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Social Distancing Detector Using OpenCV

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Abstract: With the recent outbreak and rapid transmission of the COVID-19 pandemic, the need for the public to follow social distancing norms and wear masks in public is only increasing. According to the World Health Organization, to follow proper social distancing, people in public places must maintain at least 3ft or 1m distance between each other. This project focuses on a solution to help enforce proper social distancing in public using YOLO object detection on video footage and images in real time. The experimental results shown in this paper infer that the detection of human subjects based on YOLO has stronger robustness and faster detection speed as compared to its competitors. Our proposed object detection model achieved a mean average precision score of 94.75%. The network ensures inference speed capable of delivering real-time results without compromising on accuracy, even in complex setups. The social distancing method proposed also yields promising results in several variable scenarios. The proposed system also successfully demonstrated people and crowd detection with varying degrees of the crowd. The system obtained crowd detection accuracy is around 90% and expected to be readily implemented on real hardware drones and tested in real environments.

Keywords: Human Object Detection, Feature Extraction, Distance Tracking, Machine Learning.

I. INTRODUCTION

COVID-19 belongs to the family of coronavirus caused diseases, initially reported at Wuhan, China, during late December 2020. On March 11, it spread over 114 countries with 118,000 active cases and 4000 deaths, WHO declared this a pandemic [1], [2]. On May 4, 2020, over 3,519,901 cases and 247,630 deaths had been reported worldwide. Several healthcare organizations, medical experts and scientists are trying to develop proper medicines and vaccines for this deadly virus, but till date, no success is reported. This situation forces the global community to look for alternate ways to stop the spread of this infectious virus. Social distancing is claimed as the best spread stopper in the present scenario, and all affected countries are locked-down to implement social distancing. This research is aimed to support and mitigate the coronavirus pandemic along with minimum loss of economic endeavours, N. S. Punn, S. K. Sonbhadra, S. Agarwal, Indian Institute of Information Technology Allahabad, Jhalwa, Prayagraj, Uttar Pradesh, India; emails: {pse2017002, rsi2017502, sonali}@iiita.ac.in. Fig. 1: An outcome of social distancing as the reduced peak of the epidemic and matching with available healthcare capacity. and propose a solution to detect the social distancing among people gathered at any public place. The word social distancing is best practice in the direction of efforts through a variety of means, aiming to minimize or interrupt the transmission of COVID-19. It aims at reducing the physical contact between possibly infected individuals and healthy persons. As per the WHO norms it is prescribed that people should maintain at least 6 feet of distance among each other in order to follow social distancing. A recent study indicates that social distancing is an important containment measure and essential to prevent SARSCoV-2, because people with mild or no symptoms may fortuitously carry corona infection and can infect others.

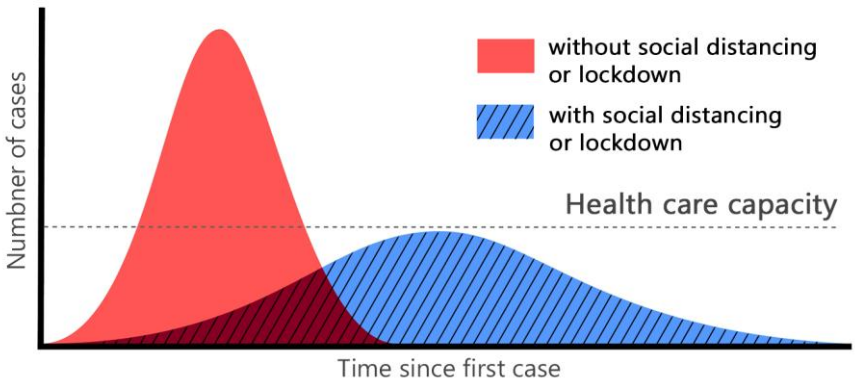

Fig. indicates that proper social distancing is the best way to reduce infectious physical contact, hence reduces the infection rate. This reduced peak may surely match with the available healthcare infrastructure and help to offer better facilities to the patients battling against the coronavirus pandemic. Epidemiology is the study of factors and reasons for

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the spread of infectious diseases. To study epidemiological phenomena, mathematical models are always the most preferred choice. Almost all models descend from the classical SIR model of Kermack and McKendrick established in 1927. Various research works have been done on the SIR model and its extensions by the deterministic system, and consequently, many researchers studied stochastic biological systems and epidemic models. Respiratory diseases are infectious where the rate and mode of transmission of the causing virus are the most critical factors to be considered for the treatment or ways to stop the spread of the virus in the community. Several medicine organizations and pandemic researchers are trying to develop vaccines for COVID-19, but still, there is no well-known medicine available for treatment.

