Identify tooth cone beam computed tomography based on contourlet particle swarm optimization

Hiba Adreese Younis, Dhafar Sami Hammadi, Ansam Nazar Younis
Computer Sciences Department, College of Computer Sciences and Mathematics, Mosul University, Mosul, Iraq

Article Info

Article history:

Received Mar 16, 2021
Revised Dec 16, 2021
Accepted Dec 28, 2021

Keywords:

CBCT
Contourlet
CPSO
Directional filter
Laplace's pyramid
Preprocessing
PSO

ABSTRACT

In this paper certain type of biometric measurements has been used to identify the cone beam computed tomography (CBCT) radiograph of the subject in a fast and reliable way. Where the CBCT radiograph of a person is used as a data and stored in database for later use in a person's recognition process. The aim of this research is to use various stages of the preprocessing operations of the CBCT radiograph to obtain the clearest possible image that will help us in the identification process more easily and precisely. The contourlet transformation was used for feature extraction of each particular CBCT image and the results were processed by a new hybrid particle swarm optimization (PSO) named "contourlet PSO" algorithm (CPSO), which is faster and produce more precise (due to apply contourlet algorithm) than traditional PSO. The proposed algorithm (CPSO) gave a detection ratio of 98% after its application on 100 CBCT radiographs.

Corresponding Author:

Hiba Adreese Younis
Computer Sciences Department, College of Computer Sciences and Mathematics, Mosul University
Mosul, Iraq
Email: hibaadreese@uomosul.edu.iq

1. INTRODUCTION

The personal secret identification number can be lost, forgotten or simply difficult to memorize. Also it may be stolen or hacked on in many occasions. Therefore, biometrics can be used for identity access as an alternative [1], [2]. The main advantage of biometric features is that these are not prone to theft and loss, and do not rely on the memory of their users. Moreover, biometrics, such as finger prints, iris print, hand geometry, ear shape, face and teeth scans don't change significantly over time and it is a difficult for a person to alter his own physiological biometrics or imitate other individuals. So, the biometric record took a lot of interest in the last decades as a safer method for personal identification. Each one of these biometric records has its advantages and disadvantages [1]. Dental biometrics uses dental structure information for the automatic identification of human remains [3]. So the aim of this article is to present a medical system for personal identification depending on forensic dentistry where an artificial intelligent system have been made using the cone beam computed tomography (CBCT) for personal identification, and despite the fact that teeth shape can be subjected to change over time, but the shape, size of jaw and facial bones usually are still clear and constant without any change, so these features can be efficiently used for personal identification and in artificial intelligence algorithms. for this reason we chose CBCT images radiographs as a database for the proposed system. The rest of this paper is outlined as shown: section 2 deals with related works, section 3 deals with CBCT, section 4 deals with contourlet algorithm, section 5 deals with the proposed algorithm, results and analysis are shown in section 6, section 7 deals with conclusion and future works, finally, the acknowledgement.

Dighe and Shriram introduced a method for identifying the individual identity from dental information.The proposed method included three main steps: feature extraction using morphological operations (mathematical morphology), dental code generation, and dental code matching.The method was implemented on 30 X-ray database [4]. Karunya *et al.* [5] proposed a new system which consists of two stages: first stage includes extraction of features and the second stage is matching. In the first stage the contour model was used for contour extraction. The second stage includes two sub stages evaluation the distances of the images and identification of the subject. The system was applied on ten normal images and fifty-five orthopantomagram (OPG) images. Rehman *et al*. [6] presented an efficient method for human authentication correctly which consists of five main processing stages: preprocessing, segmentation, processing steps for segmentation, feature extraction and biometric analysis. The method was tested on colored teeth images for 14 persons and dental radiographs images for 45 persons.

