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Real-Time Masked Face Recognition for Logging System with Health and Temperature Monitoring

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Abstract— **The COVID-19 pandemic has greatly affected the country, particularly in executing health and safety protocols. In response, the researchers designed and proposed a project which aims to implement a real-time masked face recognition for logging system with health and temperature monitoring. This includes image processing, machine learning model training, masked and unmasked face detection and recognition, facemask classification, body temperature checking, health declaration form verification for health status validation, health data integration, and log entry recording. The project implementation involved MSI-Z97M System Unit, Logitech HD Pro Webcam C920, FLIR Lepton 3.5 with PureThermalV2 smart I/O board, Dual-display Monitor, FaceNet with Single Shot MultiBox Detector training model, and Microsoft Office 365 applications. The results showed that the researchers successfully implemented the system and achieved the objectives of the study. This research offers a promising solution for real-time tracking and management of health protocols, amidst the ongoing concern brought by the pandemic.**

Keywords— real-time masked face recognition, logging system, health and temperature monitoring, image processing, machine learning model training, face detection, face recognition

I. INTRODUCTION

Based on the analysis done by Clinical Trials Arena, the Philippines is one of the countries severely affected by a novel coronavirus known to be Covid-19 [1]. The press release posted on the Department of Health's website stated that the country had its first case of COVID-19 on January 30, 2020, and it was then followed by several confirmed cases and local transmission [2]. As a preventive measure, the Department of Health (DOH), together with the Inter-Agency Task Force for the Management of Emerging Infectious Diseases (IATF-EID) formed guidelines that require people to wear a face mask and face shield, have their temperature checked before entering an establishment, and practice social distancing. People were prohibited from going outside their homes unless for emergency or when in need of basic necessities. It was also required to disinfect and provide the personal information necessary for contact tracing. Those who can work from home were advised to do so to limit physical contact. Schools and colleges were immediately closed along with other establishments that are not needed for daily living such as parlors, gyms, hardware stores, and others.

Now that vaccines are available and the COVID-19 cases are lower compared to the past two years, it can be said that people are living in a new normal. As stated by the IATF and other government agencies involved, workers can go back to their workplace, people can travel anywhere, all business establishments can continue their operations, and schools can do limited face-to-face classes provided that safety and health protocols are followed, and certain requirements are met.

This proposed study is based on the first-hand experiences of the proponents and the responses given by the persons involved in executing the safety and health protocols with regards to COVID-19. The study was conducted at First Asia Institute of Technology and Humanities (FAITH Colleges), one of the academic institutions permitted by the Commission on Higher Education (CHED) to conduct limited face-to-face classes for certain programs that require hands-on experiences such as medicine and engineering. In line with the established safety and health protocols and requirements released by CHED, a college student will only be allowed to participate in in-person classes if he/she has a complete dosage of the COVID-19 vaccine and submitted a liability waiver. The student should also submit a parent consent and health declaration form (HDF). Before entering the campus, the temperature of the student should be checked, and he/she should be wearing a face mask, and school ID.

The security officer at the school entrance is in-charge of checking every student's temperature, wearing of face mask, school ID, and HDF, which are submitted to the school clinic for monitoring of the resident nurse and/or attending doctor. An interview was conducted to clearly establish the main problem with regards to practicing the safety and health protocols in the school. As stated by Ms. Jovelyn O. Ching, one of the security personnel at FAITH Colleges, the manual checking of HDF takes time as they need to verify first the name of the student and the date when the form was submitted. As a result, people must wait in line before entering the school premises. As for Ms. Mary Aizel G. Chanco, school nurse, the manual checking of HDF is a tedious job given the number of students entering the campus each day.

Considering that these inconveniences may continue as college students enrolled in other programs will now also be

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allowed to attend in-person classes, and as the Department of Education (DepEd) plans the full implementation of face-to-face classes for all levels, the proponents thought of implementing a real-time masked face recognition for logging system with health and temperature monitoring. The proposed project will serve as an improvement of what is already available today as it includes unique features that could have made the existing studies more useful and significant.

