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Social Awareness and Safety Assistance of COVID-19 based on DLN face mask detection and AR Distancing

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ABSTRACT

The outbreak of coronavirus disease (COVID-19) has forced major countries to apply strict policy toward society. People must wear a facemask and always keep their distance from each other's to avoid virus contamination. Government employ officers to monitor citizen and warn them if not wearing a face mask. The warning message also spread through SMS and social media to ensure people about safety and awareness. This paper aims to provide face mask detection using the Deep Learning Network(DLN) and warning system through video stream input from CCTV or images then analyzed. If people not wearing a mask are detected, they will alert them through the speaker and remind them about a penalty. AR distancing very useful to give position toward violator location based on the detected person in a certain area. The system is designed to work intelligently and automatically without human intervention. With the accuracy of 99% recognition, it's expected that the system can help the government to increase people awareness toward the safety of themselves and people around them.

I. Introduction

It has been more than a year since the first Coronavirus detected at Wuhan in the middle of December 2019. According to WHO, the current total cases reach more than 118 million, with more than 2.6 million casualties[1, 2]. Particularly in Saudi Arabia, the total case has written more than 380 thousand cases, with around three thousand active cases[3]. Therefore, WHO has put standard to reduce the number of infections by obeying some standard protocol such as maintaining social distance, wearing a face mask, maintaining good ventilation, preventing gathering or visiting the crowds, washing hands regularly, and using elbow coughing and sneezing[4]. Covid-19 virus diameter fluctuates between 60nm to 140nm with thorn around its body[5].

Researcher around the world has been thinking about the ways of handling coronavirus in various fields. Some think artificial intelligence is one solution for evaluating the medical images, performing analysis on the dataset, etc. [6]. The spreading of Coronavirus through droplets that sprayed when people sneezing or coughing near to the other person. These droplets and closed distance might get other people infected by Coronavirus[7]. Even though WHO has encouraged everyone to wear a facemask, mask detection remains a challenge. Facemask utilization is still considered a crucial preventive step besides maintaining social distance to reduce the infection rate[8]. Further aspects that contributing to corona spreading is environment situation and cultural aspect of the society such as their gathering habit, and social interaction approaches: handshaking, hugging, holding hand are very crucial for virus spreading these days. Besides, most governments employ quarantine methods to prevent the virus from spreading[8, 9]. The visualization of Coronavirus dispersion across the world described in Fig. 1.

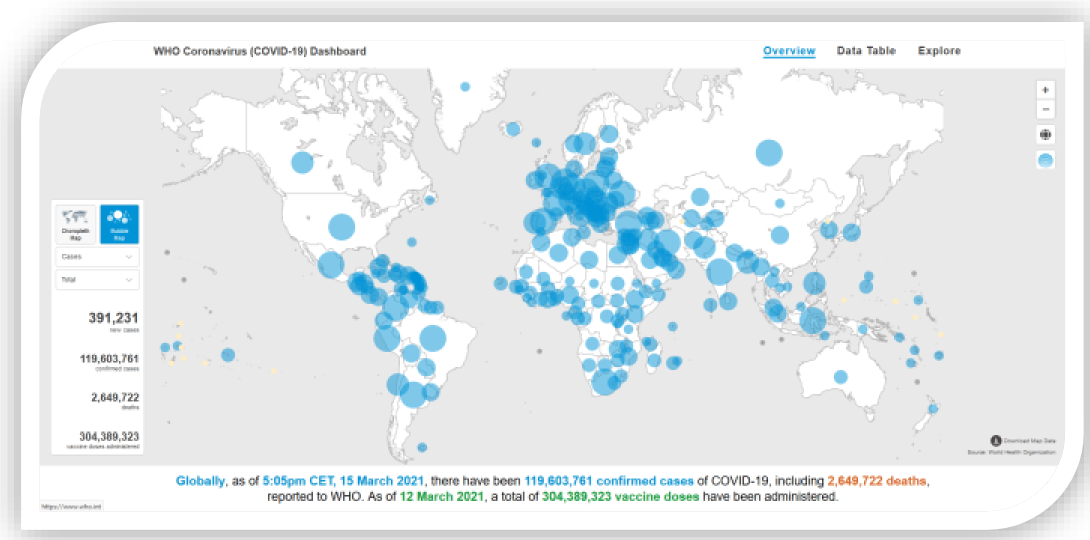

Fig. 1. Coronavirus situation across countries in the world through WHO dashboard[1].

