■ ORIGINAL ARTICLE

Human Biometric Authentication using Dental Features

K Ramasamy[1], M Jayasheela[2], E Gomathi[3], E Udayakumar[4]

ABSTRACT

Now a days, Human identification has become a major issue. Many biometric authentications like fingerprint, Iris, hand veins, etc., were introduced to identify individuals and they have more complex features in it. Under numerous occasions like disasters, traditional biometric attributes like fingerprints and so on, may not work in light of their contrariness in such cases. They may lead once in a while towards high blunder rate and furthermore the investigation is more perplexing. Biometric using dental features are becoming a leading technique for human identification. Research says that dental features of persons are unique by nature. By research, it was found that the maxillary and mandible jaws of every individual are found to be unique. Here, the majority of the likenesses are coordinated with the goal that person can be actually recognized by its novel element. Along these lines dental biometrics gets need over rather in considering highlights and examination perspective. In this sense, it has been a savvy way to deal with investigate the new fields of exploration. In this paper, a human dental biometric image processing system has been implemented using MATLAB software for easy identification and this system is rotation invariant with greater accuracy.

Keywords | Human identification, Biometrics, Dental radiographs, Segmentation and Matching.

Author's Credentials:
[1]Dean-Academics & Research, [2]Professor, [3]Associate Professor, [4]Assistant Professor, Department of ECE, KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore 641402, Tamil Nadu, India.

Corresponding Credentials:
K Ramasamy: Dean-Academics & Research, Department of ECE, KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore 641402, Tamil Nadu, India.
e-mail: ramasamy10366@gmail.com

INTRODUCTION

The territory of biometrics has such a lot of importance for as far back as couple of years in view of an energizing and an alternate way to recognize people than that of customary validation frameworks recently advanced like passwords. Under various events for example Fiascos customary biometric attributes like fingerprints and so forth, may not work in light of their contradiction.[1] For this situation, dental highlights are considered as a helpful apparatus for human identification. The verification utilizing actual attributes is called biometrics and there are numerous kinds of it. For instance, these can be fingerprints, retina examines, iris filters,

facial outputs, palm checks, hand calculation, voice acknowledgment, hand composing or console elements. Precision is the main quality of biometric framework. We need to have the most precise arrangement executed. When all is said in done, the palm examines are the most exact biometric strategy, while the console elements is the most un-precise technique.[3] At the point when somebody who parts in to the biometrics framework, they need to characterize an underlying reference profile that will be utilized as format. This is the first occasion when that an advanced portrayal of their biometric factors is recorded. While considering biometric frameworks, we need to consider the adequacy issues. We need to consider how much biometric framework influences the protection, and how much actual inconvenience does it cause. As a rule an iris check is the most worthy type of biometric, since it just outputs the outside of the eye, and there is no actual contact included.[5] The retina filter is the most un-worthy since it requires actual contact, can be awkward, and can disregard protection (can uncover ailments).

As innovation grew huge number cases are examined by scientific trained professional. Risk mortem ID for the most part happens preceding demise and furthermore known as legal distinguishing proof. Posthumous (PM) distinguishing proof is completed in the afterlife. An after death biometric identifier needs to endure serious.[13] In 2015, F Rehman et. all carried out an analysis and the feature properties have been calculated. But the identity rates for Radiograph and Coloured image are 85.7% and 88.8%, respectively. In 2016, Pranoti V et. all presented a method which involves three processing stages such as Image Acquisition, Pre-processing and Feature Extraction & Dental code formation. The Identity rates for Radiograph and Dental photograph are 92% and 94%, respectively. In 2016, Kritika P et. all presented a method which involves preprocessing, segmentation and a matching technique. But the identity rates for Radiograph and Coloured image are 94.73% and 89.46%, respectively. All the above systems lead to more compound

analysis and central to high error rate. In this paper, we present a very simple system with good matching.[8]