A study proposed by Nguyen et al. (2020) involves a system for body temperature measurement, facial recognition, masking based on deep learning, and prevention of spoofing between a real face and face-in-image recognition [3]. But upon testing, it was found that the system is not reliable when it comes to recognizing the face of a person wearing a mask. Thus, major changes in the algorithm used may be necessary. Moreover, in a recent study, Arapan et al. (2021) developed a system to detect facemasks and measure the temperature [4]. It did not include the real-time recognition of the face and the recording of temperature for monitoring purposes. Also, there is no clear and specific application of the proposed system. In this case, the project may be innovated to have a more significant impact. With these, it can be said that the proposed project will be different in the way that it will be an integration of real-time face recognition technology, health monitoring system, and temperature monitoring system which will be applied to the student logging system.

The proposed project made use of face recognition technology. Through this, the registered students will be recognized even if they are wearing a mask. Then, based on their identity, their entry will be noted and their submitted HDF will be verified and analyzed by the system. The project includes a temperature monitoring system wherein, upon measurement, the forehead temperature of the student will be recorded on the HDF. This feature lessens the delay and hassle in executing the safety and health protocols not only in FAITH Colleges but also in other schools and establishments where the system may be deemed applicable and necessary.

II. Related Literature

A. *Masked Face Recognition System*

Sitepu et al. (2021) developed a face recognition system for efficient face recognition and access control, even in scenarios where faces are partially covered by masks, which is common during the COVID-19 pandemic [5]. The system comprises three stages: face detection, face alignment, and face recognition. In the face detection stage, RetinaFace algorithm is used to detect faces in images. In the face alignment stage, the faces detected in the previous stage are aligned using facial landmark detection technique. In the face recognition stage, FaceNet algorithm is used for feature extraction and classification of faces. The results indicated that the accuracy was 98.2%, which outperformed other methods. The study concludes that the proposed system has practical applications in access control in public spaces like airports, hospitals, and offices. Furthermore, the accuracy and security of the system can be enhanced by integrating other technologies such as temperature sensor.

B. *Logging System*

The “Smart Attendance System for Covid-19” presents a contactless attendance system that can help reduce the spread of COVID-19 in workplaces [6]. Traditional attendance systems that require touching a shared surface are potential carriers of the virus, and the proposed system offers an alternative. The system utilizes a face recognition algorithm that captures the employee’s face and records their attendance without the need for physical contact. The system includes a camera, a microcontroller, and a cloud-based database. The camera captures the employee’s face, and the microcontroller processes the data and matches it with a pre-defined database to identify the employee. The attendance data’s then stored and analyzed in the cloud-based database. The study concludes that the system can be used in various settings to reduce the risk of COVID-19 transmission, although more research is needed to validate its accuracy and effectiveness in real-world settings. The author suggests that the system could be further enhanced by integrating additional features, such as contact tracing, to increase its effectiveness.

C. *Temperature Monitoring System*

In a recent study conducted by Arapan et al. (2021), entitled “Real-time Facemasks Detection with Temperature Checking System”, some fundamental Machine Learning tools such as Tensor Flow, Keras, OpenCV, tensorRT, and others were used to detect facemask wear in real-time and check a person’s temperature. An NVIDIA Jetson Nano connected with Raspberry Pi Cam V2 for RGB cam and FLIR Lepton 3.5 for the thermal camera was used in the project. The results of the study showed that the researchers were able to create a model that can detect if a person is wearing or not wearing a facemask, check body temperature that is +2 ℃ accurate due to the absence of a blackbody calibration source, addition of text-to-speech alert. When it comes to performance, their model has a 99.75% accuracy and a speed of 400-600ms (about half second) latency [4].

D. *Computer Vision and Image Processing*

Face detection is first performed in face recognition function to determine the position of the face in the picture [7]. The OpenCV Library algorithm is a common method of face detection. It extracts the characteristic image in a large set of samples by extracting facial features in the image and then uses the face detector algorithm. For face detection, the algorithm can effectively adapt to complex environments such as low light and background blur, greatly improving detection accuracy. For a training set, varying the distribution probability of each sample results in different training sets for the next job, each training set is trained to acquire a weak classifier, then this is weighted over multiple classifiers. Choudhury (2020) stated that OpenCV library can be used for various types of projects, such as face detection and recognition, object identification, classification of human behavior in videos, camera movement monitoring and identification of moving objects. Also, extract 3D models of objects, generate 3D bitmap clouds from stereo cameras, generate high resolution images by linking images, search for similar images from image database, remove red eye from flash shot images [8].