Rahmani, A.M. and Mirmahaleh, S.Y.H (2020) made a classification of prevention methods shown in Fig. 2. Social distancing and environment observation are proven effective in reducing the number of infection. The recommended social distancing to maintain droplets' safety, which most researchers suggest, is 2 meter[10-12]. Besides social distancing, distance learning also becomes the main choice to continue education around the world while maintaining students' safety [13-18].

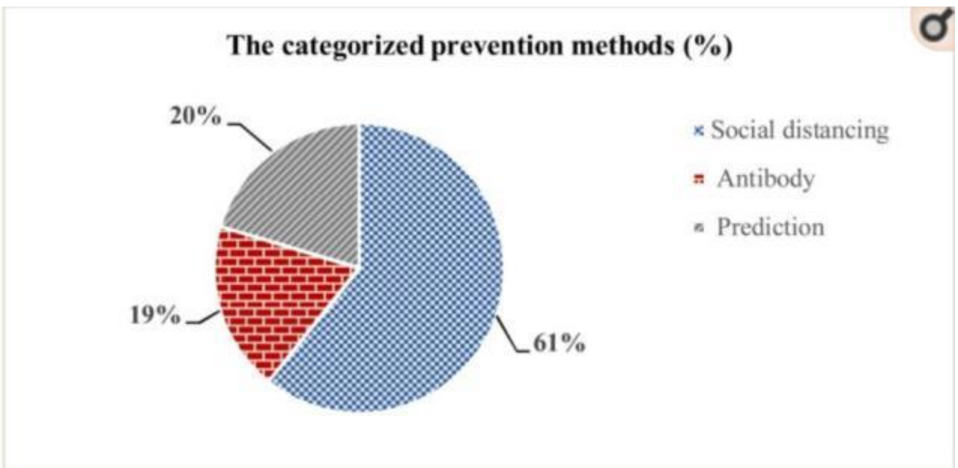

Fig. 2. Prevention method classification by Rahmani, A.M. and Mirmahaleh, S.Y.H (2020) [8]

Coronavirus attacks the respiratory system and might cause infections for the lung and cause trouble in breathing. It is also able to augment chronic disease that people have in their medical records[19]. The COVID-19 symptoms are not unique, and it difficult to be used as a standard for diagnosis. A report mentions that 44% of total patients (1099) experienced fever when they registered in hospital, while around 89% obtained fever during hospitalisation[20-22]. The other study focuses on computer vision for face mask detection. This work is crucial for safety prevention among peoples[23-25]. Researcher around the world also study robot or humanoid robot for human assistance to reduce COVID-19 spreading that mostly occurred due to social contact between human[26-35].

II. Methods

This section focused on discussing the methodology of the research, as shown in Fig. 3. Its consists of a process for loading a dataset, training the data, and classifying the ROI (Region of interest). ROI will be used to determine whether people wear a mask or not. The proses are started by loading the face mask dataset, and then it will train the face mask classifier with Keras or TensorFlow. After that, it saves the face mask classifier to disk. After saving face mask classifier, we apply the face mask detector by loading face mas classifier from disk and then detecting faces in the image or the video and extracting each face ROI (Region of interest). ROI is extracted then the face mask classifier is applied to each face ROI to analyze and detect whether the face has a face mask or doesn't have a face mask. Once it's finished analyzing, it renders the results by initiating a warning alert to people whether they have a mask or not with sound through a speaker.

