SAS-HRM: Secure Authentication System for Human Resource Management

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ABSTRACT

To guarantee data confidentiality and information sensitivity, human resource management requires secure systems. In the field of authorization and dependability in recognizing and identifying persons, facial recognition has grown in importance. In this research, a secure authentication system is proposed based on biometric aspects of the user's face and identifying it using the CNN classification model is provided to give access to human resource management and update data. The system is divided into four major stages: First, set up the system environment, beginning with smart cards, card readers, Arduino, and so on. Second, after undergoing pre-treatment steps, the facial characteristics are extracted using LDA. Third, create a high-accuracy CNN model to recognize and classify the user's face among the system's users. Finally, the user is allowed to enter the system and update his information. When compared to the accuracy of classification using machine learning techniques with a CNN proposed model, the accuracy of the model with LDA was up to 100%. K-NN has 91%, while TD has 94%.

KEYWORDS: Smart Card OS, HRM, Authentication, CNN, Face Detection.

الخلاصة

لضمان سرية البيانات وحساسية المعلومات ، تتطلب إدارة الموارد البشرية أنظمة آمنة. في مجال التفويض والاعتمادية في التعرف على الأشخاص وتحديد هويتهم ، ازدادت أهمية التعرف على الوجه. في هذا البحث ، تم اقتراح نظام مصادقة آمن يعتمد على جوانب القياسات الحيوية يتم التعرف على وجه المستخدم وتحديده باستخدام نموذج تصنيف CNN لإتاحة الوصول إلى إدارة الموارد البشرية وتحديث البيانات.ي نقسم النظام إلى أربع مراحل رئيسية: أولاً ، إعداد بيئة النظام ، بدءًا من البطاقات الذكية ، وقارئ البطاقات و Arduino ، وهكذا. ثانيًا ، بعد الخضوع لخطوات ما قبل المعالجة ، يتم استخراج خصائص الوجه باستخدام LDA . ثالثًا ، إنشاء نموذج CNN عالي الدقة للتعرف على وجه المستخدم وتصنيفه بين مستخدمي النظام. وأخيرًا ، يُسمح للمستخدم بالدخول الى النظام وتحديث معلوماته. عند مقارنة دقة التصنيف لنموذج CNN المقترح مع تقيات التعلم الآلي ، كانت دقة النموذج باستخدام LDA تصل الى مايقارب ١٠٠٪. تمتلك K-NN 91٪ ، بينما تمتلك TD 94٪.

INTRODUCTION

The human resource management system refers to processes and systems at the intersection between information technology and human resource management, and its integration is a system in particular that integrates human resource activities and operations with the field of information technology [1]. Information management systems such as academic systems and credit reporting systems include the interest and interaction of many people. Therefore, any tampering with them is very dangerous, and we notice in the central database a defect in modifying the information if a specific person has it, as modifications can be made to the information even though it is saved In the central database and possible modification and deletion [2].

Information authentication is a widely used method used by security experts before accessing the system in order to verify the identities of users. Certain controls are imposed to access all users [3][4]. There is a great need to use the biometric authentication method to

obtain better authentication against attacks and intruders in order to protect against unauthorized access to systems [3][5]. There are different types of systems provided by the use of human characteristics for biometrics.

In complex parts ,the most commonly used biometric authentication methods are passwords and fingerprint [3][6], the fingerprint is used for prevents unauthorized access to the system and detecting crime [7]. Face Recognition Technology is used to recognize faces, which is a computer application to determine what a person's identity is or verify through a video or digital image, and this is a natural way [8]. The iris method is used as an identification method, as there are unique types of iris obtained through the image acquisition system, and the iris of each person is characterized by a complex pattern [9][10]. Everyone has their hand shaped differently and this shape does not change over the years [11]. Retina Geometry Technology technique depends on the pattern of the blood vessels within the retina of the eye, and these vessels are located in the back of the eye, and each eye is different from another eye, and also every person is different from the other person [12][13]. The password is used to access the user, and the user can use an easy and simple password through the use of a text, but if it is simple, these texts can be vulnerable to attacks [14].