Proposed System

The flow diagram of the proposed system is shown in Figure 1. It includes the basic techniques which are involved in the image processing. They are: Image Acquisition, Pre-processing, Noise Removal, Feature Extraction, Segmentation and Matching.[22]
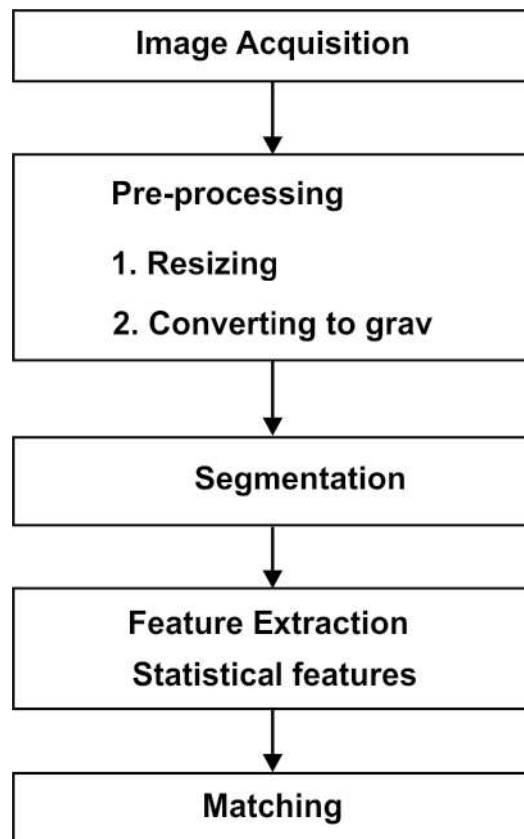

Fig.1: Flow diagram of Proposed System.

Image Acquisition

In Image acquisition process, we retrieve dental images of various humans by using certain sources. The dental radiographs of patients are likewise gathered for dental recognizable proof framework.[8]

Pre-Processing

The dental pictures were gathered from the x-beam indicative focus. The introduced work is principally centered around the component removal from the dental radio charts and not

on how the x-beams are achieved on dental piece of the body. The dental picture might be in jpeg configuration and it is changed over to dim scale design.[11] For dim scale pictures, every pixel esteem is deducted from the most extreme worth that can be spoken to by the information type and afterward yields the distinction. As result, the dim regions become lighter and light regions become hazier. These radiographs are pre-prepared to sift through undesirable foundation commotion current with radiographs and resizing is accomplished for legitimate data removal of maxillary bone.[24] Commotion is physically added for the exploratory reason. The commotion is taken out by utilizing Median Filter. Here, Median Filter works by traveling over the image pixel by pixel, displacing each an motivation with central advantage of adjoining pixels. At that point the locale of interest is chosen.[13]

Feature Extraction

After pre-preparing, highlight extraction is performed. The highlights we have extricated for teeth shading pictures[26] are force highlights. Individual normally contains these highlights. Here, we removed certain dental highlights, for example, Statistical highlights, Shape and Texture. In factual highlights, we consider, Mean, Standard deviation, fluctuation and skewness.[15] For the reason, we utilized morphological picture preparing methods on dark scale picture Morphology is a broad course of action of picture planning exercises that cycle pictures reliant on shapes.

Fig. 2.1: Resized Image

Fig. 2.2: Gray Image

Fig. 2.3: Noisy Image

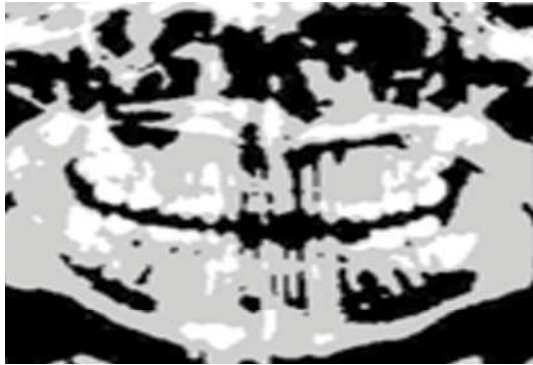Fig. 2: Input Image.

Fig. 2.4: Noise removed image.