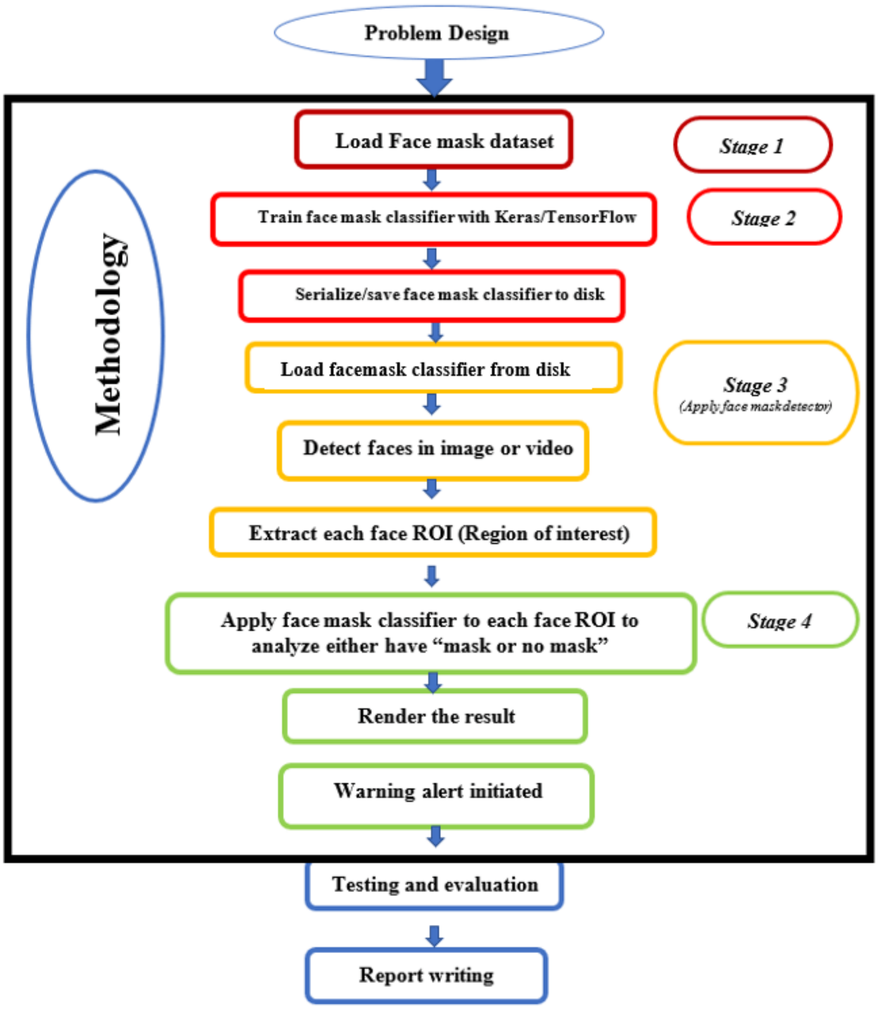

Fig. 3. Methodology of proposed system

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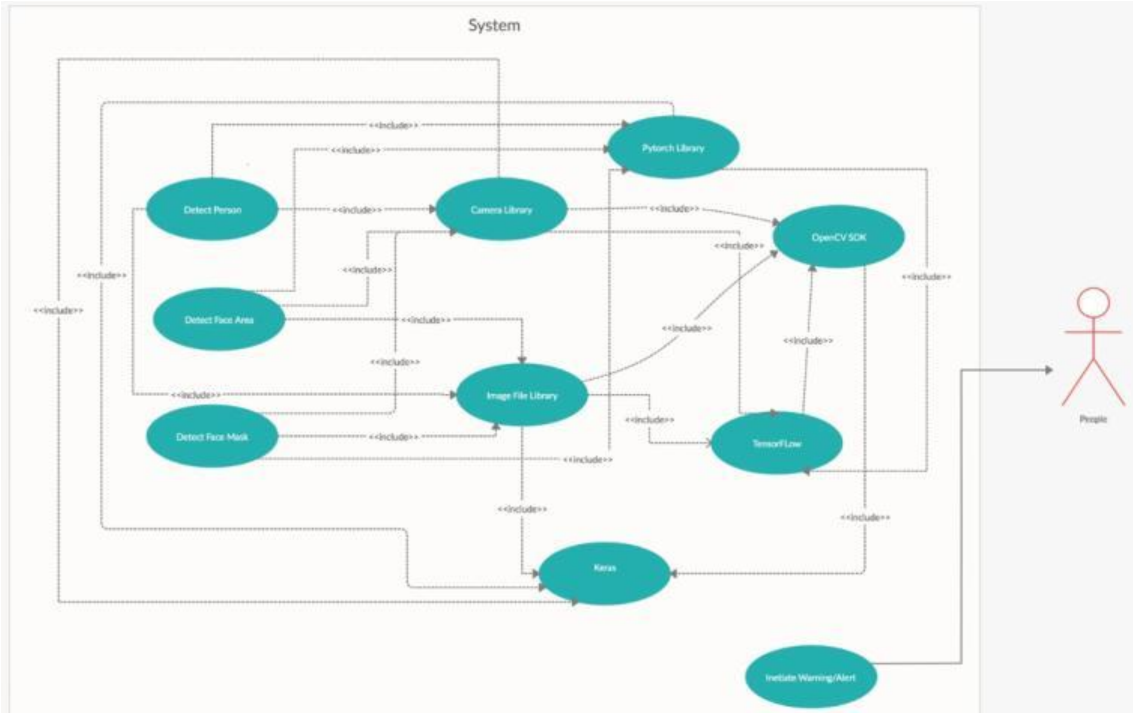