Oktay *et al*. [7] presented a method for distinguishing humans by comparing two-dimension panoramic dental X-ray images. First each tooth is detected and labeled using support vector machine and graphical probabilistic models. The matching ratings between images were calculated based on an appearance of the tooth and the geometric similarities. Shaker *et al* [8] introduced a method for identity identification based on X-ray image. The method included three stages: preprocessing, feature extraction, and matching. The preprocessing wasmean, distance and standard derivation (STD), feature extraction was variance and principal component analysis (PCA). The best results showed an identification rate of 89%. Khudhur *et al.* [9] introduced a system to construct a database containing dental ante mortem radiographic features, later used for post mortem dental matching. The algorithm which applied on X-Ray image included three stages: segmentation of images, classification and extracting features. These features were STD, euler number and area taken from bite-wing X-ray image.

In this research a hybrid method was proposed for discrimination CBCT radiation images. This method is a combination of discriminative features of contourlet coefficients and intelligent features of particle swarm optimization (PSO) algorithm. Firstly, The CBCT radiographic images was preprocessed through different steps to obtain clearest possible image That make the identification process simpler and more reliable. Then contourlet transformation was used for feature extraction of each particular CBCT image. Finally, the PSO algorithm was implemented on the extracted features for identification process. The new hybrid PSO method was faster and yielded more accurate result, and the use of CBCT radiographs images which gives information not found with the traditional two-dimension imaging added a strength point to the research. Also, the process of hybridizing the pso algorithm with a contourlet transformation added strength to the algorithm which improved the efficiency of the algorithm. A comparison with related previous studies were described in Table 1.

Table 1. Comparisons with related studies

No	Research name	Algorithms/methods	No. of images	Recognition rate
1	Dental biometrics for human identification based on dental work and image properties in Periapical radiographs/ 2012	mathematical morphological operations	30 X-ray images	90%
2	Human identification using dental biometrics/2014	Shape registration method, euclidian distance	ten normal images and fifty five OPG images	72%
3	Human identification using dental biometric analysis/2015	Different methods for segmentation and feature extraction	colored teeth images for 14 persons and dental radiographs images for 45 persons	Equal error rate (EER) 88.8% for colored images 85.7% for dental radiographs.
4	Dental X-Ray based human identification system for forensic/ 2017	Standard deviation (STD), Euler number & area taken from bite-wing X-ray image.	80 I 80 X-Ray images	70%
5	Human identification with dental panoramic radiographic images /2018	support vector machine & graphical probabilistic models	206 X-Ray images of 170 various subjects	rank-1 precision of 81% rank-2 accuracy of 89%
6	Identification based dental image/ 2018	Mean, distance, standard derivation (STD), variance & principal component analysis (PCA)	75 75 x-ray images belonging to 115 ppersons (five for every person	89%
7	The use of contourlet transformations in hybridization ar development of an intelligent PSO algorithm to distinguish cbct radiation image/ 2020	Particle swarm optimization & contourlet transformation	100 CBCT radiographs images	98%

2. THE CONE BEAM COMPUTED TOMOGRAPHY

Arai *et al*. [10] and Mozzo *et al*. [11] working separately, presented the CBCT for the oral and maxillofacial applications and like computed tomography (CT), offered 3D investigation and increasingly precise imaging contrasted with 2D imaging. The financially savvy innovation of CBCT, prompted quick entrance into the field of dentistry with interest for responsibility of dental experts and dental instructors to investigate the uses of CBCT innovation. Radiographic assessment is necessary in diagnosis treatment planning in dentistry. Aside from packing three-dimensional life structures of the zone being radiographed into a two-dimensional picture, 2D imaging has many important drawbacks (including magnification, distortion, and superimposition), together prompting distortion of structures [12]. The applications of CBCT in dentistry include as: i) implantology: missing teeth substitution by dental implants requests precise visualization of the surgical site for the successful implant installation and to keep away from damage to adjacent important structures; ii) oral and maxillofacial surgery, orthodontics, end odontics, periodontics; iii) applications in temporom and ibular joint disorders; iv) applications in forensic dentistry: one of the parts of forensic dentistry is age estimation. Enamel is usually resistant to changes beyond ordinary wear and tear; on the other hand, the pulpodentinal complex displays physiologic and pathologicalalterations with aging. usually, to measure these changes, extraction and segmenting of teeth is vital, which isn't constantly a practicable decision. CBCT, conversely, provides a non-invasive substitute; and v) virtual treatment planning and simulations [13].

