Hafiz *et al.LGU (IJECI)* 2020

LGU (IJECI)
ISSN: 2522-3429 (Print)
ISSN: 2616-6003 (Online)

LGU International Journal for
Electronic Crime Investigation

Research Article

Vol. 5 issue 4 Year 2021

Biometric Attendance Techniques in COVID-19: A Review

Hafiz Burhan Ul Haq[1], Akifa Abbas[2], Muhammad Amjad Khan[3], Memoona[4], Sabreena Nawaz[5]

[1]Burhanhashmi64@gmail.com, akifaabbas19@gmail.com[2],
amjad97@gmail.com[3], memoona1291@gmail.com[4] ,sabreena.nawaz02@gmail.com[5]
University of Education

Abstract:

Now a days COVID-19 is spreading everywhere that has badly affected the countries in social as well as economical perspectives. According to SOP's people have to maintain social distance, use face mask and avoid biometric devices for attendance in order to prevent the corona virus. Several techniques have been developed in order to maintain the attendance in Covid-19 pandemic by considering the precautions to reduce the spread of corona virus. This paper provides the review on the biometric techniques such as face recognition, palm recognition, face mask detection, face recognition and iris detection techniques adopted in COVID-19 to maintain/mark the attendance in an organizations/institutes. However, the challenges of the Covid-19 techniques also are part of this paper that highlights the issues in current techniques. The prime focus of this study is to differentiate biometric method for researchers or users to decide which tools are better for their requirements.

Keywords: *Covid-19, Face recognition, Palm recognition,Face mask detection, Irisdetection*

1. Introduction

Biometrics were introduced in 500 BC in Babylonian empire. In 1800s, Paris, France, first biometric identification system was recorded. Edward Henry developed the standard of fingerprinting known as Henry Classification System. This was considered the first system which can identify the unique architectures of fingerprints. However, the system was acquired by law enforcement for identifying the criminals [1].

Similarly, in 1960s, semi-automated facial recognition were developed. This recognition can be used for unlocking the phone. The law enforcement adopted fingerprint and facial recognition methods and FBI (Federal Bureau of Investigation) invested in its development. This was incentive in developing biometric sensors for capturing and extracting data. In 1991, facial detection technology was originated for real time recognition. The first iris

recognition system was registered in 1994 and unique features are revealed which can be used for authentication [1]. In 1999, Southern Minnesota Beet Sugar Cooperative (SMBSC) was the first organization which used an iris based time and attendance solution. They wanted to modern and automate their punch card based time and attendance solution and they go for biometrics. They decided that hand free approach will be suitable for meeting their needs. As a solution they integrated iris based method [2]. By 2000s, hundreds of biometric authentication and recognition systems and algorithms were registered in USA. Research in biometric is still advance and continued [1].

Before biometrics, manual attendance system was used for employees and students. By using this approach, many drawbacks which include error, time consumption, ineffectiveness, inconsistency and difficulty to maintain large records has been observed. To overcome these issues, we switched to biometrics based attendance systems which included finger print scanning, thumb scanning, palm scanning, facial recognition, iris recognition and signature based systems. These systems verify the input data in database and confirm identity according to information defined by admin and mark record of authorize person. By using biometric system, users can achieve accuracy and consistency in a simplified manner. It has also enhanced user security and privacy.

In COVID-19 Pandemic, physical interaction is restricted and avoided. Biometric attendance system which includes thumb scanning or fingerprint and signature-based system involves physical touch which is risky for human health and it increases chance to be infected by corona virus. So in COVID-19 pandemic we move to those biometric systems and methods which are touch-less such method are facial recognition, touch-less fingerprint scanning and iris recognition. By adopting these touch-less technologies in any organization include schools, offices, universities and factories in order to provide safe and secure environment and to reduce the causes of spreading COVID-19. Our review is on biometric methods and techniques adopted in COVID pandemic. This will help the lay man to understand which technique is more suitable for its work or organization to prevent it-self or employee from corona virus.