RELATED WORK

Authentication is one of the most important solutions to prevent unauthorized access to critical information or data, such as HRM. In recent years, the issue of authentication has garnered significant attention from researchers [15]. The following are some of the works related to the manuscript's purpose, which is to address the needs of the human resource system. These works include:

Navaz A. *et al.* (2013) [16], design a system to reduce the administrator's effort to maintain daily events such as attendance, projects, works, and appointments. The most important points that the author focused on in his work are identifying employees, recording their attendance by the hour, and calculating the actual hours for their work.

Li, H. (2021) [17], designed a platform for managing human resources, as his system consists of electronic units that work through managing resources through people. The system underwent a trial process and proved successful.

Wang, T. N. Li, and H. Li (2021) [18], design a system that contains the basic functions that In the work of managing human resources for organizations, technical support is provided. As the average response time is less than 0.4 seconds, as shown by the results. Less than 0.5 seconds is the average final response time. Where the CPU occupancy rate is controlled less than 30% and less than 30% is the memory usage rate.

Shukur, H. M. *et al.* (2021) [19], presented a proposal for an electronic human resources management system consisting of four services. Online job applicants, employee registration and related performance and salary such as annual bonus, vacation, service summary, etc. Finally, university services such as documentation and statistics. Use the System Usability Scale (SUS) scale to evaluate the system through questionnaires that are examined by university staff, which amounted to 85%.

On the other hand, authentication and authorization are important for securing information. In this field, many researchers are working on authentication problems using face recognition based on machine learning methods and deep learning technology. New search results have recently emerged.

Xi *et al.* (2017) [20], suggest a CNN network to identify the loneliness using multi-task learning. They propose a mode-oriented multitasking CNN by assembling different modes simultaneously to learn the identity features of the mode.

Huan *et al.* (2019) [21] suggest a grid to generate normal whiteness images with neutral expression and frontal position for face images which is an end-to-end network. Face recognition technology has been improved by searching for factors that affect face recognition.

Maheen Zulfiqar *et al.* (2019) [22] are presenting a system that detects faces in the input image, which is a convolutional face recognition system based on a neural network. The detection is done using the Viola Jones face

detection device, as it extracts facial features in the faces detected through the CNN network. Where results were obtained with an accuracy of 98.76%, and these results are experimental and promising. Which is depicted in automated biometric authentication systems, as it depicts the effectiveness of deep facial recognition in these systems.

Anter *et al.* (2019) [23] suggest an approach to biometric recognition based on the fusion of facial and voice recognition. Facial Components Analysis (PCA) principles and results are compared. Where three different classifiers are used to implement the voice and face recognition method and these classifiers are Supportive Vector Machine (SVM), Gaussian Mixture Model (GMM) and Artificial Neural Network (ANN).

Tahir *et al.* (2022) [24] proposed to use Hear Cascade techniques for face detection where the system includes extraction of facial features and this is done using Bilinear Pattern Graph (LBPH) algorithm with (CNN) model. The classification process is carried out using (SVM), which is the support vector machine. The study showed that this approach achieved high accuracy compared to other methods, and the accuracy is 99.56%.

MATERIALS AND METHODS

Proposed Security Model

The human resource management system using the smart card can identify the person (for example employee) through the biometric facial features stored in the smart card. The system recognizes individuals and classifies them based on the biometric features, and then allows the user to enter the system, update his data, and provide him with his profile. The face images will be saved in the system database at the client side, then collected as a data set to be used in building a classifier to make the identification process an easy task. A security authentication system for human resource management (SAS-HRM), is based on the principle of authentication to access the user's file and update his data. The authentication is designed securely based on the biometric features of the

user's face. Figure 1 shows the flowchart structure of SAS-HRM system.