E. *Deep Learning and Convolutional Neural Networks*

Deep learning is a system of many important algorithms, part of a larger group of machine learning strategies, and has been effective in many areas of computer vision for years.

Functional learning is at the heart of deep learning. The goal is to gain practical knowledge of hierarchical networks to solve problems that previously required artificial design. Convolutional Neural Networks (CNNs) have recently undergone significant development and are one of the most popular and effective multiple image recognition applications. The main advantage of CNNs is the ability to retrieve complex hidden features with complex structures from high-dimensional data. The CNN model is also often used in facial recognition activities [9]. In deep learning, a CNN is a class of deep neural networks commonly used in visual image analysis and uses a technique called convolution. Mathematical convolution becomes an arithmetic operation of two functions, creating a third function that represents how one form is modified by the other [10].

III. METHODOLOGY

A. *Research Paradigm*

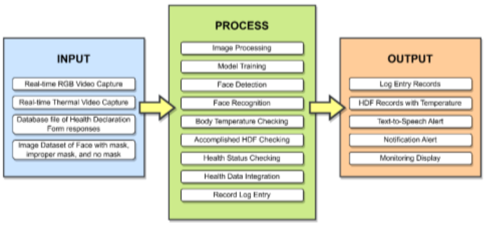

Fig. 1. Research Paradigm

The research paradigm is presented in Fig. 1. The input for the proposed system consists of the student's real-time RGB video capture, real-time thermal video capture, image dataset of face with mask, improper mask, and no mask, and database file of health declaration form responses which will be completed through Microsoft Power Automate. This tool transfers the HDF responses from Microsoft Forms to the designated Excel database file saved in the cloud storage. To start the process of the study, first, the RGB video capture frame and thermal video capture frame will undergo image processing. Through the mapping process, the thermal image will be scaled for it to have the same size as the RGB image. Here, it is important to map the forehead since this is where the temperature will be based and for the system to determine where it is in RGB image, and thermal capture. The temperature measured by the thermal camera for each pixel containing the forehead image will be added and divided by the total number of pixels. The computed mean will be the temperature of the person. After the image processing, the model will be trained using the image from the RGB camera and the face of the student will be detected and recognized. After that, the temperature will be checked based on real-time thermal capture. Using the student's identity, the system will then check if he/she accomplished HDF. If successful, the health status will be checked based on the responses in the form. Then, the measured body temperature will be integrated into the HDF and student details will be added in the log record. The output in this study is the log entry record and HDF records with temperature. A text-to-speech and notification alerts are featured to notify student and the person in-charge, with display showing the student's health status.

B. *Method of Data Collection*

To develop the method of data collection explained in this part, the researchers analyzed various literature and studies found on reliable sources. The objectives, materials, methods used, and the results of the existing studies were noted to serve as a basis and have a prior idea of the data collection setting, a focused interview with Ms. Jovelyn O. Ching, one of the security officers at FAITH Colleges, and Ms. Mary Aizel G. Chanco, the school nurse, were held separately. In this type of interview, the researchers asked a series of questions about the processes involved and the occurring problems concerning the safety and health protocols implemented by the school. After some months, follow-up interview with Ms. Ching and series of interviews with Mr. Genesis Arn M. Latido, one of the school nurses, were held to gather recent information for the development of the project.

The algorithms used in this study came from online sources. However, the researchers made use of their own dataset for training and testing the model for masked face recognition. The faces of the group members which include faces with different varieties of masks, improperly worn masks, and no masks were included in the training dataset. The total images for the test dataset are 1,488 faces with mask, 1,424 without mask, and 1,601 with improperly worn mask. For the train dataset, there are 7,637 faces with masks, 7,041 without masks, and 8,873 with improperly worn masks.

Through the system's camera, the image of the student will be captured, and a collection of images will be stored in the system folder. A thermographic camera will be used to gather data on body temperature. A health declaration form like the ones issued by FAITH Colleges will be made for system testing purposes. The submitted health declaration forms will be saved in the data storage. Upon face recognition, and temperature and health status checking, the student's body temperature will be integrated into the filed HDF. All the personal data collected for this study will be handled according to Republic Act No. 10173, otherwise known as Data Privacy Act of 2012.