3. CONTOURLET ALGORITHM

It is a true way to represent two-dimensional images, and is a new way to effectively represent the contour and texture of images [14]. The transformation consists of two-layer filters, where the laplace pyramid transformation is used to achieve multi-domain analysis and obtain discontinuous points. After this, the multidirectional analysis is carried out by the directional filter bank in order to connect the non-continuous points in the form of a linear structure [15], [16]. By incorporating the laplace pyramid and the directional filter bank it produces a multi-directional filter [17].

3.1. Laplace's pyramid

Offers the means to achieve multiscale decomposition. In each step of decomposition it produces a lowpass downsampled version of the original image and a bandpass image. A coarse image with low frequencies and a more accurate image with additional high frequencies including point discontinuities are produced. This pattern can be repeated continuously in the lowpass image and is restricted only from the size of the original image Because of the downsampling [14].

3.2. Directional filter bank

The directional filter bank (DFB) is designed to obtain high frequency contents such as smooth circumference and directional edges [18]. The DFB analyzes each detailed sub-range from laplace's pyramid (LP) to a number of directional sub-ranges. The package passing images from the LP are fed into DFB so that directional information can be obtained. The scheme of the multilayer decomposition (Contourlet). The merging between LP and DFB forms a dual filter bank which is called a pyramidal directional filter bank that analyzes the image into directional subdomains with multiple scales [14], [19]. Figure 1 shows the contourlet transform diagram.