2. Biometric Based Techniques Adopted in Covid-19 Pandemic

2.1. Face Recognition Systems

AI (Artificial Intelligence) has powered contactless system which is developed for marking the student attendance automatically by recognizing their faces. An attendance report has been generated which is customized. Machine Learning algorithms and neural networks are used in this system. Neural networks are composed of artificial neurons having set of algorithms. Convolutional Neural Network (CNN) applied to monitor the contact-less attendance system. Pre- trained models which are basis of computer vision are used. For faces, feature extraction is concluded and is stored separately. The proposed system method is compared with other methodologies including Radio Frequency Identification (RFID), Support Vector Machine (SVM), Linear Discriminant Analysis (LDA), Princi-

pal Component Analysis (PCA) and the resultantly achieved accuracy is 95%. [12]. A campus health information system is introduced that consist of multiple IOT devices, cloud database and personal cloud Pod. It can detect and record the identity and real-time body temperature and it sends that data to the cloud automatically. Then, the centrally managed data is distributed to the personal cloud Pod. The personal cloud Pod holds all data. To activate the decentralized data management, the decentralized data management model permit students to control the server. [10] Covert Human Intelligence Source (CHIS) and its structure is proposed. Covert Human Intelligence Source (CHIS) consist of plural face recognition and body temperature detection devices, group of decentralized personal cloud data models and two cloud databases. CHIS consist of the Face Recognition Temperature Detection Device (FRTDD) part, cloud database part and the personal cloud Pod part. The FRTDD is basically the data collection part which is constructed by Raspberry Pi camera and infrared sensor AMG8833. The main processes are initialization, Daily Processing and nightly updated. Two JSON data objects named User Data Object and IoT Data Object are created in the cloud database to run with FRTDD. The user data object saves the user information and the IoT data object saves the detected information. [13]. For the identification of faces in online attendance, web-based tool is developed. Two algorithms are used to propose this system, one is Local Binary Pattern Histogram (LBPH) and the other one is Convolutional Neural Network (CNN) for recognizing face. Also Haar cascade classifier is used for boosting the detection. LBPH visual descriptor is used for classification in computer system. In CNN, deep learning method used to input image or assign relevance make up Multiple Layers of artificial neurons. Accuracy found in CNN is 95% while in LBPH is 78% [15]

2.2. Touch-less fingerprint/Palm scanning

A device is developed which uses a method achieving contactless fingerprint scanning, precisely and enhancing the correlation factors. The proposed method consist of high precision of acquisition process of fingerprint as well as effective fingerprint architectural technique. Two proximity sensors of infrared have been used with contactless fingerprint scanner microcontroller (using Arduino IDE). It synchronize the sensors by using laser beam and the aperture of camera in scanning process. In scanning, the distance of 3.5 cm was found optimal between camera and targeted finger having correlation factor of 59.9%. Reports has revealed that the white light and other radiations having longer wavelength are absorbed by the layer of skin. So blue light is used as an alternative which is less absorbed by the skin. It results in enhancing the correlation factor and generating in high resolution fingerprint image. Then the highest correlation factor achieved is 78.12% at 280 lm [3]. Shao & Zhong [18], proposed a system for open set touch less palm print recognition. They use novel deep metric based method W2ML [34]. To improve the ability of generalization, deep metric learning feature extractor is learned in Meta way. To define query and support sets,

multiple sets are sampled which then combined into Meta sets. Hard sample mining and weighting are conducted to select informative Meta sets in order to improve efficiency. The accuracy is increased by 9.11% and the EER is decreased by 2.97%.