Fig. 4. Use case diagram of proposed system

Figure 4 describes the use case diagram of the overall system. It started with **Detect Person** use case: it is a process to localize whether the human already within camera reach or not. As soon as inside range, it will be automatically continued with a further process such as face detection. The human must be detected in full body to estimate the face position and doing face tracking. Afterwards, it continued with **Detect Face Area**: it is a process in our system that identifies human face within the range. Once a human face detected, it will be symbolized by a highlighted rectangle. **Detect Face Mask**: it is based on a serialized classifier that saved onto a disk. The detected face will be compared with the current face and decide either to have a facemask or not. While Fig. 5 show the variety of library used for developing the system such as OpenCV for handling Image File and Camera Library, while the other two components are TensorFlow, Keras and PyTorch for deep learning technique.

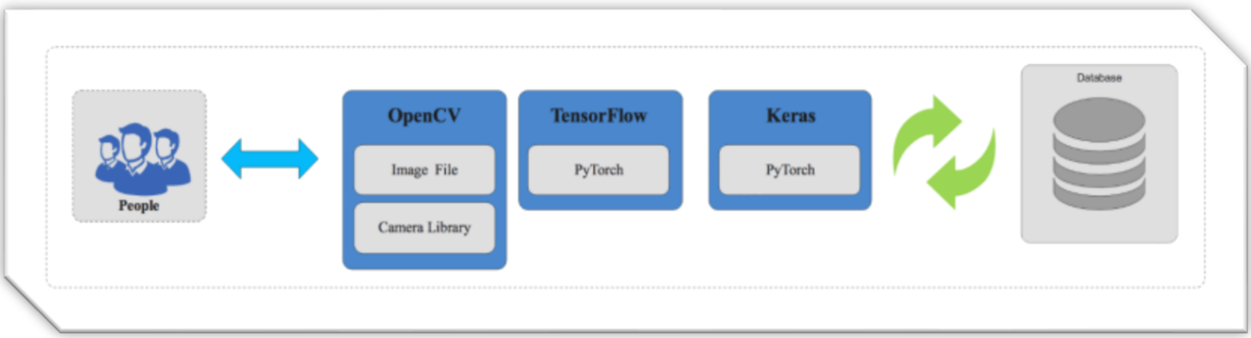


Fig. 5. Architecture diagram.

III. Result and Dicussion

Before This research aims to help society increase awareness of maintaining COVID-19 protocol, such as wearing a face mask and social distancing. A collection of the dataset was also collected to improve training accuracy and combined with the additional dataset from online resources.

A. Facemask detection in image

The first scenario will focus on image-based detection on collecting images containing people with a face mask. Our dataset has been collected during classes and gathered to train our program using the trainer, and below there is an example of both people having a mask and a collection of people having no mask. Fig. 6 shows the dataset of photos of people that we took who are not wearing a facemask.

(A)

(B)

Fig. 6 Dataset, (A) No Facemask, (B), wear Facemask

Before the process of facemask recognition started, training for the classifier is shown in Fig. 7. While the result of facemask detection depicted in Fig. 8, which shown 3 people wearing a facemask and two who didn’t wear facemask detected successfully.