IV. TECHNICAL STUDY

The proposed system shall comprise the hardware and software components enumerated in Table 4.1. An analysis and assessment of these components were conducted to ensure the selection of appropriate components for the intended system. The choice of components was also influenced by the outcomes of the alternative evaluation.

TABLE I. SYSTEM COMPONENTS

Hardware	Software
MSI Z97M System Unit	Microsoft OneDrive
Logitech HD Pro Webcam C920	FaceNet with Single Shot Multi-Box Detector Model
FLIR Lepton 3.5 with PureThermalV2 Smart I/O Module	Text-to-Speech Alert Message
AOC 1620SW LCD Monitor	GUI Alert Message Dialog

A. *Block Diagram*

The block diagram of the device is shown in Fig. 2, which illustrates how the various hardware components are connected to the System Unit. The whole system will be powered by 3-socket 220V and a 110V, 5A AC Power Supply using Power Cord Cable. The Logitech HD Pro Webcam C920 and FLIR Lepton 3.5 with PureThermalV2 Smart I/O Module will be connected to the microcomputer through USB connector cables. Also, peripheral devices such as a keyboard and mouse are connected to the microcomputer through USB connector cables. To provide audio output, a speaker will be used via microcomputer using an AUX connector cable and a USB power cable for supply. The Philips 193V LCD Monitor and AOC 1620SW LCD Monitor will serve as display monitors, connected to the microcomputer through DVI-to-VGA connector cables. The dashed line arrows indicate the power source connections for each block, and the solid line arrows are for the data transfer from each block.

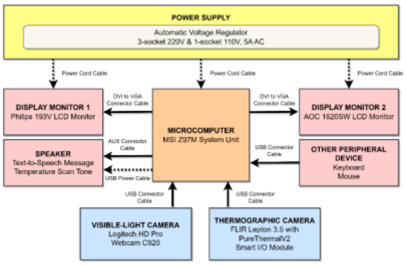

Fig. 2. Block Diagram of the System Hardware

B. *Data Flow Diagram*

Fig. 3 provides a detailed view of the system's data flow. The captured facial image will be recognized, temperature will be measured, and the system will check the health declaration form. If HDF has been submitted and found clear of any symptoms, the log entry of the student will be recorded. The level 1 dataflow diagram in Figure 3 shows the different processes involved and the flow of data in between.

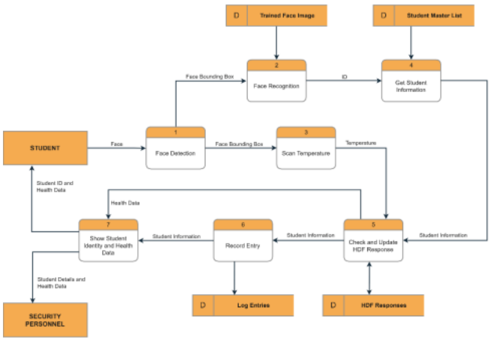

Fig. 3. Data Flow Diagram of the System

C. *Verification Plan*

a) Validation Testing: The system will be tested to see if it satisfies the expected outputs. The system will have have to detect if there is a face in a system from video captured by a camera. It should be able to recognize the face based on the registered images in the training dataset. HDF and Microsoft Excel spreadsheet are made for testing the recording of data. The temperature monitoring is used to measure the body temperature. Then, the temperature will again be measured using a thermometer. The results will be compared to assess the accuracy and percent true error of the system's temperature monitoring.

b) Prototype Setup: Range and angle will be tested through standing in front of the camera and determining up to how far can the device detect the face and temperature. While as for the angle of the camera, there would be different camera angles for each range.

c) Prototype Testing: The setup is placed on a specific spot in which the arrangement would be like it is how it should be placed at the school entrance. One person at a time will stand in front of the camera and sensor. The outputs will be checked through the display monitor.

V. Results and Discussion

A. *Model for Logging System Using Masked Face Recognition*

Fig. 4 presents the graphical user interface (GUI) of the system, depicting how it responds when a student passes through the system. If the student is registered in the system, the GUI displays the student's image along with other details such as full name, ID number, and department. This feature helps security personnel to easily verify the identity of the student who passed through the system. On the other hand, if the student is unregistered, the "UNREGISTERED" remark will appear on screen and will alert the security personnel of potential unauthorized individual who is trying to enter the school premises.

