 ISSN 2394 - 9554

VICTIM IDENTIFICATION WITH DENTAL BIOMETRICS USING CONTOURING ALGORITHM AND PCA RECOGNITION

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ABSTRACT

Usage of Image processing has been increasing in the fourth coming decade. The Bio-metric is a tool that helps in the identification and authentication of any security-based systems. Dental Biometric is one of the identification systems which provide secured authentication. Because of the unique features, security was increased to a great extinct. This approach made use of dental radiography and dental photography since they can show specific tooth characteristics like shape and contour as well as dental procedures like crowns, bridges, and fillings as well as the distance between nearby teeth. The suggested technique uses a database photo to extract features, measure distances between features, extract contours, find matches, and, in an emergency, utilize PCA identification to identify the individual. The recommended method matches people quickly and securely in a range of situations. By employing this tactic, it is possible to get the benefits indicated below. Effective identification is both ante and postmortem. Aids in locating patients in potentially fatal circumstances (accidents) and creating templates would make safe authentication easier.

Keywords: Dental Bio-metrics, feature extraction, contour, PCA recognition.

I. INTRODUCTION

Dental biometrics is the identification of people in emergencies like disasters and accidents by using dental radiography (x-rays) and original images. Dental biometrics have gained significant notoriety due to this forensic application since it has been used in both crime fiction and television dramas in addition to the actual world of the crime lab. It depends on things like tooth size, shapes, and forms, spacing between teeth, caps, restorations, and other dental work to be able to reliably identify someone from merely skeleton remains, especially in cases of terribly burnt or damaged bodies. Therefore, when other, more established methods of identification are unsuccessful, biometric examination of teeth serves as a last alternative. Because it offers a compelling alternative to established authentication methods like passwords, the topic of biometrics has attracted a lot of attention in recent years. A quantifiable anatomical, physiological, and/or behavioral characteristic is what is meant by the term "characteristic." It refers to a procedure for automatically identifying people based on their biometric traits. Because of their limited resilience, traditional biometric traits like fingerprints may not be able to be employed in extreme situations like those found in mass catastrophes. In these circumstances, dental characteristics are seen to be the greatest candidates for the identifying procedure. Forensic science aims to identify persons using dental characteristics. The foundations of dental identification are the ideas of comparison and exclusion. A person can be recognized using a variety of techniques based on their dental history. The four sorts of personal identification scenarios that presently use teeth, jaws, and orofacial features are reconstructive post-mortem, comparative dental identification, dental profiling, and DNA profiling. Forensic dentistry plays a significant role in the identification of individuals who cannot be identified physically or in other ways. The particular features of dental anatomy and the placement of custom restorations assure accuracy when the techniques are applied properly. Every dental surgeon needs to be aware of the implications of their job for forensics. The appreciation for the forensic industry should serve as further incentive for the dental doctor to keep records that are clear and compliant with the law and to help the authorities identify catastrophe victims.

II. RELATED WORKS

X-ray pictures are used in a fuzzy computing-based expert system for dental diagnostics. [1] An established way for identification is dental diagnostics using X-ray pictures. It was hypothesized that catastrophe victims may be identified using dental biometrics and semi-supervised fuzzy clustering with geographical limitations. Dental images are extracted layer-by-layer utilizing the Semi-Supervised Fuzzy clustering method, then do matching using layered extracted characteristics. The retrieved characteristics outperform the relevant algorithms such as FCM, Ostu, and eSFCM. The proposed technique outperforms existing algorithm methods in terms of accuracy. Several procedures must occur during the pre-processing phase. They continued to work on 3D scans, which would have improved the treatment's quality.

Dental radiography processing as a forensic method of human identification [2] In severe instances, dental radiography processing is a forensic method for human identification. Developed a technique to discover the culprit in a criminal case where dentistry has a distinguishing trait that would aid in efficient identification.

ISSN 2394 - 9554

Identification of dental specimens at a crime scene, identification of bite marks, and identification of pattern injuries [2].They determined the shortest distance between the features. The distance between the test picture and the enrolled images is computed, and the values that are closest to each other are identified. A better match has been discovered. Post-mortem matching will be challenging. Other segmentation ways are also available to separate the individual tooth and enhance the retrieval process's accuracy and time complexity.