Fig. 2.5: Segmented image

the distance converts procedures the distance of each object idea from adjacent boundary.
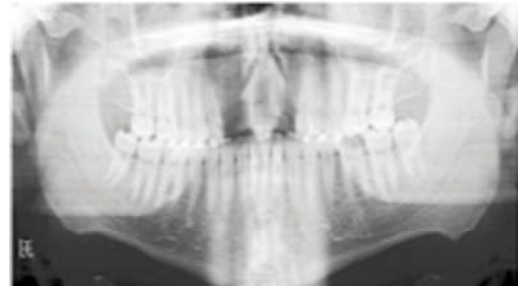
Fig.2.7: Input image

Fig. 2.6: Area part

Fig. 2.8: Resized image

Results of authenticated output

Morphological exercises apply a getting sorted out part to a data picture, making a yield image of a comparative size. In a morphological movement, the assessment of each pixel in the yield picture relies upon an assessment of the contrasting pixel in the data picture and its neighbors. GLCM features are used here for getting better yield.[12]

Segmentation and Classification

In division, Expectation Maximization figuring is used. It works by picking sporadic characteristics for the missing data centers and using those notions to measure a second game plan of data.[20] The new characteristics are used to make a prevalent gauge for the initially set and the cycle continues until the figuring meets on a fixed point. Various strategies, for instance, pixel-based segment, surface examination, etc may be considered. Here surface examination is used.[17]

Matching

Finally, Matching Technique is executed using Euclidean Distance. In image examination,

Fig. 2.9: Gray image

Fig.2.10: Noisy image

Fig. 2.11: Noise removed image

Fig. 2.12: Segmented image

Fig. 2.13: Area part

Results of Unauthenticated Output

In this work, some of the basic techniques such as Image acquisition, Pre-processing, Segmentation, Matching technique and Feature Extraction were implemented using MATLAB Software.[25] Human Biometric features is extracted initially and then pre-processed, Segmented, along with that, noise in the image can be removed by adding salt and pepper noise into the image. After the removal of noises in the image, identification and matching techniques were used in order to authenticate the individuals by considering their dental features. The whole process is implemented using MATLAB Software.[4]
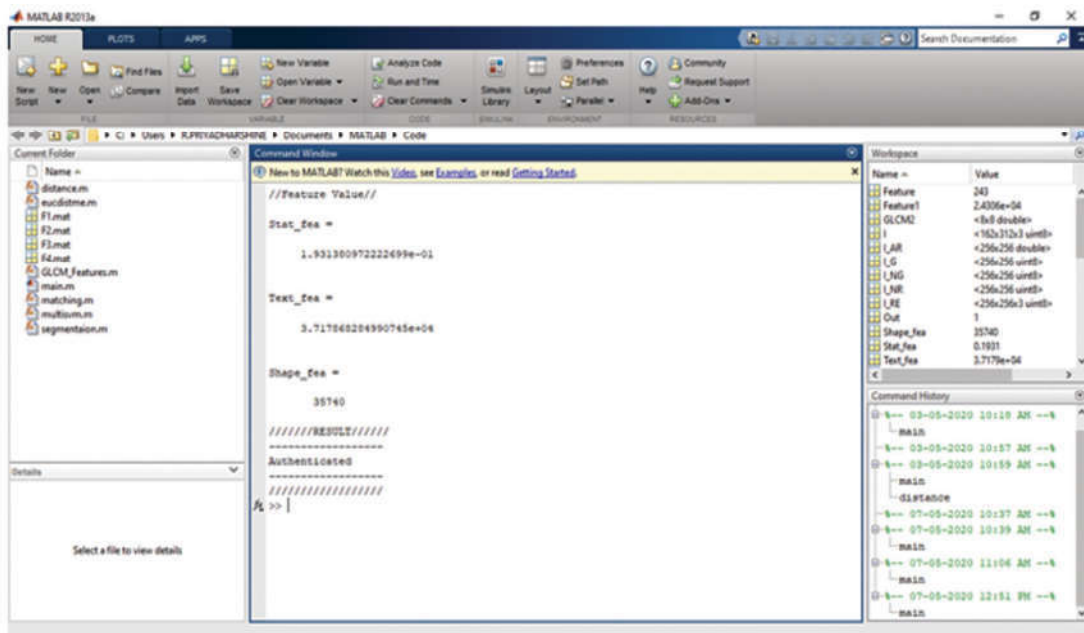

Fig. 3: Features of Proposed System

Table 1: Outcome of Proposed System.