Fig. 4. System's GUI Response for Masked Face Recognition

Fig. 5 (a) shows an unsuccessful entry because the student has remarks. On the other hand, Fig. 5 (b) illustrates a successful entry of a student who has passed through the masked face recognition system. The students' accomplished HDF is clear, indicating that they have complied with the necessary health information, and they are wearing a facemask properly. These images depict that the masked face recognition model has been successfully integrated into the logging system, providing an effective tool for monitoring compliance with the school's COVID-19 prevention guidelines.

Fig. 5. Unsuccessful and Successful Log Entry After Recognition

B. *Integration of Temperature and Health Status Checking and Monitoring with an Alert System*

Fig. 6. Temperature Monitoring

Fig. 6 displays the temperature readings with different statuses that the thermographic camera captures when an individual's face is detected by the system. The temperature status has three classifications: "NORMAL," "HIGH," or "LOW." The system algorithm has a set of variables that determine the maximum and minimum threshold temperature values. If the temperature is equal to or greater than the maximum threshold, the temperature status is "HIGH." If the temperature is equal to or less than the minimum threshold, the temperature status is "LOW." If the temperature is between the maximum and minimum thresholds, the temperature status is "NORMAL."

DATE	TIME	STUDENT_ID	FULL_NAME	TEMPERATURE	REMARK
Saturday, 8 April 2023	3:33:50 PM	S2019102804	BURDEOS, MARCO ALVARADO	37.27	CLEAR
Sunday, 9 April 2023	3:33:50 PM	S2019102804	BURDEOS, MARCO ALVARADO	0	CLEAR

(a) BEFORE PASSING TO THE SYSTEM

DATE	TIME	STUDENT_ID	FULL_NAME	TEMPERATURE	REMARK
Saturday, 8 April 2023	3:33:50 PM	S2019102804	BURDEOS, MARCO ALVARADO	37.27	CLEAR
Sunday, 9 April 2023	3:33:50 PM	S2019102804	BURDEOS, MARCO ALVARADO	36.13	CLEAR

(b) AFTER PASSING TO THE SYSTEM

Fig. 7. Student's HDF Response Before and After Passing to the System

Fig. 7 depicts the status of the HDF response before and after a student pass through the system. It clearly shows how temperature data is integrated into the HDF response, which allows the school nurse/physician to evaluate the student's HDF response more accurately. This integration ensures that the system can detect any abnormalities in the student's temperature, enabling the school to take necessary measures to ensure the safety of everyone on the school premises.

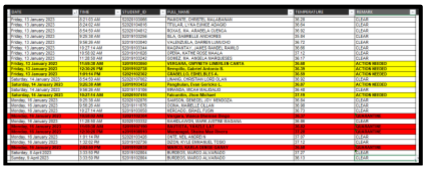

Fig. 8. Students' HDF Responses with Different Remarks

Fig. 8 displays three kinds of remarks: "CLEAR," "ACTION NEEDED," and "QUARANTINE." These remarks are used to highlight a student's health status. "CLEAR" (no colored highlight) means there are no concerns, "ACTION NEEDED" (yellow highlight) indicates a health issue that requires attention, while "QUARANTINE" (red highlight) implies that the student is not allowed to enter the school premises due to COVID-19 symptoms.

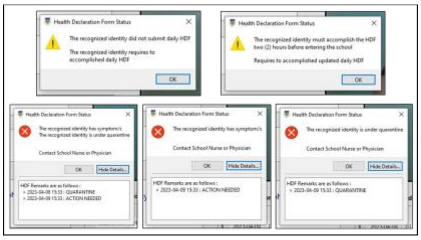

Fig. 9. GUI Alert Message Dialogs

The GUI alert message dialogs in Fig. 9 serve as notification messages for various situations, indicating any irregularities regarding the student's HDF, which is the primary tool for monitoring their health status. The GUI Alert Message Dialogs are crucial as they aid security personnel in determining whether a student who has passed through the system has completed the HDF or not. Moreover, they inform security personnel if a student is under quarantine or exhibiting symptoms requiring action, as denoted by the "ACTION NEEDED" remark. Aside from these notification messages, the system utilizes a text-to-speech alert for unregistered students and those who did not submit daily HDF. As for the temperature checking and monitoring, the system makes use of a short, high-pitched sound as an indicator.