Through the use of bitewing radiographs of a person's teeth and dental work, they may be identified via dental biometrics [3]. to reduce the unreliable contours' impact on alignment accuracy. Using the point-reliability approach, the outlier detection method, and the alignment-frequency feature. The contouring method was applied, and the contoured picture was processed to achieve high accuracy with the contour image. The retrieval accuracy is higher, and the identification using simply dental outlines is more successful. It Increases the accuracy and speed of identification. In the universal teeth number system, a tooth numbering approach is used to identify each tooth as a distinct one. The method may be used for 3-D photographs as well as radiography images. In human forensic identification, dental radiographs and pictures are used [4]. In human forensic cases, the system as a whole focuses on employing dental biometrics to identify the victim. To compare post-mortem and ante-mortem dental radiographs, an unique form matching approach based on skeleton and contour tracing method selected binary and Gaussian filtering regularized level set was created. Although it was designed for radiographic pictures, photography images might potentially use it with lesser computations. Because created exclusively for radiography pictures, an extra technique for photography images was necessary. Contouring was created over each tooth before being processed to match the test picture for identification. Even for bitewing photos, the contour tracing approach works well. Additional descriptors for photographic pictures might be explored to increase performance.

Dental biometrics: radiograph alignment and matching [5]. To identify victims in such scenarios, a technique based on dental radiographs was devised. To view the alignment and matching with the distance between the contours, the contouring technique was utilized. Developed tooth correspondence and picture distance calculation Individuals have been identified in broad terms. They achieved a 91% accuracy rate with x-ray radiography pictures. Shape extraction is a tough challenge for dental radiographs, especially when the curves of certain teeth are indistinguishable. Contouring suffers from various drawbacks due to low-quality radiography pictures.

Using mathematical morphology, teeth are segmented in digital dental x-ray films [6]. The segmentation of teeth from dental radiography images is a critical step toward highly automated post-mortem identification. The bitewing x-rays were utilized to analyze the picture and generate the segmentation using the mathematical technique. A mathematical morphology technique was used to solve the problem of tooth segmentation. Reduce the rate of bitewing picture segmentation failure. Enhances segmentation performance by utilizing an internal filter and thresholding the picture to better handle low-quality photos and to add panoramic dental radiograph views Panoramic dental radiography is useful for removing the entire tooth in a single picture, which helps to boost the recognition rate. Using the size invariant feature transform approach, teeth features are extracted and matched for human identification [7]. Using an invariant property of the teeth to identify The Gaussian filter was applied at different scales, and then the scale-invariant feature transform technique was employed to decrease noise and detect picture edges, Yielding 91% matching accuracy and a match time of less than 1 second For feature matching, the minimal distance technique was also employed. To extract and match the tooth characteristics, minimal computing time and an automated technique are applied. Dental image recognition may be done on a larger dataset and on a million order dataset. It involves extensive data gathering that has to be quickly identified utilizing the sift algorithm.

The two-2 degree gray scale differential technique for dental image recognition [8] may find a specific tooth in a digital picture of multiple teeth. The two-degree gray scale differential method can make it much easier to find patterns in teeth. They used the method of calculating the difference by row and column, adding the findings, and then implementing it. calculated the differences between the two levels using total, and located the particular tooth. The two-degree gray scale differential method can make it much easier to find patterns in teeth. For various kinds of pattern recognition, the technique may be applied by increasing the difference and decreasing the comparable rate. Different tooth patterns can be treated using this technique. In this method, teeth are identified by their shapes. Dental image matching using the Canny algorithm for individual identification [9] The dental image matching was constructed using a clever algorithm, which cut down on the time needed for identity matching. The intensity level of the processed picture was compared. using the picture collection to test and compare the altered image to the test image. The cunning method is effective for creating picture edges. Due to intensity level matching that happened at a slower time matching rate, identification was

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finished quickly. In circumstances where identification is possible in the actual world, this strategy may be applied. Because the color and x-ray images of the teeth are of low quality, the sophisticated algorithm fails. Low-quality photographs result in a lower matching rate. Dental x-ray image matching for person identification [10] was proposed to use image processing and pattern recognition algorithms for identification. Gap Valley as a feature to makes it seem like the picture. On the basis of dental radiographs, a semi-automatic method for human identification is proposed, when photographs are very hazy and the query shape is partially hidden, leaving inadequate information to categorize the teeth, gap valley distance and matching with numerous data set gap valleys are applied to improve the accuracy of person identification using dental images. It was suggested to develop an automated human recognition system based on form extraction and matching methods, as well as an efficient method for extracting dental shapes that makes use of contour data and Mahalanobis distance [11]. Supported features include edge information, structural content, observable spots produced from contours and surfaces, statistical moments, and shape extraction. The tooth shape information can provide better matching than any of these factors, making it the most suitable for this application. The matching distance observed for this method is thought to be superior to the semi-automatic contour extraction method previously employed.

