COVID-Counter Room or Laboratory Access

Zian Wang
Computer and Information Technology
Purdue University
West Lafayette, IN, USA
wang4258@purdue.edu

Seunggyun Jeong
Dept. of Mobile Software
Daegu Catholic University
Daegu, Republic of Korea
jskyun98@cu.ac.kr

Jeonghun Lee
Dept. of Smart IoT
Daegu Catholic University
Daegu, Republic of Korea
ukidd002@gmail.com

Ho Kim
Dept. of Software Convergence
Daegu Catholic University
Daegu, Republic of Korea
rlagh1073@naver.com

Jiwon Seo
Dept. of Smart IoT
Daegu Catholic University
Daegu, Republic of Korea
sshong48@naver.com

Yungyeong Ma
Dept. of Cyber Security
Daegu Catholic University
Daegu, Republic of Korea
kwn07191@gmail.com

***Abstract*—COVID-19 is a virus that has been causing problems worldwide since 2019. Being infected with COVID-19 can cause fever, fatigue, headache, loss of taste or smell, and in severe cases, difficulty breathing or chest pain, and speech or movement problems. Therefore, many programs have been developed to mitigate the damage caused by the corona virus, such as a system for the status of confirmed cases by region or a system that displays the movement routes of confirmed cases. The primary objective of the paper is to describe a system that reduces the likelihood of corona infection by limiting the number of people in an enclosed space, such as a laboratory or lecture hall. Additionally, this report can be used to help people who need to obtain information on object recognition or study related to it.**

***Keywords*—COVID-19, information technology, lab access, room monitoring**

I. Introduction

As COVID-19 continues, people are not able to go outside freely and outdoor activities are increasingly restricted. Also, if a person becomes infected with COVID-19, they have to be quarantined, which interferes with their daily life. Thus, the limitation on the number of people in confined spaces is necessary due to COVID-19 virus, and the information of people who have entered the spaces must be recorded. With this information, a movement route can be secured when a confirmed person appears, and personnel overlapping with the confirmed person's movement can be traced.

Therefore, the demand for a system that can authenticate people and can limit number of people in confined spaces is starting to emerge.Through this study, people can use the laboratory relatively safely, and if there are confirmed cases, the system would make it easier to find people who were in the same space through the records.

In the end, this study will develop a system that contains following functions: recognizing people through a camera, monitoring the status of the number of people in the laboratory, QR code generation, QR code Scanner, laboratory reservation function, administrator monitor interface, and alert function.

II. Background

W. H. Organization [1] The COVID-19 is a new form of pneumonia discovered in Wuhan, China. Coronavirus is a disease that is transmitted through the respiratory tract. World Health Organization [2] Coronavirus is a disease caused by infection through droplets. F. M. Risso. [3] To prevent the coronavirus, a method called "social distancing" has been adopted in many countries, and it is effective. [4] The number of patients due to the corona virus is increasing, and Korea is responding to the coronavirus using a step-by-step social distancing method. N. S. Punn. [5] Machine learning algorithm is used for prevent of coronavirus. Gaudenz Boesch. [6] Computer vision is being used in many areas of the coronavirus situation. Yugesh Verma. [7] Checking the number of people through object detection is a system that can effectively monitor social distancing. OpenCV is an object recognition method through Python and is a library that enables image processing. [8] And in Korea, using QR code to record access or to check access rights. Simon Hill. [9] To read the QR code, it need to use a camera app that has a QR code recognition function. There are prior studies on social distancing using object detection. N. S. Punn. [10] Social distancing is the best way to prevent COVID-19 in the absence of a vaccine. Monitoring of social distancing after detecting objects using surveillance cameras. The framework used used the YOLO v3 model. Mohd. Aquib Ansari. [11] use Convolutional Neural Networks (CNN) as a way to detect objects. A human detection algorithm detects a person and measures the distance between the two objects. CNN. [12] was created to complement DNN, which managed data in one dimension. CNNs take images as raw input and build up a layer of features while maintaining spatial/local information. In addition to social distancing, there are cases of using object recognition to determine positive for COVID-19. Tulin Ozturk. [13] Binary classification and multiple classification were used. The accuracy was 98.08% for binary classification and 87.02% for multiple classification. There are research results similar to our project. Minchan Shin. [14] Using DeepSORT, a multi-object algorithm, it detects the path of the infected person and then the movement path of the infected person, and then detects

the object that violates social distancing. Through YOLOv4, image data and labeled data from the MS COCO dataset are trained to derive training weights for object detection..