C. Implementation of the System Using a Microcomputer with Interface Visible-light Camera, Thermographic Camera, and Display Monitor

Fig. 10 shows the testing setup, where various components of the system are placed. The prototype shown in the right photo includes a box that contains a visible-light camera and a thermographic camera, which capture images of individuals passing through the system, facing it. The box is adjustable and can be tilted up and down to accommodate individuals of different heights. Furthermore, the box is designed with holes on its sides to prevent the buildup of heat from the cameras. The second monitor is positioned beneath the box and connected to a 58.5-inch metal stand to ensure stability of the prototype.

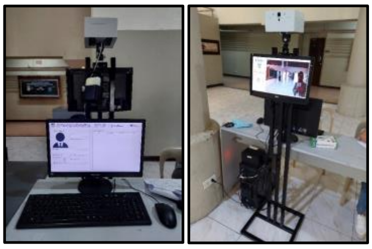

Fig. 10. Complete Prototype Setup for Testing Phase

For the system implementation, the link and quick response code for accessing the HDF and the HDF response database, log entry database, student details database, and student facial image database are all provided. If the response in the HDF response database has a yellow highlight, it is marked as "ACTION NEEDED." This type of visual cue alerts the school nurse or physician to evaluate the HDF response further. On the other hand, if the response has a red highlight, it means that the school nurse or physician has already evaluated the response and marked it as "QUARANTINE." If there is no highlight, it indicates that the response is clear, and the individual is allowed to enter the school premises. With these conditions, the system can assist the security personnel in identifying students who have remarks in their HDF response that may need further actions or quarantine. The log entry database contains the time-stamped records of students who successfully entered or exited the school premises through the prototype system. The student master list contains the necessary information of each student for the HDF verification and log entry confirmation processes. The database of students' images is used to train the masked face recognition model. Each image file name serves as a unique identifier or label for the recognition output. Specifically, the student ID number is used as the file name for each image. Once the model recognizes a student, the output is the corresponding student ID number. It is worth noting that the database is simply a file folder where the main algorithm can easily access the folder path to train the images. The use of student ID numbers as file names facilitates the matching of recognized faces to their respective student records in the system, ensuring a seamless and accurate identification process. This approach not only streamlines the recognition process but also enhances security measures and enables efficient tracking of student entry.

Fig. 11 provides a visual representation of the graphical user interfaces (GUI) utilized in the system. The GUI consists of two displays, one for the security personnel and another for the students. The GUI for the security personnel displays detailed information about the student, including their identification number, HDF response status, facemask and temperature detection status, real-time video capture, and log entry records. This information is critical for the security personnel to determine whether the student is allowed to enter the school premises. On the other hand, the GUI for students displays their identification number, temperature status, and remarks. This interface is designed to provide students with real-time feedback regarding their temperature status and remarks, allowing them to take immediate action if necessary. Overall, the graphical user interfaces provide a user-friendly and intuitive way for both security personnel and students to interact with the system.

Fig. 11. System's GUI

D. Evaluation of the performance of the system in terms of accuracy and speed

Table 2 highlights the prototype's ability to accurately and efficiently carry out the different processes involved in the system. The table also provides a summary of the overall performance of the prototype system, which consists of facemask classification, masked face recognition for logging system, and the reliability of temperature monitoring. The metrics used for each process and their respective values, such as accuracy, precision, recall, F1 score, average inference time, and percent true error are also presented. These metrics were used to evaluate the speed and accuracy of the system. Overall, the prototype system showed promising results in terms of performance, demonstrating the potential for its application in logging, temperature, and health monitoring systems. Additionally, the system implementation has been presented to the project beneficiaries which includes the school nurse and the security personnel in order to gather feedback regarding its output. According to them, the system is helpful in carrying out their tasks concerning the health and safety in the institution.