Database	No. of Persons	Total Images	No. of correctly identified persons	Accuracy Rate
Radio-graphs	100	200	99	99%
Color Images	100	100	94	94%

RESULT ANALYSIS

The dental radiograph of individuals which has been collected and stored in a database undergoes various processes simultaneously. In Image Acquisition process, the collected images are retrieved and moved on to pre-processing phase.

Here, image resizing, conversion of image into grey scale and removal of noise by using median filter is implemented. After that, Image segmentation is done by using the Expectation maximization algorithm. Then, statistical features are extracted and the images are compared by using Matching Technique by Euclidean distance feature.

A database is being created with a set of dental images and the details are fed into it. After implementing all these processes successfully, the dental radiographs are compared for the identification process. The image which is selected or obtained image is then compared with the features of images in the database. If the image is coordinated with the any radiographs in the folder, then it is displayed as "Authenticated" and if not, it is displayed as "Unauthenticated", likewise, the results are obtained. In Figure 2a& 2b, the input, resized, grey, noisy, noise removed, segmented, area part, authenticated and unauthenticated images are shown.

The dental features such as Statistical features, Shape and Texture extracted in this system are shown in Figure 3. Table1 shows the accuracy rates of the proposed system using radiographs and color images are 99% and 94%, respectively and is greater compared to the other systems.

Rotation Invariant

The process of identifying the image even if it is rotated was also implemented using Rotation invariant algorithm into the source code. Figure 4 shows that the proposed system is rotation invariant as the same features can be extracted even though the dental image is rotated in a different angle of 35 degree. Hence it is angle independent. This makes it compatible over the dental biometric as it won't serve under such circumstances; this will be of better use. The features removed from the rotated image also provide the same as that of the original image.[18]

Fig. 4: Image rotated over an angle of 35 degree

App Development

The MATLAB App Designer is a cooperating growth situation for scheming an app layout and programming its performance. For the purpose of dental authentication, the preview has been generated using MATLAB 2019a. As shown in Figure 5, two levels of matching (one to one and many to one) have been done. In the case of one to one, two dental images are provided with the desired algorithm the features are extracted and the matching is done if the images are from the same person then validity is given else the invalid status is provided.