III. METHOD

A. Project Design

In current study, two kinds of web page were created, one for user login and another one is for administrators to monitor and send alerts. The prototype involved a Raspberry Pi, three cameras and a speaker.

B. Usage of Each Equipment

1) Raspberry PI

Raspberry pies are used to build databases. Ubuntu system was installed on Raspberry Pi and then Docker software was installed under the Ubuntu environment. Maria DB image was downloaded to Docker so that the database can be accessed remotely.

2) Camera

Camera one detects people that going in or outside of a laboratory. The movement direction is determined by measuring the Y-axis of the movement of a person. If a person goes to the Y axis, add number of people in the lab by one. If a person goes to the negative Y axis, subtract number of people currently in the lab by one. Then what camera two does is to analyze the graphics captured by the camera to count the number of people in the laboratory by using OpenCV. Camera three is on the door, it can locate the QR code and read data from it.

3) Speaker

The speaker is set up in the laboratory to alert people in the lab that current number of people have exceeded the maximum capacity.

C. Webpage Settings

This simulation can be started after the test environment is properly set up. The purpose of the simulation is to prevent large gatherings of people due to the Coronavirus and to allow administrators to monitor the number of people in the room.

User information is collected after registering as a member on the webpage.

1) Membership registration

SignUP (Method : POST)

Data collection:

- identificationNumber
- firstName
- lastName
- phoneNumber
- email
- password

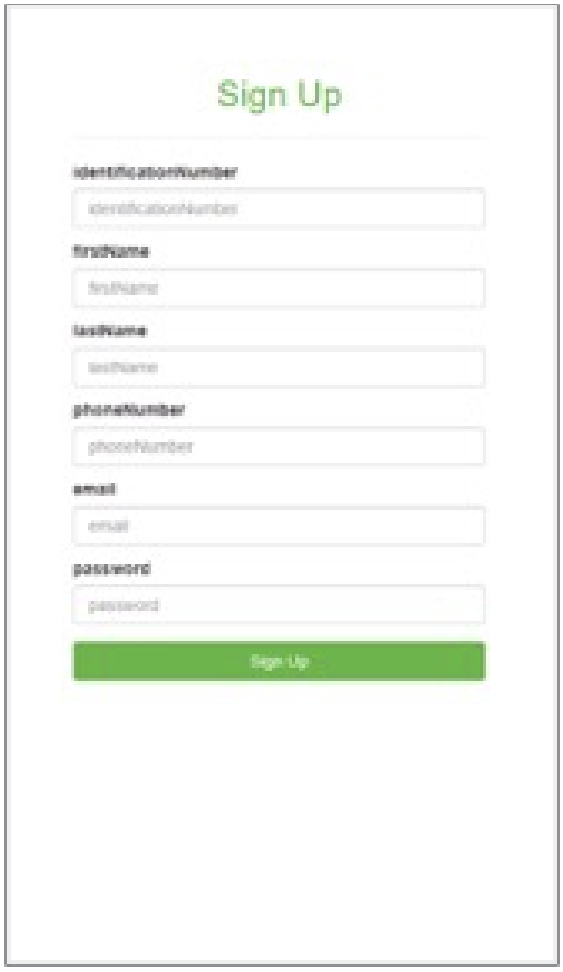

Figure 1 - Sign Up Webpage

2) QR code

Create QR code(Method : GET)

Data is used:

- identificationNumber
- firstName
- lastName
- phoneNumber
- email
- password

By showing the QR code to the camera on the door, the camera locates the QR code first, then reads information that is contained in the QR code, then display the content below.

Figure 2 - QR Code Scanning

After recognizing the QR code and authentication process, people are allowed to enter the lab.

3) Check availability and make reservation

Users can check the number of people currently in the laboratory through the web page after they logged in. Users can also make reservations for themselves.