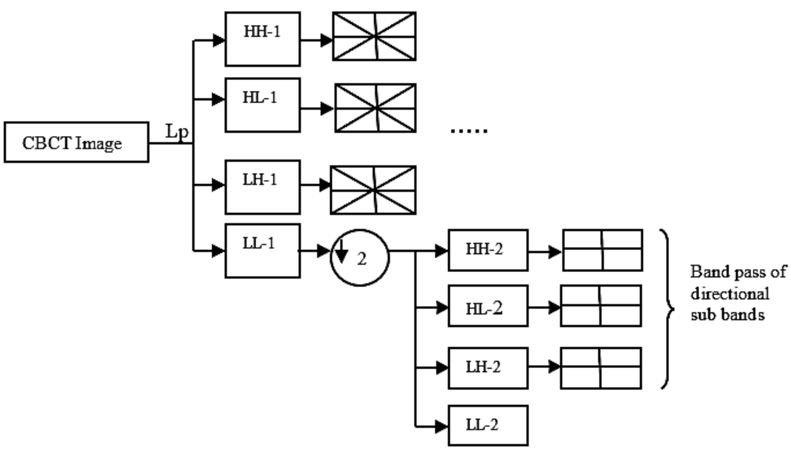


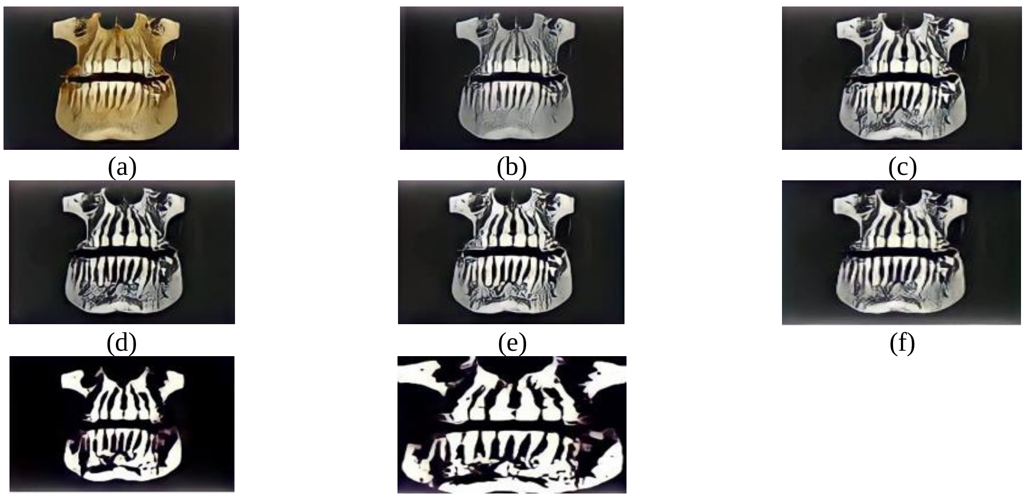
Figure 1. Contourlet transform diagram

4. PROPOSED ALGORITHM

4.1. Preprocessing

This is very important step which includes the basic steps performed on CBCT images. These steps improve the image quality and facilitate to use in the next stages. The steps of primary processing include the following Figure 2:

- Taking CBCT images for a group of persons and incorporating them into the suggested database system as shown Figure 2(a) Then all the CBCT images were read from the available system database so the preprocessing starts for every image according to the following steps.
- The CBCT images are converted from (RGB) to gray scale as shown Figure 2(b).
- Improving the gray scale image color distribution by changing color pixels values through the use of contrast limited at adaptive histogram equalization (CLAHS), which is one of the morphological algorithms where the result used as a mask for the next [20]. This step improves the image to a great extent so the teeth, facial bones and the bones surrounding the teeth appear in dark colors with a higher contrast as shown in Figure 2(c).
- Using another morphological algorithm known as (Erode) and applying it to the previous mask in order to restore the possible lost parts of the image in the previous stages through the use of SE=1, and "disk" function where they are used in rapidly restoring the lost parts without affecting the basic features of the image [21]. so, the teeth, jaws and facial bones become more clear. This step will result to a dark image that focuses on the cavities and bones as shown in Figure 2(d).
- Applying one of the morphological methods named (morphological reconstruction) between the mask and image resulted from the previous stage where the contacted points in the images are extracted and rearranged in a new image [22]. This method utilizes the gray colors in a hybrid way and rebuilds them in a better condition. The results of this stage can be noticed in Figure 2(e).
- The result from this stage gave a clear, less noise image which concentrating on the teeth and bones. the morphological methods and filters are considered effective in the image improvement process and color redistribution [23].
- Implementing sharpening for image improvement in order to make the borders be marked clearly including the edges of the teeth, bones and cavities. Also, dental fillings and the fixed dentures are seen in a clear white color as shown in Figure 2(f).
- The image is converted to binary as shown in the Figure 2(g).
- The black rows and colors surrounding the teeths and bones are deleted from the CBCT images as shown in Figure 2(h).



(a) (b) (c) (d) (e) (f) (g) (h)

Figure 2. Preprocessing steps results for CBCT image, where (a) the source image of CBCT, (b) the CBCT image after converted from (RGB) to gray scale, (c) the CBCT image after using morphological algorithms (CLAHS), (d) the CBCT image after applying morphological algorithm (Erode), (e) the CBCT image after applying morphological reconstruction, (f) implementing sharpening for the CBCT image, (g) the previous CBCT image converted to binary, and (h) after deleting the black rows and colors surrounding the teeths and bones from output images

4.2. Feature extraction

The enhanced images resulted from previous stage are fed into 2-level contourlet transformation for feature extraction. The coefficients were unique for each individual image which gave a distinct feature for the particular image and thereby helped in the next step for recognition.

4.3. Apply contourlet particle swarm optimization algorithm

The main idea is to imitate the behavior of animals looking for food, such as fish, birds, or bees [24]. A variety of simple variations have been developed in order to increase the speed of convergence and the consistency of the solution found by the PSO [25]. PSO is developed for distinguishing images entered easily using extracted contourlet coefficients as the first generation in PSO algorithm.