In the initial stages, the smart card is designed and configured to work within the system's hardware environment, and then provides it with features for each person or individual of the organization in order to use it in the recognition and authentication phase to enter the resource management system.

Before an identification and authentication stage, several procedures must be taken for the images in the database before entering them into the classification stage to perform the authentication process.

As shown in Figure 2, the block diagram of the identification system, which illustrates the stages of the proposed system used to design the smart card and build a database that includes images of each individual with their biometric features, then identifying the person and giving authorization to enter the human resource management system. A secure HR system consists of the following four basic stages: Initializing System Requirements, Data Collection, authentication and authorization, and managing files.
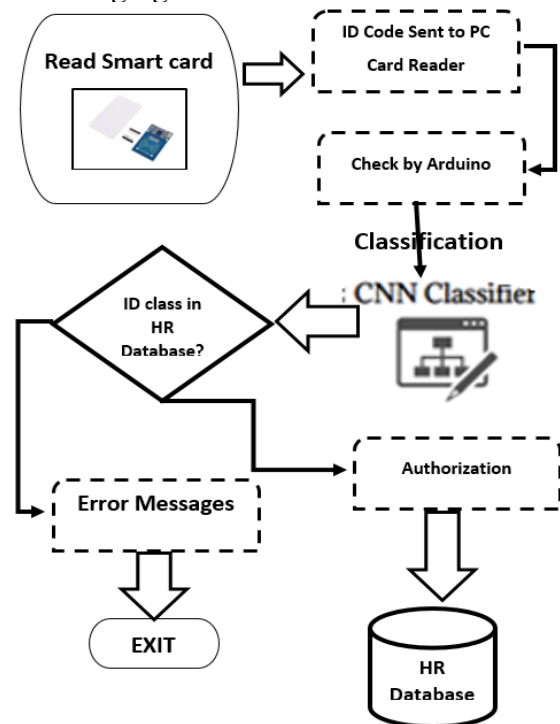

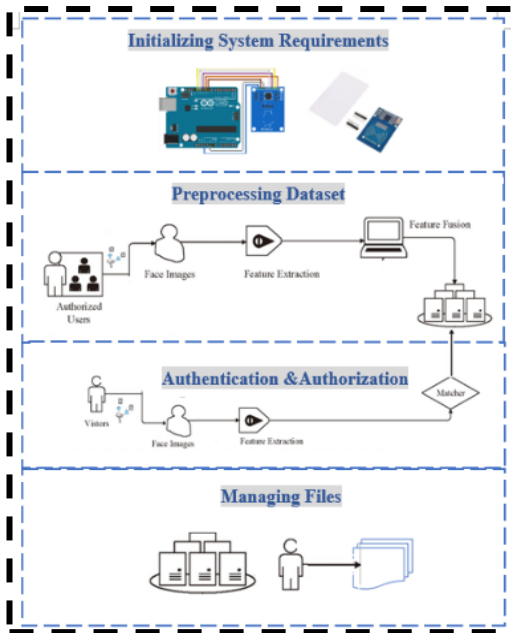Figure 1: Overall System SAS-HRM for Classification and Authentication

Figure 2: The Block Diagram Proposed SAS-HRM System

Data Collection

The image collection utilized throughout this thesis for facial recognition purposes. 200 color facial images of men and women were gathered then separated into 10 classes, with each class including 20 images that would be subjected to multi-level transformations before being employed in the proposed detection method.

The 20 images for each user is token in different directions, as examples shown in the Figure 3 for two users.
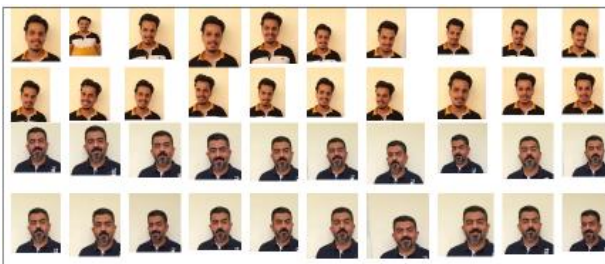

Figure 3: Simples of 20 different directions of images Dataset

Preprocessing

Before facial detection and feature extraction can take place, the input facial images must undergo a series of preparation operations, including grayscale conversion and histogram equalization.