II. LITERATURE REVIEW

Since the COVID-19 pandemic took the world by storm, tough but necessary measures were taken by governments throughout the world to control its spread. This resulted in bringing normal day-to-day activities to a complete standstill. Months into lock down, when we see the curve flattening in several countries, the community grows restless. Relevant authorities like WHO have laid down certain guidelines to minimize people's exposure to the virus. Some safety measures people are encouraged to follow include wearing masks and maintaining a distance, which is approximately 1m, from another individual. In vast establishments, it's hard to ensure that people are adhering to these crucial social distancing rules. To allow for easy tracking of such violators, an automated system is an absolute need of the hour. The use of our model is to determine whether or not social distancing is being maintained between 2 individuals, in the most efficient, accurate and simple manner, hence requiring overseeing authorities to take minimum effort.

[1]Managing a crowd of varying densities involves detection of the individual humans in the crowd. In a high density crowd, because of inter-object occlusion, detection and tracking of humans in the crowd be a challenge in computer vision. Existing tracking algorithms present challenges due to difficulty of background modelling. Inter-object occlusion also is a big challenge to body shape models and detection of body parts. Researchers have proposed and studied the tracking methods based on features like motion blobs, texture and color. There have been studies for head detection based on background modelling, head-shoulder detection using omega model and so on. This study focusses on training a cascade classifier for human head detection by taking positive samples and negative samples. The trained cascade is then used to process the video frames in which the human heads are detected and the count of the humans in the scene is provided. Training the cascade for head detection provides efficient detection in areas subjected to inter-object occlusion. The detected human heads are then tracked using optical flow algorithm. This tracking provides the direction of motion of the persons in the scene. Author's proposed work is to develop a system for crowd management and human tracking using Raspberry pi. Initially, a cascade classifier is trained for head detection with the samples collected from the scene. Haar features are used to train the cascade classifier through OpenCV. The set of rectangular features (Haar) provides an image representation which provides effective learning. Crowd management using head detection is realized using computer vision in our study, implementing our study using video taken from our institution. We use Haar features and Adaboost algorithm to detect the person's head region. We track the human using optical flow concept. Using increased number of samples, the results are found to be efficient. The human detection and tracking can generally be used in surveillance tasks.Some Improvements can be made in this study that is We can use Algorithms To Calculate distance Between Peoples to determine whether Social Distancing Rules are being followed or not.

[2]This section highlights some of the related works about human detection using deep learning. A bulk of recent works on object classification and detection involve deep learning are also discussed. The state-of-the-art review mainly focuses on the current research works on object detection using machine learning. Human detection can be considered as an object detection in the computer vision task for classification and localization of its shape in video imagery. Deep learning has shown a research trend in multi-class object recognition and detection in artificial intelligence and has achieved outstanding performance on challenging datasets. Nguyen et al. presented a comprehensive analysis of state-of-the-art on recent development and challenges of human detection.
In this Study Authors have Proposed an approach to local image processing in distributed monitoring systems is considered. The proposed approach makes possible to optimize traffic transmitted from monitoring devices generating images or video streams. Image processing, object recognition and identification are performed locally. Based on information received from all monitoring devices, including images, event logs are generated locally for their further transmission to the central data collection, processing and analysis unit. The method of local image processing was tested on the example of face recognition of people who took part in the experiment. Under various experimental conditions, it was found that the proposed method has a sufficiently high accuracy. The methodology defined by authors is as follows,

1. Data collection
2. Image labelling
3. Training data generation

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4. LBPH Face Recognizer
5. Training configuration
6. Inference graph

[3]This paper focuses on a solution to help enforce proper social distancing and wearing masks in public using YOLO object detection on video footage and images in real time. The experimental results shown in this paper infer that the detection of masked faces and human subjects based on YOLO has stronger robustness and faster detection speed as compared to its competitors. Our proposed object detection model achieved a mean average precision score of 94.75% with an inference speed of 38 FPS on video. The network ensures inference speed capable of delivering real-time results without compromising on accuracy, even in complex setups. The social distancing method proposed also yields promising results in several variable scenarios.
The research we have done to add contributions to the analysis of the situation and come up with a solution to detect the violations includes:

- Data Collection from various data-sets, and self-annotations of images to test in difficult scenarios for mask detection, as well as creation of measured video test sets for social distancing.
- Thorough examination of methods to determine whether people are maintaining the recommended social distance or not, as well as development of an original method with minimum and user-friendly calibration.
- Study of several object detection methods that give maximum accuracy and FPS, so that the model has applications in real-time usage

III. CONCLUSION

We have hence created a well-integrated real time face mask and social distancing violation detection system, where object detection takes place using YOLO v4. The three classes that are simultaneously detected are masked and unmasked faces, as well as whole people. Using the coordinates given by the detection of the class person, the relative distance between 2 individuals is hence estimated using the principles of optics. After rigorous testing, we observe that the model yields fairly accurate results for a wide field of view, which is an essential criteria for usage in public places. Without any addition of time consuming computations or image warping, this light weight model is easy to calibrate and can be well used in real time due to high FPS and good accuracy.

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