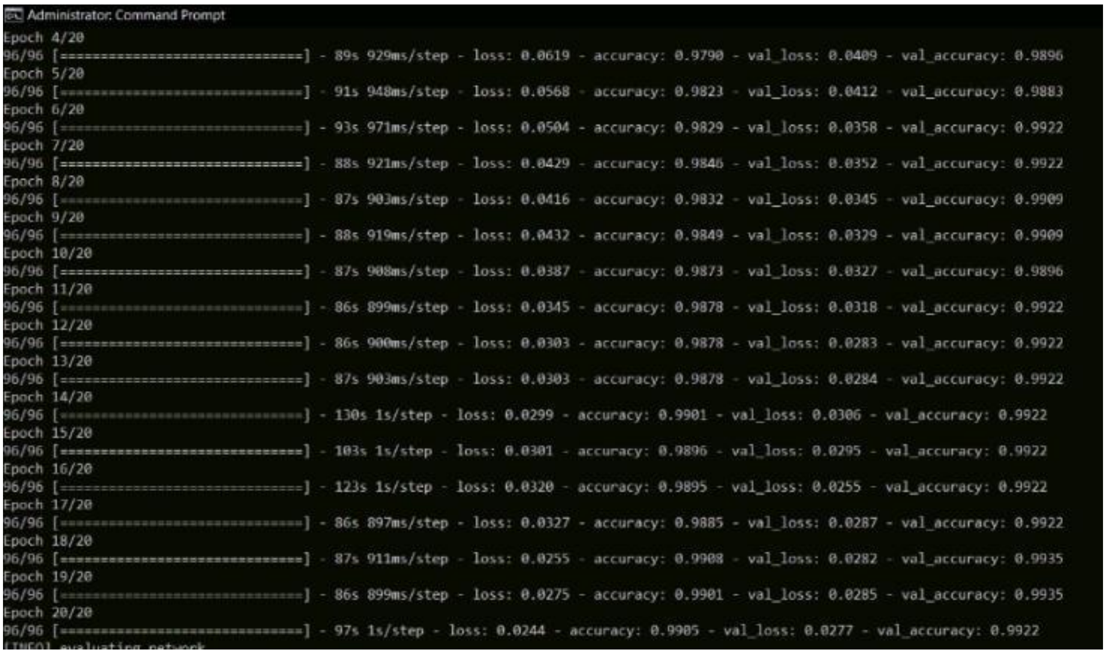


Fig. 7. Training Process

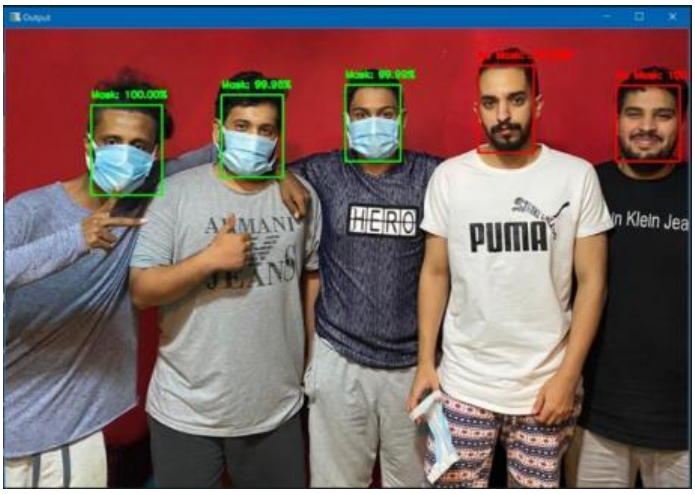
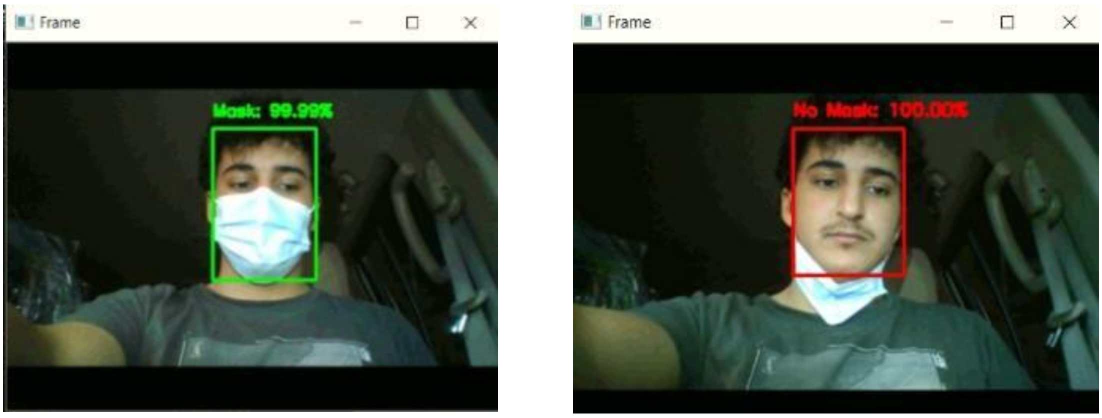