2.3. Face recognition with mask

A smart attendance system is developed by using face recognition algorithm, deep learning techniques, open CV, python and caffe layer network. Mainly two tasks are performed by this system. Firstly, face mask detector is trained to check if the person is wearing mask or not. It will be classified as with mask or without mask. Secondly, the person identification will be identified with mask. The variability changes in human faces such as expression, mask, scarf, difficulty will be faced in this model [5]. A US health center 'Client' decided to move to the face recognition time attendance system for eliminating the spread of corona virus. The tools and technologies used in this system include pytorch, python, OpenCV, faiss, and augmentations. The main focus is to detect face with mask. The system is trained to detect the employee identity who is wearing mask by recognizing facial attributes (forehead, eye, facial hair etc). Time clock entry is also added into the system. Different experiments are concluded by using different masks with multiple people and the system accuracy achieved is 91% [6]. KENT RO Systems Limited, announced Kent Cam Attendance, a Next-Gen Touch-less Attendance System based on Facial Recognition and Artificial Intelligence (AI). This system is the extension of AI product portfolio which was introduced with KENTCamEye. The system used computer vision which is AI based for capturing and recognizing the face of an employee and attendance will be marked. The records are managed by secured cloud application. It includes extra features like inbuilt algorithm for optional mask detection and have a smart alert in case of any person not wearing a mask. Also this system include patented algorithm for real person detection. The face recognition takes less than a second achieving accuracy of 99.9 % [7]. Keshavdas, M. [8] proposed a contact less system which uses facial recognition technology for identifying the student facial features and marking attendance automatically. This system can work with cloud or on local server or can provide hybrid solution. However, this system also have features for detecting mask and thermal sensors are integrated for checking fever of the scanned person. The system can identify four thousand unique faces. Depending on the need, it can be scaled up to sixty thousand plus faces. AttendX-Net facial recognition is developed by using ResNet method, multi-layer feed forward network and faiss. The face will be scanned through face detection module then AttendX-Net API will extract the 128-d vector according to architectures (AttendXNetV1 [29], AttendXNetV2 [30], AttendXNetV3 [31]) for verification. In results, AttendX-NetV1 and AttendXNetV2 are having more accuracy than AttendXNetV3 [32]. The system can also identify the human wearing mask. In the trials, 49 people are detected in which 17 were men and 32 were women. From 882 trials, when wearing mask the accuracy

achieved was 56% and when not wearing mask the accuracy achieved was 79%. The correct total percentage for men was 78% of 612 trials and for women it was 77%. Therefore, the overall 68% accuracy achieved [11]. A multi granularity masked face recognition model is proposed by using three types of faced masked data sets. A system is having two applications named Face Mask Detection and Masked Faces Recognition. The Face Mask Detection check that everyone must wear the mask. The Masked Faces Recognition is an application which recognize and verify any person's face who wear the mask. Three types of datasets will used for recognition of masked faces that are following: (i) Real-World Masked Face Recognition Dataset (RMFRD) [26] (ii) Masked Faced Detection Dataset (MFDD) [25] (iii) Simulated Masked Face Recognition Dataset (SMFRD) [27, 28]. RMFRD is now the largest real world masked face dataset. The recognition accuracy of masked faces achieved is 95% [14]. Furthermore, a face mask detection is proposed that helps in identifying whether a student has worn a mask and uses Barcode/RFID tags to mark his/her attendance. To detect a face mask a combination of HAAR Cascade, ADAM classifiers are adopted. With 'no mask', the system achieved accuracy is 95% and 'valid mask' the accuracy is 88%-92% in proper surroundings. For increasing the accuracy improvement in camera quality can be made and by keeping distance of 0.7m for face mask detection [16]. For real time mask detection and face recognition, two techniques are adopted: Eigen faces and Local binary pattern histogram (LBPH). The system will capture the image, detects the face and mask and attendance will be recorded. The LBPH performance is better than Eign faces for recognizing the face. The system achieved accuracy with eigen faces is 73.3% and 100% with LBPH [17]

2.4. Iris and face recognition

In an access control system (facial or iris recognition), thermal camera is integrated for detecting the high temperature of an employee. As a fever is considered as a main symptom of COVID-19, thermal camera will detect that person who is having high temperature and he/she will be not granted for access and the process will be terminated. If the temperature is sensed normal by thermal camera, it will send green signal and control is transferred to the access control system. Then the process will be continued to match the record of a person in database. If matched, the person will grant access otherwise the person is not allowed to enter. However this method is limited in terms of accuracy [4]. The iris detection is introduced for the authentication of an employee by using the fusion of iris and face recognition. This method is highly robust and takes less than a second to identify employee with time and date. Iris time provides an android based platform which can take hundreds of time and attendance applications [9]. Iris ID's technology is also used by the number of hotels existed in Iraq. However, with the help of iris recognition technique- iris access, Iris ID's iCAM 7S biometric scanners is used to automate the attendance system [10]. Table 1 describes the brief overview of the Biometric Techniques.