TABLE II. OVERALL PERFORMANCE OF THE PROTOTYPE

Process	Metrics	Acquired Values
Facemask Classification Model	Accuracy	98.00 %
	Inference Time	5.19 seconds
Masked Face Recognition Model for Logging System	Accuracy	94.23 %
	Precision	100.00 %
	Recall	90.32 %
	F1 Score	94.92 %
Temperature Monitoring	Percent True Error	0.40

VI. CONCLUSIONS AND RECOMMENDATIONS

The researchers created a model for a logging system using masked face recognition and successfully integrated temperature and health status checking and monitoring with an alert system. They evaluated different existing algorithms for face recognition, including FaceNet, ArcFace, and VGG-Face, based on aspects such as LFW Dataset Accuracy and Initial Implementation. Key devices such as a microcomputer with a visible-light camera, thermographic camera, and a dual-display monitor were utilized. Lastly, the prototype's overall performance was evaluated in three different aspects as follows: Facemask Classification Model with 98% Accuracy and an average inference time of 5.19 seconds; Masked Face Recognition Model for Logging System with 94.23% Accuracy, 100% Precision, 90.32% Recall, and 94.92% F1 Score; and Temperature Monitoring having a Percent True Error Rate of 0.40%. The beneficiaries of the project find this research helpful in the fields of health and security.

Upon completion of the system, the researchers offer the following recommendations to help future contributors in the engineering field. Firstly, a more powerful microcomputer device is suggested for better outcomes, particularly if the configuration is portable. Secondly, a hybrid power source could be used for a portable setup, and a portable power supply is also feasible. An anti-spoofing function should be implemented as fraud using someone else's image is common. Twins should be considered during testing, and a test that takes appropriate lighting into account should be carried out. When collecting data, subjects should be instructed to eliminate reflections from their eyeglass lenses for better outcomes. The system's capability to recognize faces with sunglasses on should be explored, and the system's scope could be expanded to include visitors and employees. Finally, to enhance security, a function that allows a screenshot to be taken for an unregistered person's log entry could be included.

REFERENCES

[1] Coronoavirus in Philippines: How the COVID-19 affects Philippines (n.d.) *www.pharmaceuticalTechnology.com* https://www.clinicaltrialarena.com/analysis/coronavirus-affected -countries-philippines-measures-impact-tourism-economy/

[2] Department of Health. (2019, January 30). DOH Confirms first 2019-ncov case in the country; Assures public of intensified containement measures | Department of health website. *Doh.gov.ph.* https://doh.gov.ph/doh-press-release/doh-confirms-first-2019-nCoV-case-in-the-country

[3] Nguyen, V.-A,-Q., Park J., Joo, K., Tra Vinh Tran, T., Tin Tran, T., & Choi, J. (2020). Human face recognition and temperature measurement based on deep learning for COVID-19 quaratine checkpoint. *The 4th International Conference on Future Networks and Distributed Systems (ICFNDS).* https://doi.org/10.1145/3440749.3442654

[4] Arapan A., Sadsad J., Fruelda A., & Villa, R. (2021). Real-time facemasks detection with temperature checking system. *FAITH Colleges Multiversity Library.*

[5] Sitepu, I. R., & Jati, G. N. (2021). FaceNet with RetinaFace to identify masked face recognition. *Journal of Physics: Conference Series, 1832(1), 012082. https://doi.org/10.1088/1742-6596/1832/1/012082*

[6] Kodhai, E. (2021). Smart attendance system for COVID-19. *International Journal of Innovative Technology and Exploring Engineering, 10(8), 286-291.* https://www.semanticscholar.org/paper/Smart-Attendance-System-for-Covid-19-Dr.E.Kodhai/5d6dc71a156dcceddc38a97e180497073e4b3ddb

[7] Lu, D., & Yan, L. (2021). Face detection and recognition algorithm in digital image based on computer vision sensor. *Journal of Sensors, 2021, 1-16.* https://doi.org/10.1155/2021/4796768

[8] Choudhary A. (June 2020). Why is opencv gaining prominence?. *Analytics India Magazine.* https://analyticsindiamag.com/why-is-opencv-gaining-prominence/]

[9] Abdulazeez, A. & Hassan, R. (January 2021). Deep learning convolutional neural network for face recognition: a review. *International Journal of Science and Business*, pp. 115, doi: 10.5281/zenodo.4471013]

[10] Mandal, M. (2021, May 1). CNN for deep learning | Convolutional neural networks. *Analytics Vidhya.* https://www.analyticsvidhya.com/blog/2021/05/convolutional-neural-networks-cnn/