Fig 8. Facemask and non-facemask detected

B. Real time tracking

The second scenario focused on real-time tracking, which used video as an input. The trackers will localize the face area and check either the particular region(mouth, nose and chin) of the face is covered or not. Fig. 9A shows the person wearing facemask detected, while Figure 9B, no Facemask noticed. The accuracy of detection toward 16 subjects is outstanding, with a value of more than 99%. While Fig. 10 show the graph of percentage for all experiment accuracy.



(A) (B)

Fig. 9 Facemask detected in real time tracking

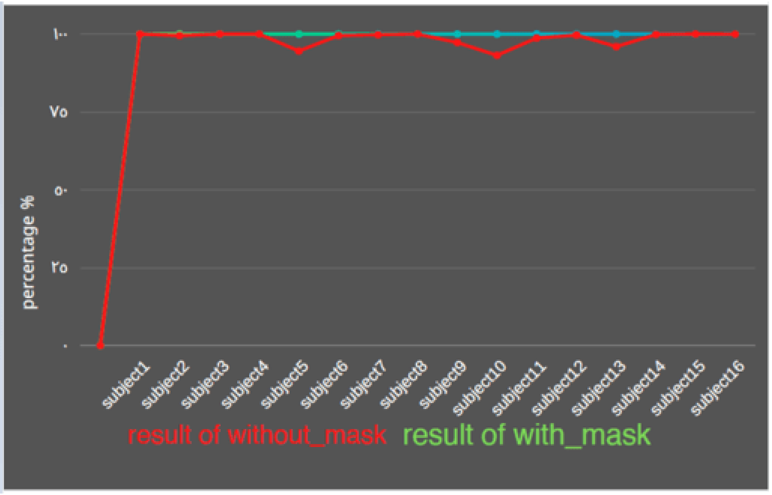


Fig. 10. Accuracy percentage

The evaluation for the proposed system is measured by equation 1-4 and presented in Table 1, while the training progress with 20 epoch presented in Fig. 11. Table 1 describes that our F1 Score reach 99% accuracy as well as for precision and recall value.

$$Accuracy = \frac{T_p+T_n}{(T_p+F_p+F_n+T_n)} \quad (1)$$

$$Precision = \frac{T_p}{(T_p+F_n)} \quad (2)$$

$$Recall = \frac{T_p}{(T_p+F_n)} \quad (3)$$

$$f1\ score = 2 * \frac{Recall * Precision}{(Recall + Precision)} \quad (4)$$

Where : Tp: True positive
Fp: False positive
Tn:True negative
Fn:False negative

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Fig. 11. Training loss and accuracy performance

Table 1. Classification evaluation

	Precision	**recall**	**F1 Score**	**support**
with mask	0.99	1.00	0.99	384
without mask	1.00	0.99	0.99	386
accuracy			0.99	770
Macro average	0.99	0.99	0.99	770
Weighted average	0.99	0.99	0.99	770

The system also performed initial testing using AR distancing to measure the distance from the location where the protocol violation occurred. Fig. 12 shows where the experiment conducted in our campus location. The distance where the non-facemask person detected is 35 meter, with location near the faculty building.

Fig. 12. Training loss and accuracy performance.

IV. Conclusion

Giving those who are trying to survive from this pandemic Covid-19 (coronavirus) being cautious and taking their safety measures seriously. The project has successfully trained the dataset and generates a model. Afterwards, image detection based also tested and successfully able to detect the facemask in people face. Furthermore, real-time tracking presents the detection of facemask on people who are captured by the camera. The result is quite convincing and able to detect multiple facemasks simultaneously with accuracy reach 99%. The AR distancing believes in monitoring the violation position so the authority can localise the violator location. The system will also notify the violator with warning messages to wear their facemask for their safety and safety. The future work can extend into the CCTV dataset, where the people face quite far from a camera, so the model can improve further to achieve better accuracy. The warning message also can be integrated with IoT sensor with a geolocation sensor to send the violator location to the authority.