TABLE 1. Overview of Biometric Techniques adopted in Covid-19 for attendance purpose

S.No.	Authors / Organizations	Methodology	Category	Remarks
1	Oduah et al. [3]	Finger print acquisition process, fingerprint architectural technique.	Contact less fingerprint scanning.	The highest fingerprint correlation factor 78.12% was achieved at 280 lm.
2	Dhawale, S. P. [5]	face recognition algorithm, deep learning techniques, open CV, python and caffe layer network	Face detection with mask.	The recognition is difficult in case of variation face expressions.
3	Kent RO [7]	Facial Recognition and Artificial Intelligence	Face recognition	Robust and achieved accuracy of 99.9%.
4	Keshavdas, M. [8]	Facial recognition technology integrated, thermal sensor	Face detection, fever detection	It can be scaled up to sixty thousand plus faces.
5	Securityinfowatch [9]	Fusion of iris and face recognition	Face and iris recognition	Highly robust model to identify the user with time and date.
6	Bist et al. [11]	ResNet method and multi-layer feed forward network and faiss	Face recognition with mask	Overall achieved accuracy is 68%. Comparatively low accuracy.
7	Rajamanogaran, M. et al., [12]	Machine Learning algorithms and neural networks	Face recognition	Achieved accuracy 95%.
8	Wu, et al., [13]	the Face Recognition Temperature Detection Device (FRTDD) part, cloud database part and the personal cloud Pod part	Face recognition and temperature detection	Wearing mask will affect the accuracy of face recognition.
9	Suhaimin, et al., [17]	Eigen faces and Local binary pattern histogram (LBPH)	Face detection with mask	The accuracy achieved for Eigen faces is 73.3% and for LBPH it is 100%
10	Indatalabs, [6]	pytorch, python, open CV, faiss, and albumentations	Face detection with mask	Accuracy achieved is 91%
11	Archana, et al. [15]	Binary Pattern Histogram (LBPH) and Convolutional Neural Network (CNN)	Face recognition	Accuracy found in CNN is 95% while in LBPH is 78%
12	Jain et al. [16]	HAAR Cascade, ADAM classifiers	Face detection with mask	'No mask', the system accuracy is 95%. 'valid mask' the accuracy is 88% to 92%
13	Gupta et al. [4]	Access control system with thermal camera integrated.	Face or iris detection	There is a need of more work on camera and it can be advanced for better results.
14	Wang, et al. [14]	Three data sets MFDD, RMFRD and SMFRD.	Masked face recognition	The recognition accuracy of masked faces achieved is 95%
15	Shao, & Zhong [18]	Deep metric learning-based feature extractor	Touch less palm print recognition	Accuracy is increased by up to 9.11%

Different techniques are overviewed and discussed which can be adopted for taking attendance in COVID-19 Pandemic. It is a major concern to reduce the spread of corona virus and to have secure attendance system. Mostly face recognition techniques are adopted for marking attendance and most of them are having good results. But face recognition with mask have not shown such good results as compared to other detections and recognitions. Touch-less fingerprint or palm recognition are considered to be moderate. For any organization, face recognition and iris detection techniques are more accurate and suitable in order to mark attendance in safe and protected environment. The accuracy in face and iris recognitions are having better results than other recognition techniques. They can be considered best and suitable approach for marking attendance and for reducing the spread of virus effectively.

3. Challenges in Techniques Adopted in Covid-19

- In contact less finger print scanning, the distance between finger and camera have affected the correlation factor. The background light intensity also assorted the correlation factor.
- By using Eigenfaces recognition, it is good for data representation but not for class discrimination in recognizing face.
- Those Face recognitions using thermal camera for detecting temperature of the person are having conditions. If one person is infected by virus and the system fail to show increase in temperature he will be allowed to enter. In other situation, if the person is not infected by virus and the system shows increase in temperature then he will be not allowed to enter.
- Wearing mask affects the accuracy of face recognition.
- Variable changes in human faces such as facial expressions, scarf and lightning conditions may cause difficulty.
- Touch-less sensors are expensive to be implemented and it might be not possible for some organizations.
- Misuse of face and iris recognition is a concern when it comes to privacy.