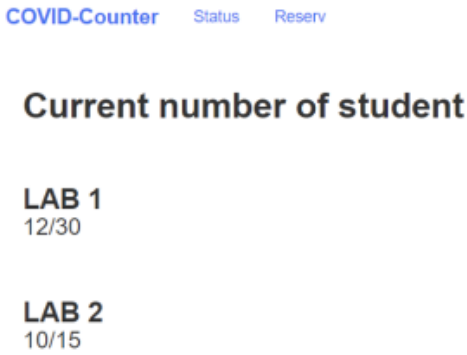

Figure 3 - Check Availability

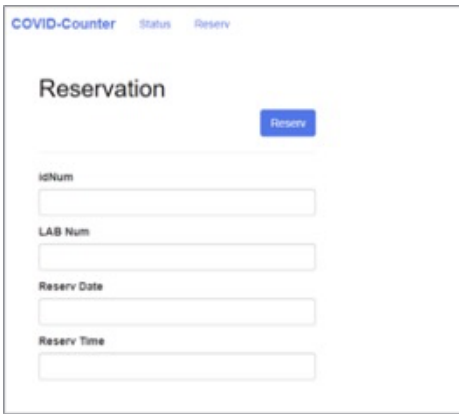

Figure 4 - Reservation Page

4) Administrator interface

Administrators can monitor the usage of each laboratory, and if the maximum occupancy is exceeded or the number from camera two and the number from camera one does not match, administrators can an alarm to the laboratory.

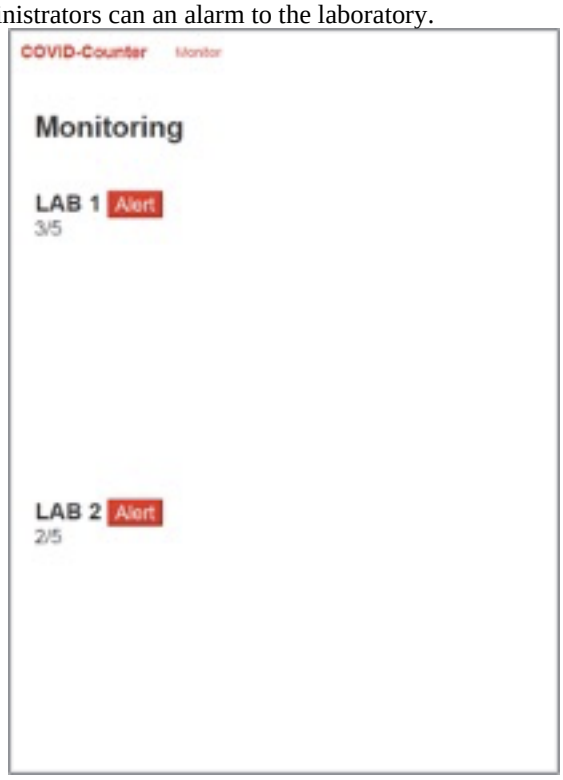

Figure 5 - Administrator Interface

D. Server Settings

1) Project Design

A server is developed to combine database, webpage, and algorithms. This server allows administrators to change the maximum capacity for different laboratories, generating QR code, and it contains the alert system.

2) Environment Setup

The function that adjusts lab's maximum capacities and the alert system test environment can be started after the web pages are developed. If the maximum number of people allowed in each laboratory is changed, it will be synchronized to administrator web page. Aadministrators can send an alarm to the lab via web page. The QR code generation test environment used the API format at https://goqr.me/api/ and MariaDB. The system installed jdbc from https://mariadb.com/kb/en/about-mariadb-connector-j/ to get the user information included in MariaDB and used it in the project.

3) Procedures

General system can be started after Door system, Lab system, and Web system are completed. The maximum capacity of the administrator's Monitor page of the web system has been changed for the test of changing the maximum capacity of the laboratory. After changing the maximum occupancy, we saw that the maximum number of people on the Current People page that admins and users can see respectively has changed.

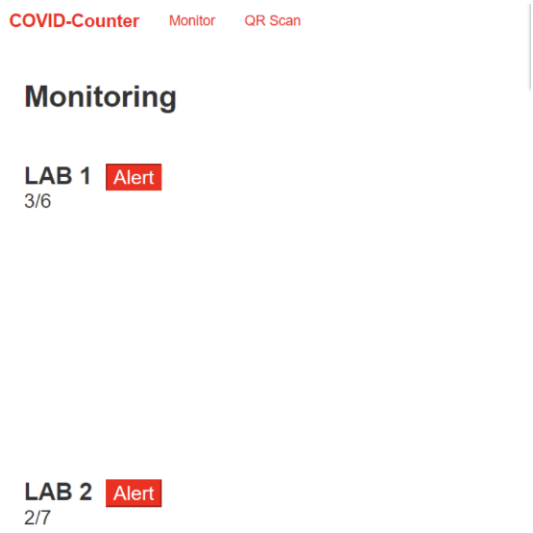

Figure 6 - Admin Page

4) QR code generation

The QR code generation system defines ip, username, password, etc. in the code so that it can access the database to generate the QR code containing user information.

```
private static final String DB_DRIVER_CLASS = "org.mariadb.jdbc.Driver";
private static final String DB_URL = "jdbc:mariadb://203.250.32.29:2002/PHOTO";

private static final String DB_USERNAME = "mari";
private static final String DB_PASSWORD = "1234";
```