The use of contourlet coefficients resulting from contourlet transformations as input to the PSO algorithm made the algorithm faster to reach the solution and gave more accurate results, because the inputs to the algorithm are coefficients of a size less than the size of the original images, and therefore the number of iteration needed to reach the required results became less by 1/10, Where the optimal solution is continuously searched for in these transactions until it reaches the ideal solution depending on search and repetition. The PSO algorithm considers each solution as a particle and has two significant characteristics: position n and velocity vi. The two characteristics are related to each particle. So that n= (n_j1, n_j2…, njN) and vi= (vi$_j$1, vij2,…,vi$_j$N), where N reflects the dimensions of the problem and at each stage, the particles in the swarm are given a fitness function at each stage of the search for a solution. The speed and location values are modified in accordance with the (1) and (2):

$$v = w * v + c1\ m1(n\ Best - 1) + c2m2(p\ Best - 1) \quad (1)$$

$$n = n + v\Delta t \quad (2)$$

where W: represents weight of inertia responsible for regulating the impact of particles on past velocities; c_1, c_2: positive constants that are referred to as parameters of acceleration; m_1, m_2: random values in each appearance take on new values; Δt: represents the time steps; Best: is the best current position that has entered the particle or passed it until the present moment; pBestIt: is the best current location reached or moved by a particle of neighboring particles until the present moment. The contourlet PSO (CPSO) algorithm pseudo code will be:

```
Input: Create community member sites by initialized position randomly of the practices: nj
(0) and velocityvj (0).
Output: - best position of the global optima n*.
F(nj)=fitness, Which is calculated from equation [26]:
SSIM (a, b) =
```

$$((2\mu\_a\ \mu\_b + X\_1)(2\sigma\_ab + X\_2))/((\mu\_a\hat{}2 + \mu\_b\hat{}2 + X\_1)(\mu\_a\hat{}2 + \mu\_b\hat{}2 + X\_2)) \quad (3)$$

```
Begin
Repeat while max number of iteration is not reached do
Begin
For j=1 to number of particles
IF F(nj) <F(nnewj) then
nj = nnew j;
Update vj: using (1);
Update nj: using (2);
j++;
End
End
```

While fitness function for each member of the primary community is done using the similarity scale function (SSIM), where: μa: average of a, μb: average of b, μ_a^2 : variance of a, μ_b^2 : variance of b, σ_{ab}: Covariance of a and b, X_1,X_2,are Two variables to allow consistency in the partition process with a non-strong denominator. The following Figure 3 summaries the whole work.

5. RESULTS AND ANALYSIS

The results obtained after processing 30 different CBCT images of different people using the proposed algorithm (CPSO), as shown in Table 2 and Figure 4. It showed 100% detection rate in the training stage, it is the optimum value obtained from any recognition system. In the testing stage, another 57 different radiographs have been processed and the results were 98%. when minor changes to the radiographs were made on 13 images belonging to the same persons these changes include (a change in the teeth such as extraction, the placement of fillings, or a change in the dimensions of the radiographs of the same person) The result was 100%.

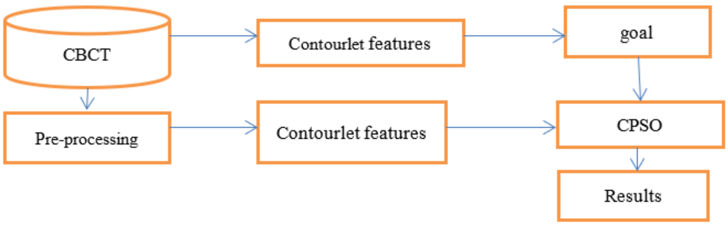


Figure 3. The work stages

Table 2. Comparisons with related studies

No. of processing	Type of processing	Type of dataset	No. of images	DR	ER	WR
1	Training	familiar	30	100	0	0
2	Testing	familiar	57	98	1.8	5
3	Testing	Unfamiliar (after changes)	13	100	0	0

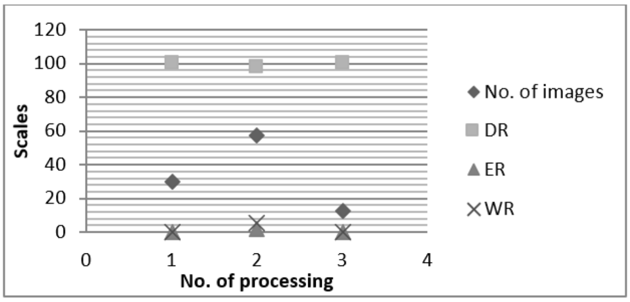


Figure 4. Results of proposed algorithm (CPSO)

These results showed the strength of the system in identifying dental rays through the use of primary treatment, which showed the jaws very clearly, with the cancellation of all unwanted parts. Also, these high percentages show how important it is to use the contourlet method in the process of extracting features and identifying important points from the x-ray images and using them as inputs to the proposed algorithm and obtain matching results in properties by means of the SSIM equation, which was used in developing PSO algorithm and reaching the goals directly with the least mistakes.