4. Related Work

During COVID-19 Pandemic, many challenges and opportunities and impact of this virus have been discussed in different papers. Gomez-Barrero et al. [19], discussed about the main challenges faced in COVID era on hand based and facial biometrics. The researcher also described the new opportunities by overviewing the existing systems based on iris scanners, touch-less biometric recognitions and mobile recognitions. Okereafor et al. [20], discussed the control measures for the infectious disease transmission through fingerprint recognitions which is touch based and considered the approaches to make fingerprint systems hygienic and safe in order to prevent the disease but not focused on touch-less systems. Lewis, N. [21], considered the biometric technology which include facial recognition features using thermal imaging and discussed the ethical challenges. The system focused on touch free identification and

temperature screening. Srinivas, G. R. [22], discussed the challenges by using touch based attendance systems and move on to facial recognition and also considered other available technologies for biometric attendance system. Elliot, M. [23], analyzed the challenges and opportunities of incorporating emerging technologies which include Artificial Intelligence, Internet of Things and Big data used in COVID-19 pandemic. Yashaswini et al. [24], focused on the image processing and Iot technologies such as RFID (Radio Frequency Identification), Open CV and SSD (Single Shot Detector). However, these techniques are used in COVID-19 as an alternative to biometric scanners.

5. Conclusion

This work discusses and assesses the impact of COVID-19 on different biometric systems and outlines its weakness and strengths. Then we discuss evaluation of different biometric detection and recognition techniques and methods in very advanced and compared them which can be adopted in this COVID-19 Pandemic. Our focus is on the latest biometric technologies acquired during COVID. Those organizations, where wearing mask is compulsory can adopt the system which is having feature of mask detection. We proposed an Overview of biometric techniques based attendance system during COVID. Also we have seen that better results are produced by deep learning models in real time scenarios. For preventing spread of virus through physical contact, attendance system which are contact less are focused in this paper.

6. References

1. [Online]. Available: https://bioconnect.com/2021/12/08/a-brief-history-of-biometrics/#:~:text=While%20the%20earliest%20accounts%20of,classification%20and%20comparison%20of%20criminals. [Accessed 1-Jan-2022].

2. [Online]. Available: https://www.irisid.com/download/IrisID_TimeAttendance.pdf.[Accessed 1-Jan-2022]

3. Oduah, U. I., Kevin, I. F., Oluwole, D. O., & Izunobi, J. U. (2021). Towards a high-precision contactless fingerprint scanner for biometric authentication. Array, 11, 100083.

4. Gupta, A., Maurya, S., Mehra, N., & Kapil, D. (2021, January). Covid-19: Employee fever detection with thermal camera integrated with attendance management system. In 2021 11th International Conference on Cloud Computing, Data Science & Engineering (Confluence) (pp. 355-361). IEEE.

5. Dhawale, S. P., (2021). Human Face with Mask Detection and Recognition for Smart Attendance System in a Pandemic Scenario. International Journal of Research in Engineering and Science (IJRES), 9(7), 68 -70.

6. [Online]. Available: https://indatalabs.com/resources/face-recognition-time-attendance. [Accessed 12-Jan-2022]

7. [Online]. Available: https://www.business-standard.com/content/press-releases-ani/k

ent-ro-launches-zero-human-touch-attendance-system-120082700960_1.html [Accessed q5-Jan-2022]

8. [Online]. Available: Keshavdas, M., (2022), https://fleetroot.com/blog/contactless-attendance-using-facial-recognition-for-students-wearing-masks/

9. [Online].Available: https://www.securityinfowatch.com/access-identity/biometrics/biometric-time-attendance/product/21159646/iris-id-systems-inc-iristime-biometric-time-and-attendance-solution-from-iris-id. [Accessed 1-Jan-2022]

10. [Online].Available: https://www.infomet.com.tr/uploads/mediaresources/newsarchieve/20200819FindBiometrics.pdf[Accessed 1-Jan-2022]

11. Bist, A. S., Febriani, W., Lukita, C., Kosasi, S., & Rahardja, U. (2020). Design of face recognition attendX for recording student attendance data based on artificial intelligence technology. Solid State Technology, 63(2s).

12. Rajamanogaran, M., Subha, S., Priya, S. B., & Sivasamy, J. (2021). Contactless Attendance Management System using Artificial Intelligence. In Journal of Physics: Conference Series (Vol. 1714, No. 1, p. 012006). IOP Publishing.