Figure 7 - QR code generation

E. Laboratory Settings

1) Project Design

This part actually helps to detect the number of people in the lab and adjust the number in the database.

2) Environment Setup

OpenCV and python3 are installed as the tools to count the number of people by using the following command: sudo apt-get update; sudo apt-get install python3 commands; sudo pip3 install opencv-python. OpenCV is an open-source library that can be used for various image processing. OpenCV is distributed under the BSD license and is used by many people because it is free for academic and commercial use. This prototype imports HaarCascade for human recognition.

IV. Discussion

This section contains descriptions and effects of social distancing to control the number of people infected with COVID-19, as well as the expected effects of the project.

A. Social Distancing

The South Korean government is implementing social distancing step by step to control the number of confirmed coronavirus cases. In addition, because the population density varies from region to region, the spread rate is also different, so different distancing steps are applied from region to region.

Depending on the social distancing stage, many educational institutions, including universities, convert classes to remote classes or conduct face-to-face classes. As many students gather when conducting face-to-face classes, the number of students should be limited and quarantine rules should be observed to keep social distancing by classroom. However, the failure to comply with the quarantine rules will also lead to the rapid spread of confirmed cases.

B. Effects of Social Distancing

The reason for this project is to monitor and limit some students who did not comply with the social distancing policy implemented to control the number of confirmed cases of COVID-19.

There is a re-production number (R), which refers to the number of people transmitting an infection during the period during which one infected patient can spread it. If R is 1, one infected person infects one person, so if 10 infected patients enter the community, 10 patients will continue to be maintained, which means that the disease will not disappear and become indigenous. If R is greater than 1, a trend occurs in which the number of patients is increasing, and from the time R becomes less than 1, the trend passes the inflection point and turns to a decline.

It is known that R is usually determined by three factors: p is the probability of infection when I meet an infected person, c is the level of contact with the infected person, and d is the duration of the patient's transmission. To reduce R, these three factors must be lowered.

Social distancing should be done to reduce contact (c) with patients. In particular, for diseases with weak initial symptoms and even asymptomatic infections like this coronavirus 19, it is impossible to know who the patient is, so it is inevitable to make social distancing as actively as possible.

Social distancing can also reduce the duration (d) of infections spread by infected people. If an infection is suspected, care should be taken to reduce contact as much as possible so that the infection does not spread to the surroundings. If social distancing is actively implemented to reduce contact, the need for masks for ordinary people can be reduced, thereby reducing the probability of infection (p) by providing masks to medical personnel and high risk of infection (chronic patients, facility workers, etc.).

C. Expectation Effectiveness

It is expected to reduce the risk of an explosive increase in the number of confirmed cases due to violations of the quarantine rules of a minority. Reduce the risk of coronavirus re-proliferation by more accurately identifying the route of confirmed cases. In confined space like laboratoriess, the threat of virus spread can be reduced by preventing a large number of people from entering.

In the laboratory, people are monitored and encouraged to observe quarantine rules and distancing. The number of people in the laboratory is monitored by the manager, and meetings that violate social distancing are prevented in advance.

D. Limitation of Social Distancing

Social distancing cannot be a complete solution. It can slow down the rate of virus infection by limiting contact between people, but it is more important to follow personal quarantine rules such as wearing masks and washing hands frequently than to limit social distancing.

Also, in a democratic society, it is difficult to work because it cannot fully control people's contact or movement and relies on citizens' voluntary participation. Furthermore, social distancing is economically damaging and cannot be a complete solution.

E. Limitations of Technology

At least two physical cameras are needed. This will consume a lot of capital. The ability to monitor people in an indoor space can cause personal privacy breaches. it can't see people in the blind spot of the camera. It is impossible to identify acts that violate prevention rules, for example, taking off masks in blind spots of cameras.