In case of the of the many to one matching the database is shaped with all the images of the users and for matching only the testing image is given as input to the scheme if the user is present in the database the authentication is provided or else invalid is displayed.[13]
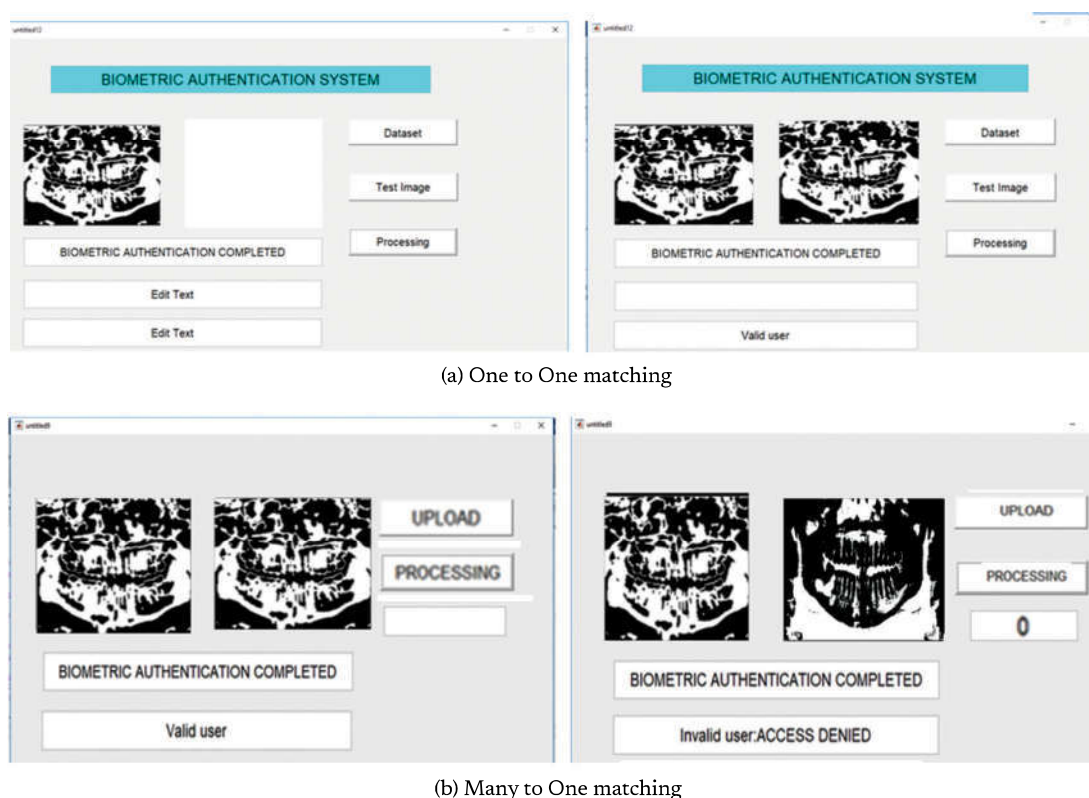
(a) One to One matching

(b) Many to One matching

Fig. 5: App development

CONCLUSION

Dental biometrics should not best be the lower part of ID of an individual. Rather it ought to be dealt with as a corroborative gadget. For instance, if an individual's face is totally harmed and its recognizable proof is absurd by utilizing face, at that point dental biometrics can likewise be utilized as corroborative instrument alongside other like unique mark, vein sway and so on. Dental biometrics is used in measurable science for human ID, dental radiographs are struggled to be treated as one of the biometric realities of person. The framework introduced in this paper is basic, less mind boggling, revolution invariant with more prominent exactness. The system presented in this paper is simple, less complex, rotation invariant with greater accuracy.

REFERENCE

1. **Adaline suji** and et.al, "Classification of Malignant Melanoma and Benign Lung Cancer by using Deep Learning Based Neural Network", International Journal of Innovative Technology and Exploring Engineering, vol 9, issue 3, 2020.

2. **Anil K. Jain, Hong Chen,** "Matching of dental X-ray images for human identification", The journal of the pattern recognition society, 2003, pp. 1519-1532.

3. **Shubhangi Jadhav1, Revati Shriram,"** dental biometrics used in forensic science", Journal of Engineering Research and Studies, 2012, vol3, pp.26-29.

4. **Faisal rahman,** M.usman Akram, Kunwa Faraz, Naveed Riaz, "Dental Biometric Approach for Human Identification using Dental X-Ray Images of MaxillaryBone" Rawalpindi, pakistan2015.

5. **Sunita Sood, Ranju Kanwar, Malika Singh,** "Dental Bio- metrics as Human Personal Identifier using Pixel Neighborhood Segmentation Techniques", Punjab college of engineering.

6. **Maja Omanovic and Jeff J.Orchard,** "Exhaustive Matching of Dental X-rays for Human Forensic Identification" Journal of the Canadian Society of Forensic Science, 41(3), 2008.

7. **Gamal Fahmy, Diaa Nassar,** "Towards an Automated Dental Identification System (ADIS)" West VirginiaUniversity.

8. **A. Jain, R. Bolle, S. Pankanti,** Biometrics-Personal Identification in Networked Society, Kluwer Academic Publishers, Dordrecht,1999.

9. American Board of Forensic Odontology, Body identification guidelines, J. Am. Dent. Assoc. 125 (1994) 1244–1254.

10. **Omaima Nomir and Mohamed Abdel-Mottaleb"** Identification From Dental X-RayImages Based on the Shape and Appearance of the Teeth", IEEE Transactions on InformationForensics and Security 2(2):188 – 197, July 2007.