13. Wu, H., Pan, Y., Weng, X., & Chen, H. (2021). Design of Campus Health Information System Using Face Recognition and Body Temperature Detection. In 2021 IEEE Intl Conf on Cyber Science and Technology Congress (CyberSciTech).

14. Wang, Z., Wang, G., Huang, B., Xiong, Z., Hong, Q., Wu, H., ... & Liang, J. (2020). Masked face recognition dataset and application. arXiv preprint arXiv:2003.09093.

15. Archana, M. C. P., Nitish, C. K., & Harikumar, S. (2022). Real time Face Detection and Optimal Face Mapping for Online Classes. In Journal of Physics: Conference Series (Vol. 2161, No. 1, p. 012063). IOP Publishing.

16. 16] Jain, D., Upadhyay, A., Nirban, A., Arya, M., & Mishra, R. (2021). Face Mask Detection & Attendance System. International Journal of Scientific and Research Publications (IJSRP), 11(3).

17. Suhaimin, M. S. M., Hijazi, M. H. A., Kheau, C. S., & On, C. K. (2021). Real-time mask detection and face recognition using eigenfaces and local binary pattern histogram for attendance system. Bulletin of Electrical Engineering and Informatics, 10(2), 1105-1113.

18. Shao, H., & Zhong, D. (2022). Towards open-set touchless palmprint recognition via weight-based meta metric learning. Pattern Recognition, 121, 108247.

19. Gomez-Barrero, M., Drozdowski, P., Rathgeb, C., Patino, J., Todisco, M., Nautsch, A. & Busch, C. (2021). Biometrics in the era of COVID-19: challenges and opportunities. arXiv preprint arXiv:2102.09258.

20. Okereafor K, Ekong I, Okon Markson I, Enwere K Fingerprint Biometric System

Hygiene and the Risk of COVID-19 Transmission JMIR Biomed Eng 2020;5(1):e19623 URL: https://biomedeng.jmir.org/2020/1/e19623.DOI: 10.2196/19623

21. [Online].Available: https://www.shrm.org/resourcesandtools/hr-topics/technology/pages/biometric-technology-use-during-pandemic-can-pose-ethical-problems.aspx. [Accessed 15-Jan-2022]

22. [Online].Available: https://government.economictimes.indiatimes.com/news/technology/contact-based-biometric-attendance-system-is-dead-what-if-facial-recognition-triggers-personal-data-privacy/75368517. [Accessed 15-Jan-2022]

23. Mbunge, E. (2020). Integrating emerging technologies into COVID-19 contact tracing: Opportunities, challenges and pitfalls. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 14(6), 1631-1636.

24. Yashaswini, K. S., Harmya, T. V., Sukrutha, B., Surabhi, N., & Kumar, A. S. (2021). Prevention of COVID Spread: A Review. International Journal of Research in Engineering, Science and Management, 4(8), 92-94.

25. [Online].Available: https://zhuanlan.zhihu.com/p/107719641?utm_source=com. yinxiang. [Accessed 18-Jan-2022]

26. [Online].Available: https://tzutalin.github.io/labelImg/. [Accessed 19-Jan-2022]

27. D. Yi, Z. Lei, S. Liao, and S. Z. Li, "Learning face representation from scratch", arXiv:1411.7923, 2014.

28. Jain, V., & Learned-Miller, E. F. A Benchmark for Face Detection in Unconstrained Settings. University of Massachusetts; Amherst, MA. USA: 2010. Technical Report, UMass Amherst Technical Report.

29. Krishnan, M. G., & Balaji, S. B. (2015). Implementation of automated attendance system using face recognition. International Journal of Scientific & Engineering Research, 6(3), 30-33..

30. Kawaguchi, Y., Shoji, T., Lin, W., Kakusho, K., & Minoh, M. (2005, October). Face recognition-based lecture attendance system. In The 3rd AEARU workshop on network education (pp. 70-75)..

31. Doctorow, C. (2012). Share or die: Voices of the Get Lost Generation in the Age of Crisis. New Society Publishers.

32. Wang, X., Han, X., Huang, W., Dong, D., & Scott, M. R. (2019). Multi-similarity loss with general pair weighting for deep metric learning. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 5022-5030).