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References

[1] WHO. (2021, 1 March 2021). *WHO Coronavirus (COVID-19) Dashboard, https://covid19.who.int/, Last Accessed March 2021*. Available: https://covid19.who.int/

[2] E. Dong, H. Du, and L. Gardner, "An interactive web-based dashboard to track COVID-19 in real time," *The Lancet Infectious Diseases*, vol. 20, no. 5, pp. 533-534, 2020.

[3] S. A.-M. o. Health. (2021). *Covid 19 Dashboard, Ministry of Health, Covid19 Command and Control Center CCC, The National Health Emergency Operation Center NHEOC. https://covid19.moh.gov.sa/, Last Accessed: March 2021*.

[4] W. Advice. (2021, March). *Coronavirus disease (COVID-19) advice for the public, https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public?gclid=EAIaIQobChMIib-i3L2q7wIVk6SyCh3Tyw2GEAAYAiAAEgKbPvD_BwE, Last Accessed: March 2021*.

[5] T. Singhal, "A Review of Coronavirus Disease-2019 (COVID-19)," (in eng), *Indian journal of pediatrics,* vol. 87, no. 4, pp. 281-286, 2020.

[6] J. Bullock, A. Luccioni, K. Hoffmann Pham, C. Sin Nga Lam, and M. J. a. e.-p. Luengo-Oroz, "Mapping the Landscape of Artificial Intelligence Applications against COVID-19," p. arXiv:2003.11336Accessed on: March 01, 2020Available: https://ui.adsabs.harvard.edu/abs/2020arXiv200311336B

[7] P. Kumar *et al.*, "Temporary reduction in fine particulate matter due to 'anthropogenic emissions switch-off' during COVID-19 lockdown in Indian cities," (in eng), *Sustain Cities Soc,* vol. 62, p. 102382, Nov 2020.

[8] A. M. Rahmani and S. Y. H. Mirmahaleh, "Coronavirus disease (COVID-19) prevention and treatment methods and effective parameters: A systematic literature review," (in eng), *Sustainable cities and society,* vol. 64, pp. 102568-102568, 2021.

[9] C. M. Peak *et al.*, "Individual quarantine versus active monitoring of contacts for the mitigation of COVID-19: a modelling study," (in eng), *Lancet Infect Dis,* vol. 20, no. 9, pp. 1025-1033, Sep 2020.

[10] T. Abel and D. McQueen, "The COVID-19 pandemic calls for spatial distancing and social closeness: not for social distancing!," (in eng), *Int J Public Health,* vol. 65, no. 3, p. 231, Apr 2020.

[11] T. L. D. Huynh, "Does culture matter social distancing under the COVID-19 pandemic?," (in eng), *Saf Sci,* vol. 130, p. 104872, Oct 2020.

[12] S. Tuli, S. Tuli, R. Tuli, and S. S. Gill, "Predicting the growth and trend of COVID-19 pandemic using machine learning and cloud computing," *Internet of Things,* vol. 11, p. 100222, 2020/09/01/ 2020.

[13] S. L. Schneider and M. L. Council, "Distance learning in the era of COVID-19," (in eng), *Arch Dermatol Res,* pp. 1-2, May 8 2020.

[14] H. Durmuş, M. E. Gökler, and S. Metintaş, "The Effectiveness of Community-based Social Distancing for Mitigating the Spread of the COVID-19 Pandemic in Turkey," *J Prev Med Public Health,* vol. 53, no. 6, pp. 397-404, 11 2020.

[15] J. Jakhar and P. Kharya, "Social distancing and promoting psychological well being during COVID-19 pandemic," *International Journal of Social Psychiatry,* p. 0020764020968132, 2020.

[16] I. Kuitunen, M. Artama, L. Mäkelä, K. Backman, T. Heiskanen-Kosma, and M. Renko, "Effect of Social Distancing Due to the COVID-19 Pandemic on the Incidence of Viral Respiratory Tract Infections in Children in Finland During Early 2020," vol. 39, no. 12, pp. e423-e427, 2020.

[17] N. B. Masters *et al.*, "Social distancing in response to the novel coronavirus (COVID-19) in the United States," *PLOS ONE,* vol. 15, no. 9, p. e0239025, 2020.

[18] M. Qian and J. Jiang, "COVID-19 and social distancing," (in eng), *Zeitschrift fur Gesundheitswissenschaften = Journal of public health,* pp. 1-3, 2020.