Face Detection Phase (Viola & Jones)

Face recognition is a hot topic in biometrics since it is widely understood to be a special example of object-class detection. The first stage in any reliable face recognition system is a reliable face detection method [25]. Key features and the primary purpose of the Viola and Jones algorithm are depicted as follows:

Integral Image

By setting the value of each pixel to the sum of the values of the pixels above and to the left of it, the integrated image is obtained.

Features scaling

When the integral image is found, every Haar-like attribute at any scale or location will be found at the same time. Quantity of Haar-like characteristics for a two-rectangular-feature. the value of the two-rectangle feature is determined by subtracting the sums of the pixels in each of the rectangle's two sub regions [26].

AdaBoost Training

AdaBoost training is a machine learning technique where a few classifiers are chosen in place of the delicate ones, and each is accurately characterized with a single Hear-like feature, and then these features are combined to make a potent classifier.

Resize Facial Image

In order to scale the digital facial images once the viola & jones method has detected the face, a bilinear interpolation technique is used

Feature Extraction by LDA

Through the use of the LDA method, it is possible to extract features from the matrix of preprocessed face images and then project those features onto a space with a low dimension. There are three necessary procedures to follow in order to accomplish the goal of feature extraction. The first step is to calculate the between-class matrix, sometimes called the distinction, which measures the degree of disengagement between different groups. The next step was to determine the variation within each class by determining how far each sample was from the class average of facial images. Reducing the within class variation and

increasing the between-class variance are two side effects of the third phase, which is to generate the lower dimensional space [27][28].

Facial Image Classification

For image recognition, convolutional neural networks (CNNs) are among the most essential forms of neural networks. It takes an input image, does analysis, and outputs labels. An open-source deep learning program called keras was used to create a CNN model.

Figure 4 provides a detailed overview of the 18 layers that make up the proposed CNN model:

1. **Nine** convolutional layers is used to extract a feature of type 1D
2. **Seven** Maxpooling 1D layers
3. **One** fully connected layer that represented by the (**Dense).**
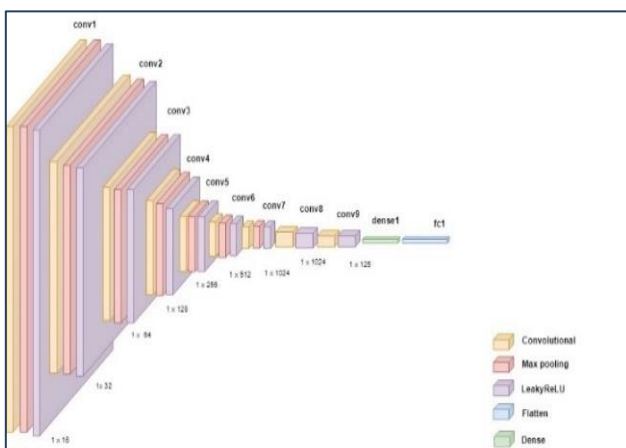4. **One** flatten layer

Figure 4: Layers of the proposed CNN model.

THE EXPERIMENTAL RESULTS

The experimental results achieved by applying the proposed SAS-HRM phases are discussed in this section with outcomes for facial image preprocessing, classification, and authentication for HR management. As indicated in the Figure 5 (a,b,c, and d), the user's name, address, and age are input alongside the findings of the analysis, where the data is processed and a prediction of the person is authorized or not is made.