The scale used to calculate the overall degrees of discrimination in the system is detection rate (4). Where this measure represents the ability of the system to identify the person to whom the inserted dental rays belong. Therefore, it is calculated from the ratio of the number of correctly identified dental x-rays to the total number of x-ray images available in the system dataset. Therefore, the higher percentage of this scale is considered as a greater force for the system to discover the identity of the people to whom these rays belong. Thus, the value of detection rate is calculated as follows [26].

$$\text{Detection Rate (DR)} = (\text{no. of correctly detected sampels})/(\text{total no. of samples}) * 100 \quad (4)$$

The extent of the system's errors in identifying people who have dental radiation inserted can be calculated by the scale Error Rate, and that was 1.8%, which is a small percentage that was calculated by the (5). This scale the lower its value, the higher the system has the ability to correctly achieve goals, due to the strength of the algorithm to find the right targets and avoid alien targets, This percentage can be calculated by the ratio of the number of images that were not found by the system from among the images entered to the number of images in the system dataset [26].

$$\text{Error Rate} = (\text{no. of false detected samples})/(\text{total no. of samples}) * 100 \quad (5)$$

Also, the wrong acceptance rate (6) in this system was 5%, meaning that any radiograph that does not exist in the radiograph dataset of the systemis not accepted. And this was done according to the following formula [27], [28]:

$$\text{Wrong acceptance rate} = (\text{no. of samples accepted error})/(\text{total no. of images}) * 100 \quad (6)$$

6. CONCLUSION

The initial treatment stages that were performed on the images contributed to the clear visibility of the radiograph and in turn helped to obtain high results in the identification process. using contourlet with the intelligent algorithm increases the ability of the algorithm to find the optimal solution effectively because it gives distinctive values for each image, which represent the characteristics and properties of that particular image. The challenges faced were the limited number of images available in the database which were used in the training and testing stages and difficulty distinguishing in the case of teeth falling out due to accidents or in the case of dental implant. The process of distinguishing dental rays is a good way to distinguish the identity of people, especially after physical changes have occurred to the external features of the human body over time. The radiograph identification rate with this system was high comparing with previous related studies, and thus the hybridization of the PSO algorithm with the Contourlet is considered a successful hybridization.

7. FUTURE WORKS

The possibility of making changes to a number of parameters of the proposed algorithm. This includes increasing the number of images acquired by the CBCT rays, also increasing the number of levels in the contourlet transformation, which leads to an increase in the number of features (coefficients) in the images and observe the magnitude of these effects on the results. Comparison of results using the proposed algorithm on both conventional and CBCT radiographs. Doing some noise on the images acquired in the database, applying to them the steps of the proposed algorithm, and observe the effect of this on the results. Use dental images to determine the identity of the deceased person by matching dental images of the deceased person provided by his relatives. The use of other methods in the discrimination process, such as machine learning.

ACKNOWLEDGEMENTS

Great thanks to the University of Mosul for its support and assistance during making this research.

REFERENCES

[1] A. Jain, R. Bolle, and S. Pankanti, *Biometrics: personal identification in networked society*. USA: Kluwer Academic Publishers, 2006.

[2] A. Morales, M. A. Ferrer, and A. Kumar, "Improved palmprint authentication using contactless imaging," Sep. 2010, doi: 10.1109/BTAS.2010.5634472.

[3] S Jeyanthi and N Uma Maheswari and R Venkatesh, "Human identification using dental biometrics," *International Journal of Advanced Engineering and Global Technology*, vol. 1, no. 5, 2013.