11. **S.Santhi** and et.al, "TB screen based SVM & CBC technique", Current Pediatric Research, Volume. 21, pp.338-342, 2017.

12. **P. Vetrivelan and A Kandaswamy.,** "Neural Network Classifier based Blurred and De-Blurred Image Classification for Bio Medical Application", Journal of Web Engineering, vol 17, issue 6, pp. 3858 – 3864.

13. **S.Yogadinesh** and et al "Certain Investigation of Identify the New Rules and Accuracy using SVM algorithm", Middle-East Journal of Scientific Research, IDOSI Publications, 2015;23:2074-2080.

14. **P. Vetrivelan** and et.al, "An Investigation of Bayes Algorithm and Neural Networks for identifying the Breast Cancer", Indian Journal of Medical and Paediatric Oncology, Medknow Publications, Vol 38, Issue 3, July 2017, pp.340-344.

15. **J.Rama** and et.al, "Automatic Detection of Diabetic Retinopathy through Optic Disc using Morphological Methods", Asian Journal of Pharmaceutical and Clinical Research, I Volume 10, pp.28-31, 2017.

16. **P. Vetrivelan** and et.al, "An Identify of efficient vessel feature of Endoscopic Analysis", Research Journal of Pharmacy & Technology, Volume. 10, pp.2633-2636, 2017.

17. **Dr.S.Santhi** and et.al, "Region Growing Image Segmentation for Newborn Brain MRI", BioTechnology: An Indian Journal, Trade ScienceInc Journals, Vol 12, Issue 12, December 2016, pp.1-8.

18. **S.Santhi** and et.al, "An Identify of efficient vessel feature of Endoscopic Analysis", Research Journal of Pharmacy & Technology, Volume. 10, pp.2633-2636, 2017.

19. **I.A. Pretty, D. Sweet,** A look at forensic dentistry- Part 1: the role of teeth in the determination of human identity, Br. Dent. J. 190 (7) (2001)359–366.

20. **Abaza, A, Ross, A. & Ammar,** H. (2009). Retrieving dental radiographs for postmortem identification, Proc. of IEEE International Conference on Image Processing (ICIP).

21. **Amoedo, O.** (1897). The role of the dentists in the identification of the victims of the catastrophe of the 'bazar de la charité', paris, 4th of may,1897, The Dental Cosmos 39: 905–12.

22. **E. H. Said, D. E. M. Nassar, G. Fahmy, and H. H. Ammar.** "Teeth segmentation in digitized dental X-ray films using mathematical morphology," IEEE Transactions on Information Forensics and Security, vol.1, no. 2, pp. 178-189, 2000.

23. **S.Sindhumathy** and et.al, "Analysis of Magnetic Resonance Image Segmentation using spatial fuzzy clustering algorithm", Journal of Global Pharma Technology, vol. 10(12), 88-94, 2018.

24. **C.Ramesh** and et.al, "Detection and Segmentation of Optic Disc in Fundus Images", International Journal of Current Pharmaceutical Research, vol 10(5), pp.20- 24, 2018.

25. **S.Sivaganesan** and et.al, "Design and development of Smart Glucose Monitoring System", International Journal of Pharma and Biosciences, vol 8(3), pp.631-638, 2017.

26. **K.Yogeshwaran** and et.al "An Efficient Tissue Segmentation of Neonatal Brain Magnetic Resonance Imaging", Research Journal of Pharmacy and Technology, vol 12(6), pp.2963-2966, 2019.

27. **C.Ramesh** and et.al, "A Review on diagnosis of Malignant Melanoma from Benign Lesion by using BPNN and ABCD Rule Parameters", International Research Journal of Pharmacy, vol.9(10), 2018.

28. Segmentation in Dental X-ray Image Using Modified Active Contour", 2011 International Conference on Intelligent Computation and Bio-Medical Instrumentation, 2011.