(a) Upload image.
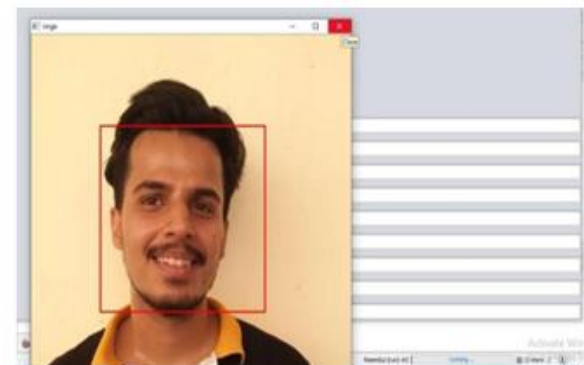
(b) Face detection.

(c) Check authorization.

(d) Complete authorization.

Figure 5: The proposed SAS-HRM system.

Preprocessing

Facial image preprocessing is the second phase of the system. The images will go through a multi-step preprocessing procedure, each of which will produce a somewhat different image and have a varied impact on the final outcome. There are two stages of preprocessing that together provide high-quality facial images for the classification phase. Figure 6 includes all stages of pre-processing for one user.

Figure 6: The Preprocessing operations for one user.

Feature Extraction by LDA

Features are extracted using various methods and techniques, such as linear discriminant analysis. As shown in Table 1, the detail the outcomes of using the LDA feature extraction technique for one person (20 image in different direction).

Table 1: Experimental results of implemented LDA

No.	Precision	Recall	F-measure
	1.00	1.00	1.00
1	1.00	1.00	1.00
2	1.00	1.00	1.00
3	1.00	1.00	1.00
4	1.00	1.00	1.00
5	1.00	1.00	1.00
6	1.00	1.00	1.00
7	1.00	1.00	1.00
8	1.00	1.00	1.00
9	1.00	1.00	1.00
10	1.00	1.00	1.00
11	1.00	1.00	1.00
12	1.00	1.00	1.00
13	1.00	1.00	1.00
14	1.00	1.00	1.00
15	1.00	1.00	1.00
16	1.00	1.00	1.00
17	1.00	1.00	1.00
18	1.00	1.00	1.00
19	1.00	1.00	1.00
Accuracy		1.00	

Facial Image Classification

The performance of the K-NN and DT are evaluated with CNN model depending on MRI testing dataset.
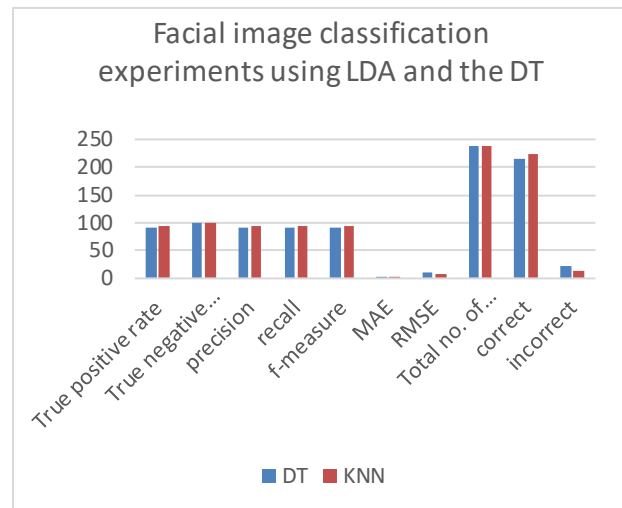

Figure 7: Comparison between DT and KNN algorithms for face classification.

To analyze the effectiveness of the CNN model and each of machine learning as K-NN and DT classifiers the set of familiar measures depends on confusion matrices and these matrices are constructed and used to calculate the values of the measures in order to find the discrepancy between the expected and the actual value. The most common measures for evaluating the quality of prediction are the three measures recall, F- measure, accuracy, and others, and they appear due to the use of KNN and DT with LDA. is shown in Figure 7 and .
Table 2.