[4] S. C. Dighe and R. Shriram, "Dental biometrics for human identification based on dental work and image properties in Periapical radiographs," Nov. 2012, doi: 10.1109/TENCON.2012.6412216.

[5] R. Karunya, A. Askarunisa, and A. Athiraja, "Human identification using dental biometrics," *International Journal of Applied Engineering Research*, vol. 9, no. 1, pp. 4428–4433, 2014.

[6] F. Rehman, M. U. Akram, K. Faraz, and N. Riaz, "Human identification using dental biometric analysis," in *2015 Fifth International Conference on Digital Information and Communication Technology and its Applications (DICTAP)*, Apr. 2015, pp. 96–100, doi: 10.1109/DICTAP.2015.7113178.

[7] A. B. Oktay, "Human identification with dental panoramic radiographic images," *IET Biometrics*, vol. 7, no. 4, pp. 349–355, Nov. 2018, doi: 10.1049/iet-bmt.2017.0078.

[8] S. H. Shaker and H. Najah, "Identification based dental image," *Journal of Al-Qadisiyah for computer science and mathematics*, vol. 10, no. 3, 2018, doi: 10.29304/jqcm.2018.10.3.438.

[9] S. Dh Khudhur and M. S. Croock, "Dental X-Ray based human identification system for forensic," *Engineering and Technology Journal*, vol. 35, no. 1, pp. 49–60, 2017.

[10] Y. Arai, E. Tammisalo, K. Iwai, K. Hashimoto, and K. Shinoda, "Development of a compact computed tomographic apparatus for dental use," *Dentomaxillofacial Radiology*, vol. 28, no. 4, pp. 245–248, 1999, doi: 10.1038/sj.dmfr.4600448.

[11] P. Mozzo, C. Procacci, A. Tacconi, P. Tinazzi Martini, and I. A. Bergamo Andreis, "A new volumetric CT machine for dental imaging based on the cone-beam technique: Preliminary results," *European Radiology*, vol. 8, no. 9, pp. 1558–1564, Nov. 1998, doi: 10.1007/s003300050586.

[12] W. C. Scarfe and A. G. Farman, "What is cone-beam CT and how does it work?," *Dental Clinics of North America*, vol. 52, no. 4, pp. 707–730, Oct. 2008, doi: 10.1016/j.cden.2008.05.005.

[13] F. Yang, R. Jacobs, and G. Willems, "Dental age estimation through volume matching of teeth imaged by cone-beam CT," *Forensic Science International*, vol. 159, no. 1, pp. S78–S83, May 2006, doi: 10.1016/j.forsciint.2006.02.031.

[14] S. Katsigiannis, E. G. Keramidas, and D. Maroulis, "A contourlet transform feature extraction scheme for ultrasound thyroid texture classification," *Final Draft-Published in Engineering Intelligent Systems, Special issue: Artificial Intelligence Applications and*

