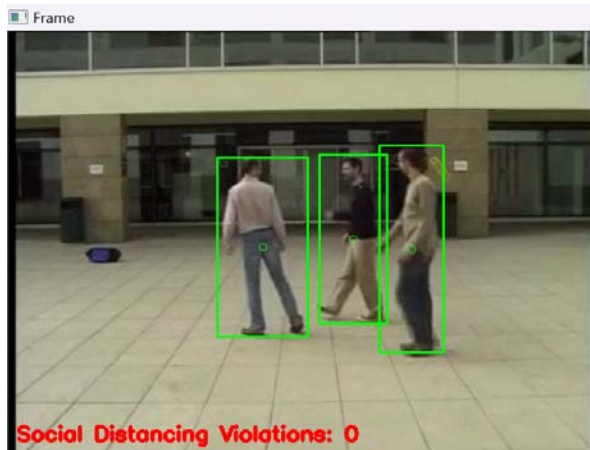The following images depict the expected result that we achieved when we ran the application.
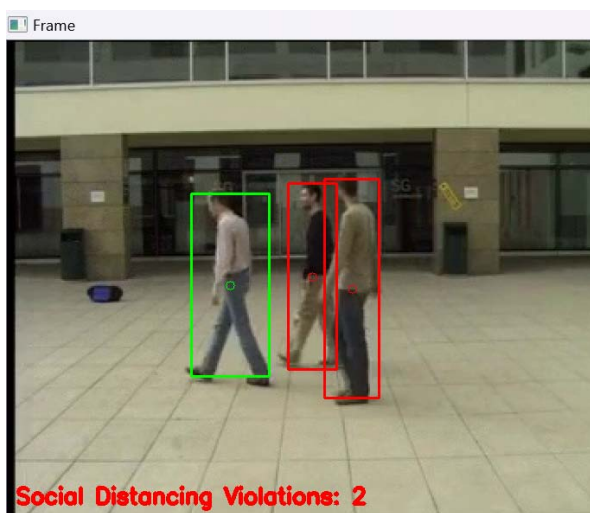

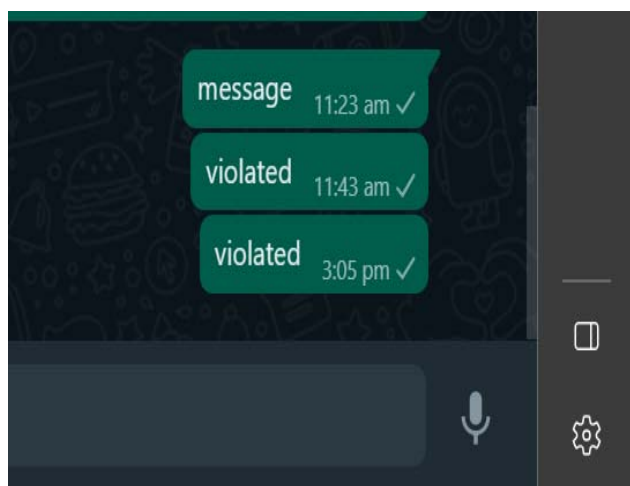Fig 2: Initial Detection

Fig 3: Violation Detected

Fig 4: WhatsApp text sent

The above image displays the real time video that was taken and then monitors using the YOLO algorithm to see how many people are exactly following the social distancing norms and how many violations are being made.

The first image (fig 2) displays at a normal condition where the people are standing 1-1.5 meters away from each other and thus, there are no violations. The second image (fig 3) displays that 2 violations have occurred and this is because the people have crossed the minimum distance with themselves.A message is also sent to the group (fig 4). Using this information, we can control the violations. The predictions that came were 100% accurate.

VII. FUTURE ENHANCEMENTS

As technology keeps developing andthe virus getting stronger every day, the following system might not be useful in long run. For this we have planned for few enhancements such as instead of sending a WhatsApp message to the groups, we could send a personalized message to each person's mobile phone saying that they have violated the protocol. This will help in more personalized control of the violation and increase the privacy as well.

We have also planned to use this for the betterment of the society by providing it to the nearest hospitals so that people around us feel safe and SARS-COV-2 could be destroyed completely.

VIII. CONCLUSION

The major motive to consider this project was for a social cause.SARS-COV-2 is a deadly virus which is highly contagious. It easily spreads through air, or even skin contact. Our primary goal in implementing this project is to alleviate this problem, and as a result, our algorithm will subtract social distance between individuals. Since Health care workers are the ones who work every day, this aids them.As there is increased crowding in areas like malls, theatres, beaches, etc., it is difficult to identify those who are keeping social distance and to encourage them to do so. As a result, our model will use a camera to identify every individual in these public spaces, closely observe them, and slap a red mark on anyone who is too near to another person. Also, the YOLO method for our image processing model. Our methodology will thus primarily benefit Health care workers and aid to lower the number of COVID cases.

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