Table 2: The results of facial image classification experiments using DT and LDA and KNN algorithms

Metrics	DT	KNN
True Positive Rate	90.717	94.092
True Negative Rate	99.510	99.690
Precision	91.215	94.337
Recall	90.717	94.092
F-Measure	90.763	94.64
Mae	0.928	0.590
Rmse	9.634	7.685
Total No. Of Instances	237.0	237.0
Correct	215.0	223.0
Incorrect	22.0	14.0

Since deep learning algorithms reliably generate accurate answers with high scores, they are considered appropriate for use with huge

datasets. The outcomes of using the CNN with LDA are shown in Table 3.

Table 3: The experimental results of implemented the CNN with LDA

	Precision	Recall	F-measure
CNN+LDA	0.99	0.99	0.99

CONCLUSIONS

One of the primary objectives of the classification process is to establish a system for identifying individuals. In this study, the primary goal of the classification system was to identify the user, detect their presence, and acquire or update their information through a secure authentication method.

We propose a secure authentication system designed to grant access to human resources management and update data based on the user's biometric facial features, distinguishing them using a CNN classification model. In this work, we extract the biometric features from the user's facial images using the LDA method. Utilizing these biometric facial features to differentiate between users provides a secure mechanism for granting or denying access to the system.

The authentication process in the human resources department relied on facial features, a novel approach not previously explored. Unlike prior methods that employed low-frequency smart cards and reader programming for user verification, our system focuses on facial recognition. In the future, researchers may consider incorporating high-frequency smart cards that can be read by smart card readers over longer distances.

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REFERENCES

[1] R. J. Stone, A. Cox, and M. Gavin, *Human resource management*. John Wiley & Sons, 2020.

[2] M. Sokolova and S. Matwin, "Personal privacy protection in time of big data," in *Challenges in computational statistics and data mining*: Springer, 2015, pp. 365-380.

[3] N. Yusuf, K. A. Marafa, K. L. Shehu, H. Mamman, and M. Maidawa, "A survey of biometric approaches of authentication," *International Journal of Advanced Computer Research,* vol. 10, no. 47, pp. 96-104, 2020.

[4] M. Bharath and K. R. Rao, "A novel multimodal hand database for biometric authentication," *International Journal of Advanced Technology Engineering Exploration,* vol. 9, no. 86, p. 127, 2022.

[5] S. A. Alazawi, H. Abdulaaliabdulbaqi, and Y. M. Mohialden, "New authentication model for multimodal biometrics based on shape features vectors," *Journal of Southwest Jiaotong University,* vol. 54, no. 6, 2019.

[6] B. Kumari, P. Gurjar, and A. K. Tiwari, "A Review Study on Biometric Authentication," *World Journal of Research and Review,* vol. 14, no. 6, pp. 10-13, 2022.

[7] J. Liebers and S. Schneegass, "Introducing functional biometrics: Using body-reflections as a novel class of biometric authentication systems," in *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, 2020, pp. 1-7.

[8] L. Li, X. Mu, S. Li, and H. Peng, "A review of face recognition technology," *IEEE access,* vol. 8, pp. 139110-139120, 2020.

[9] C. D. Patel, S. Trivedi, and S. Patel, "Biometrics in IRIS technology: A survey," *International Journal of Scientific Research Publications,* vol. 2, no. 1, pp. 1-5, 2012.

[10] A. S. Shaker and S. R. Ahmed, "Information Retrieval for Cancer Cell Detection Based on Advanced Machine Learning Techniques," *Al-Mustansiriyah Journal of Science,* vol. 33, no. 3, pp. 20-26, 2022.

[11] H. H. Mohammed, S. A. Baker, and A. S. Nori, "Biometric identity authentication system using hand geometry measurements," in *Journal of Physics: Conference Series*, 2021, vol. 1804, no. 1: IOP Publishing, p. 012144.