Innovations, vol. 18, no. 4, 2010.
[15] K. I. AlSaif and M. M. Salih, "Text embedding based on contourelet transformation coefficients," *International Journal of Information Technology and Business Management*, vol. 12, no. 1, pp. 60–67, 2013.
[16] D. Guo and J. Chen, "The application of contourlet transform to image denoising," *Procedia Engineering*, vol. 15, pp. 2333–2338, 2011, doi: 10.1016/j.proeng.2011.08.437.
[17] D. B. Mali and J. B. Jadhav, "Performance comparison of contourlet and wavelet transform in denoising of ultrasound image," *International Journal of Development Research*, vol. 8, no. 10, pp. 23405–23409, 2018.
[18] A. A. Dawood, "A Contourlet-Based Image Denoising Technique With Coefficient Threshold Level Estimation.", *Tikrit Journal Of Engineering Sciences*, vol. 20, no.4, pp. 11-22, March. 2013.
[19] A. H. H. AlAsadi, "Contourlet transform based method for medical image denoising," *International Journal of Image Processing (IJIP)*, vol. 9, no. 1, pp. 22–31, 2015.
[20] N. M. Sasi and V. K. Jayasree, "Contrast limited adaptive histogram equalization for qualitative enhancement of myocardial perfusion images," *Engineering*, vol. 05, no. 10, pp. 326–331, 2013, doi: 10.4236/eng.2013.510B066.
[21] B. Gatos, S. J. Perantonis, N. Papamarkos, and I. Andreadis, "Fast implementation of morphological operations using binary image block decomposition," *International Journal of Image and Graphics*, vol. 4, no. 2, pp. 183–202, Apr. 2004, doi: 10.1142/S0219467804001361.
[22] L. Vincent, "Morphological grayscale reconstruction: Definition, efficient algorithm and applications in image analysis," in *Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, 1992, vol. 1992-June, pp. 633–635, doi: 10.1109/CVPR.1992.223122.
[23] I. Jivet, A. Brindusescu, and I. Bogdanov, "Image contrast enhancement using morphological decomposition by reconstruction," *WSEAS Transactions on Circuits and Systems*, vol. 7, no. 8, pp. 822–831, Aug. 2008.
[24] W. R. Abdul-Adheem, "An enhanced particle swarm optimization algorithm," *International Journal of Electrical and Computer Engineering*, vol. 9, no. 6, pp. 4904–4907, Dec. 2019, doi: 10.11591/ijece.v9i6.pp4904-4907.
[25] D. Palupi Rini, S. Mariyam Shamsuddin, and S. Sophiyati Yuhaniz, "Particle swarm optimization: technique, system and challenges," *International Journal of Computer Applications*, vol. 14, no. 1, pp. 19–27, Jan. 2011, doi: 10.5120/1810-2331.
[26] D. S. Hammadi, A. N. YOUNIS, and F. M. RAMO, "Hybridization and modification of the pso algorithm and its use in personal recognition by opg x-ray," *Journal of Engineering Science and Technology*, vol. 16, no. 1, pp. 325–338, 2021.
[27] M. J. Al-Shamdeen, A. N. Younis, and H. A. Younis, "Metaheuristic algorithm for capital letters images recognition," *International Journal of Mathematics and Computer Science*, vol. 16, no. 2, pp. 577–588, 2020.
[28] A. N. Younis, "Personal identification system based on multi biometric depending on cuckoo search algorithm," *Journal of Physics: Conference Series*, vol. 1879, no. 2, p. 22080, May 2021, doi: 10.1088/1742-6596/1879/2/022080.

BIOGRAPHIES OF AUTHORS

Hiba Adreese Younis Graduated from the collage of computer sciences and mathematics, university of Mosul, Iraq at 2003, she worked as a programmer at the same college till 2009 when she started studying masters of science at the college of computer sciences and mathematics (university of Mosul), then she finished MSC. Degree at 2011. Now she works as assistant lecturer at the college of computer sciences and mathematicsl (university of Mosul) specialized in multimedia processing, she has a research gate account under the name hiba adreese. She can be contacted at email: hibaadreese@uomosul.edu.iq.

Dhafar Sami Hammadi Graduated from the department of computer sciences collage of computer sciences and mathematics, university of Mosul, Iraq. she worked as a programmer at the same college till 2013 when she started studying masters of science at the college of computer sciences and mathematics (university of Mosul), then she finished MSC. Degree at 2016. Now She work as assistant lecturer at the college of computer sciences and mathematics (university of Mosul) specialized in image processing and artificial intelligence, She can be contacted at email: dhafar_un@uomosul.edu.iq.

Ansam Nazar Younis She has been an assistant literature at department of computer sciences, college of computer sciences and mathematics, the University of Mosul, Iraq since 2018, Graduated from the Computer Science and Mathematics Collage at the University of Mosul, Iraq in 2005, and worked as a programmer in the same collage until 2013 when she also started studying Masters of Science in the same collage, then she finished MSC. Degree at 2018. General expertise is computer science, and specialty is in the area of artificial intelligence and image processing. She. She has a research gate account under the name Ansam Nazar Younis. She can be contacted at email: anyma8@uomosul.edu.iq.