V. CONCLUSION

Our life has changed largely because of COVID-19, but it is almost impossible to stop using laboratories. Hence, this paper provides a method to monitor the usage of laboratories and limit the lab access. This paper talks the background of developing the project. By combining many different technologies such as programming tools, database, image processing, etc. to provide a solution to covid-counter room or laboratory access. The prototype of this study can also be used in other situations that need to limit the number of people stay in a confined room simultaneously, not only the laboratories or rooms under a pandemic.

REFERENCES

[1] W. H. Organization, “Coronavirus disease (COVID-19),” https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19 12 October 2020 [Online; accessed August 15, 2021]

[2] W. H. Organization, “Coronavirus disease (COVID-19): Risks and safety for older people,” https://www.who.int/news-room/q-a-detail/coronavirus-disease-covid-19-risks-and-safety-for-older-people 8 May 2020 [Online; accessed August 15, 2021]

[3] F. M. Risso, G. Cozzi, “Social distancing during the COVID-19 pandemic resulted in a marked decrease in hospitalisations for bronchiolitis,” 17 August 2021 [Online; accessed August 15, 2021]

[4] 코로나바이러스감염증-19 중앙사고수습본부. “Direction of Social Distancing System and Guidelines by Social Distancing Level,” http://ncov.mohw.go.kr/en/tcmBoardView.do?brdId=12&brdGubun=125&dataGubun=&ncvContSeq=366611&contSeq=366611&board_id=1365&gubun= 26 July 2021 [Online; accessed August 15, 2021]

[5] N. S. Punn, S. K. Sonbhadra, and S. Agarwal, “Covid-19 epidemic analysis using machine learning and deep learning algorithms,” https://www.medrxiv.org/content/10.1101/2020.04.08.20057679v1 08 April 2020 [Online; accessed August 15, 2021]

[6] Gaudenz Boesch “8 Computer Vision Applications for Coronavirus Control in 2021,” https://viso.ai/applications/computer-vision-applications-for-coronavirus-control/ 28 February 2021 [Online; accessed August 15, 2021]

[7] Yugesh Verma, “Guide To Template Matching With OpenCV: To Find Objects In Images,” https://analyticsindiamag.com/guide-to-template-matching-with-opencv-to-find-objects-in-images/ 21 July 2021 [Online; accessed August 15, 2021]

[8] 유한빛, ““인증해주세요!”...QR 코드 의무화 첫날, 대형마트 • 쇼핑몰 가보니,” https://biz.chosun.com/distribution/channel/2021/07/30/F4KC4BYG7VFLDI4FE35OB3MSS4/ 30 July 2021 [Online; accessed August 16, 2021]

[9] Simon Hill, “How to Scan a QR Code,” https://www.wired.com/story/how-to-scan-a-qr-code/ 12 August 2021 [Online; accessed August 16, 2021]

[10] Narinder Singh Punn, Sanjay Kumar Sonbhadra, Sonali Agarwal and Gaurav Rai “Monitoring COVID-19 social distancing with person detection and tracking via fine-tuned YOLO v3 and Deepsort techniques” arXiv:2005.01385v4 [cs.CV] 27 Apr 2021

[11] Mohd. Aquib Ansari and Dushyant Kumar Singh “Monitoring social distancing through human detection for preventing/reducing COVID spread,” 10 October 2020

[12] Wikipedia “Convolutional neural network,”https://en.wikipedia.org/wiki/Convolutional_neural_network

[13] T. Ozturk, M. Talo, E. A. Yildirim, U.B. Baloglu, O. Yildirim and U. R. Acharya “Automated detection of COVID-19 cases using deep neural networks with X-ray images,” 28 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7187882/ 28 April 2020

[14] Minchan Shin and Nammee Moon “Indoor Distance Measurement System COPS (COVID-19 Prevention System),” https://www.mdpi.com/2071-1050/13/9/4738/htm 14 April 2021

[15] Adrian Rosebrock “OpenCV People Counter” https://www.pyimagesearch.com/2018/08/13/opencv-people-counter/ 13 July 2021 [Online; accessed August 18, 2021]

[16] Dr. W. K. Tan, “5 best front-end web development technologies in 2020,” https://techbullion.com/5-best-front-end-web-development-technologies-in-2020/ 16 June 2020 [Online; accessed August 17, 2021]