[19] P. Kumar and L. Morawska, "Could fighting airborne transmission be the next line of defence against COVID-19 spread?," *City and Environment Interactions,* vol. 4, p. 100033, 2019/12/01/ 2019.

[20] W.-j. Guan *et al.*, "Clinical Characteristics of Coronavirus Disease 2019 in China," vol. 382, no. 18, pp. 1708-1720, 2020.

[21] S. Katal, S. K. Johnston, J. H. Johnston, and A. Gholamrezanezhad, "Imaging Findings of SARS-CoV-2 Infection in Pediatrics: A Systematic Review of Coronavirus Disease 2019 (COVID-19) in 850 Patients," (in eng), *Acad Radiol,* vol. 27, no. 11, pp. 1608-1621, Nov 2020.

[22] B. Udugama *et al.*, "Diagnosing COVID-19: The Disease and Tools for Detection," (in eng), *ACS Nano,* vol. 14, no. 4, pp. 3822-3835, Apr 28 2020.

[23] P. Nagrath, R. Jain, A. Madan, R. Arora, P. Kataria, and J. Hemanth, "SSDMNV2: A real time DNN-based face mask detection system using single shot multibox detector and MobileNetV2," (in eng), *Sustainable cities and society,* vol. 66, pp. 102692-102692, 2021.

[24] S. Yang, P. Luo, C. C. Loy, and X. Tang, "WIDER FACE: A Face Detection Benchmark," in *2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 2016, pp. 5525-5533.

[25] K. Zhang, Z. Zhang, Z. Li, and Y. Qiao, "Joint Face Detection and Alignment Using Multitask Cascaded Convolutional Networks," *IEEE Signal Processing Letters,* vol. 23, no. 10, pp. 1499-1503, 2016.

[26] M. M. Abrar, R. Islam, and M. A. H. Shanto, "An Autonomous Delivery Robot to Prevent the Spread of Coronavirus in Product Delivery System," in *2020 11th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)*, 2020, pp. 0461-0466.

[27] K. H. S. Allehaibi, A. H. Basori, and N. N. Albaqami, "B-COV:Bio-inspired Virtual Interaction for 3D Articulated Robotic Arm for Post-stroke Rehabilitation during Pandemic of COVID-19," *International Journal of Computer Science and Network Security,* vol. 21, no. 2, pp. 110-119, 2021.

[28] D. D. Auria and F. Persia, "Robots against the Coronavirus: the need for a new generation of robots to help global society," in *2021 IEEE 15th International Conference on Semantic Computing (ICSC)*, 2021, pp. 421-424.

[29] A. H. Basori, "Emotion Walking for Humanoid Avatars Using Brain Signals," *International Journal of Advanced Robotic Systems,* vol. 10, no. 1, p. 29, 2013/01/01 2013.

[30] C. L. Chung, D. B. Chen, and H. Samani, "Action Detection and Anomaly Analysis Visual System using Deep Learning for Robots in Pandemic Situation," in *2020 International Automatic Control Conference (CACS)*, 2020, pp. 1-6.

[31] V. kamalasanan and M. Sester, "Living with Rules: An AR Approach," in *2020 IEEE International Symposium on Mixed and Augmented Reality Adjunct (ISMAR-Adjunct)*, 2020, pp. 213-216.

[32] D. Zhang, W. Wei, W. Zheng, and Z. Guo, "The Navigation Design of Mobile Robot in the Man-Machine Environment for Service Assist," in *2020 4th International Conference on Automation, Control and Robots (ICACR)*, 2020, pp. 37-43.

[33] N. N. Albaqami, K. H. S. Allehaibi, and A. H. Basori, "Dynamic Heterogeneous Crowd Behaviour Detection Framework for Evacuation Plan during Emergency Situation," *International Journal of Computer Science and Network Security,* vol. 19, no. 12, pp. 61-68, 2019.

[34] H. M. A. AlJahdali and A. H. Basori, "Emotional Contagion Driven of Parent-Child's Agents in Crowd during Panic Situation," *International Journal of Computer Science and Network Security,* vol. 19, no. 1, pp. 261-266, 2019.

[35] A. H. Basori, "NAOCared: Intelligent and Communally Humanoid assistive robot for elderly care support " *International Journal of Computer Science and Network Security,* vol. 20, no. 4, pp. 113-120, 2020.