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

Andi Tenriawaru\textsuperscript{a,1}, Andi Besse Firdausiah Mansur\textsuperscript{b,2}, Ahmad Hoirul Basori\textsuperscript{b,3,*}, Qusai Al-Qurashi\textsuperscript{b,4}, Abdullah Al-Muhaimeed\textsuperscript{b,5}, Majid Al-Hazmi\textsuperscript{b,6}

\textsuperscript{a}Department of Mathematics, Faculty of Mathematics and Natural Science, Halu Oleo University, Kendari 93231, Indonesia
\textsuperscript{b}Faculty of Computing and Information Technology in Rabigh, King Abdulaziz University, Makkah 21911, Saudi Arabia
\textsuperscript{1}andi.tenriawaru@uho.ac.id; \textsuperscript{2}abmansur@kau.edu.sa; \textsuperscript{3}abasori@kau.edu.sa*; \textsuperscript{4}iTzQusai.Q@gmail.com; \textsuperscript{5}almohaimeed.a.m@gmail.com; \textsuperscript{6}majody.gx@gmail.com

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\cite{1,2}. Particularly in Saudi Arabia, the total case has written more than 380 thousand cases, with around three thousand active cases\cite{3}. Therefore, WHO has put standard to reduce the number of infections by obeying some standard protocol such as maintaining social distance, wearing 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.
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].

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

Fig. 2. Prevention method classification by Rahmani, A.M. and Mirmahaleh, S.Y.H (2020) [8]
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 processes 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 mask 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
Andi Tenriawaru et.al Social Awareness and Safety Assistance of COVID-19 based on DLN face mask detection and AR Distancing)

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.
III. Result and Discussion

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.

![Dataset](image)

(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.
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.

Andi Tenriawaru et.al Social Awareness and Safety Assistance of COVID-19 based on DLN face mask detection and AR Distancing)
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 \[= 2 \cdot \frac{Recall \cdot Precision}{(Recall + Precision)} \]  \quad (4) 

 Where :  
 \(T_p\): True positive  
 \(F_p\): False positive  
 \(T_n\): True negative  
 \(F_n\): False negative
Andi Tenriawaru et.al Social Awareness and Safety Assistance of COVID-19 based on DLN face mask detection and AR Distancing

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.
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.

Acknowledgment

This work was supported by the Deanship of Scientific Research (DSR), King Abdulaziz University, Jeddah Saudi Arabia. The authors, therefore, gratefully acknowledge the DSR technical and financial support.

References