[12] S. Alwahaishi and J. Zdrálek, "Biometric authentication security: an overview," in *2020 IEEE International Conference on Cloud Computing in Emerging Markets (CCEM)*, 2020: IEEE, pp. 87-91.

[13] S. A. Alazawi, N. M. Shati, and A. H. Abbas, "Texture features extraction based on GLCM for face retrieval system," *Periodicals of Engineering*

Natural Sciences, vol. 7, no. 3, pp. 1459-1467, 2019.

[14] A. Sarkar and B. K. Singh, "A review on performance, security and various biometric template protection schemes for biometric authentication systems," *Multimedia Tools Applications,* vol. 79, pp. 27721-27776, 2020.

[15] K. Dowlatshah, M. Alizadeh, M. A. Raji, and E. N. Alkhanak, "A secure and robust smart card-based remote user authentication scheme," *International Journal of Internet Technology Secured Transactions,* vol. 10, no. 3, pp. 255-267, 2020.

[16] A. Navaz, A. Fiaz, C. Prabhadevi, V. Sangeetha, and S. Gopalakrishnan, "Human Resource Management System," *arXiv preprint arXiv:.* 2013.

[17] H. Li, "Optimization of the enterprise human resource management information system based on the internet of things," *Complexity,* vol. 2021, pp. 1-12, 2021.

[18] T. Wang, N. Li, and H. Li, "Design and development of human resource management computer system for enterprise employees," *Plos one,* vol. 16, no. 12, p. e0261594, 2021.

[19] H. M. Shukur, S. R. Zeebaree, R. R. Zebari, B. K. Hussan, O. H. Jader, and L. M. Haji, "Design and implementation of electronic enterprise university human resource management system," in *Journal of Physics: Conference Series*, 2021, vol. 1804, no. 1: IOP Publishing, p. 012058.

[20] X. Yin and X. Liu, "Multi-task convolutional neural network for pose-invariant face recognition," *IEEE Transactions on Image Processing,* vol. 27, no. 2, pp. 964-975, 2017.

[21] H. Tu, K. Li, and Q. Zhao, "Robust Face Recognition with Assistance of Pose and expression Normalized albedo images," in *Proceedings of the 2019 5th International Conference on Computing and Artificial Intelligence*, 2019, pp. 93-99.

[22] M. Zulfiqar, F. Syed, M. J. Khan, and K. Khurshid, "Deep face recognition for biometric authentication," in *2019 international conference on electrical, communication, and computer engineering (ICECCE)*, 2019: IEEE, pp. 1-6.

[23] A. Abozaid, A. Haggag, H. Kasban, and M. Eltokhy, "Multimodal biometric scheme for human authentication technique based on voice and face recognition fusion," *Multimedia tools applications,* vol. 78, pp. 16345-16361, 2019.

[24] T. Hussain *et al.*, "Internet of things with deep learning-based face recognition approach for authentication in control medical systems," *Computational Mathematical Methods in Medicine,* vol. 2022, 2022.

[25] K. Vikram and S. Padmavathi, "Facial parts detection using Viola Jones algorithm," in *2017 4th international conference on advanced computing and communication systems (ICACCS)*, 2017: IEEE, pp. 1-4.

[26] M. Karimi and E. Entezami, "Quality Assessment for Retargeted Images: A Review," in *2020 International Conference on Machine Vision and Image Processing (MVIP)*, 2020: IEEE, pp. 1-6.

[27] H. Yu and J. Yang, "A direct LDA algorithm for high-dimensional data—with application to face recognition," *Pattern recognition,* vol. 34, no. 10, pp. 2067-2070, 2001.

[28] R. K. Sahu, Y. P. Singh, and A. Kulshrestha, "A Comparative Study of Face Recognition System Using PCA and LDA," *International Journal of IT, Engineering and Applied Sciences Research,* vol. 2, no. 10, 2013.