Using dental records to identify catastrophe victims [12] the process of identifying disaster victims was developed. In order to identify the subject, the database's images were compared to the images from the oral radiography. The method uses phase-only correlation, a highly precise image matching technique, to identify correspondences between the two x-ray images, correct image distortion, and determine how close they are to one another. After many points have been matched, the distance is estimated. Dental identification is far more trustworthy than DNA-based identification and fingerprint/palm print the identification, it became apparent after the accident. A high rate of person identification became possible. The accuracy and speed of large-scale identification might be greatly increased and accelerated by contemporary radiograph-based human identification approaches.

III. DATASET

The dental database provided the data set, which includes images of the front, middle, upper, and lower jaws' teeth. Additionally, radiographic images of the tooth are provided to help with identification. The specific individual is then identified using this data gathering, analysis, and recognition. Students from dentistry and medical colleges provided a total of 300 cases. Both radiography and x-ray images are included. The procedure for color images and radiography images differs somewhat. They are handled in the same code, but with different levels

Fig.1. (a) Colored image, (b) Radiography x-ray image

of the threshold value. Because the intensity of the color image has a high resolution, the threshold value is lower. As a result, while processing the image, the thresholding for the color image is kept high. The following procedure depicted in Fig 1 depicts the processing and execution of image recognition.

IV DESIGN AND IMPLEMENTATION

Dental radiography is used to identify human remains that might otherwise go unidentified (x-rays). Since it has been used in forensic applications, as well as in crime novels, television series, and the real world of the crime lab, dental biometrics have become well-known. The ability to properly identify persons from skeletal remains or corpses that have been severely burnt or deformed depends on the size, shape, and spacing of the teeth as well as on crowns, fillings, and other dental work. As a result, when more conventional methods of identification are unsuccessful, biometric analysis is utilized in dentistry as a last resort. This work aims to efficiently perform recognition by precisely extracting the feature. Dental work matching is done by the algorithm using registered dental radiographs. The algorithm is constructed in Matlab and conducts dental work matching onto registered dental radiographs and color photos. The subsequent phases of the process entailed the victim's processing and identification. The processes for creating radiography and color images differ just a little. They are handled using the same code but at different threshold levels.

Table I Phases of the Images

PHASES	COLOR IMAGE	RADIOGRAPHY X-RAY IMAGE
Data Acquisition Phase	Collected through Camera	Collected through X-ray tube in X-ray film
Pre-Processing Phase	Resizing, Sharpening, Gray-Conversion	Resizing, Sharpening
Feature Extraction Phase	Thresholding, Contouring	Thresholding, Contouring
Recognition Phase	PCA	PCA

Because the color picture's intensity has a higher resolution, the threshold value is lower than the color image. As a result, when processing the color image, the thresholding is kept high. The processing and application of recognition pictures are shown in the method illustrated in Table 1.

A. Resizing

The number of pixels in the image does not change when the image is resized; instead, the pixels are printed further apart or closer together. An image's screen display will not be impacted by resizing or scaling. The image must be resized to reduce the pixel length, making the pre-processing step effective. Read the picture from the data collection while allowing pixel resizing.

B. Gray Scale Conversion

A grayscale image is one in which each pixel's value consists of a single sample carrying solely information about the intensity of the light. Only shades of gray, ranging from black at the lowest intensity to white at the highest, make up images.

C. Sharpening

Resolution and acutance are two variables that together makeup sharpness. Resolution is uncomplicated and objective. It simply refers to the picture file's size in pixels. When all other things are equal, an image can be sharper with a higher resolution since it contains more pixels. Acutance is slightly more challenging. It is a purely arbitrary measurement of edge contrast. There is no unit for acutance; an edge is either perceived as having contrast or as not. The human visual system gives the impression that edges with higher contrast have more clearly defined edges.

D. Thresholding

Image thresholding is a quick and easy way to tell a picture's foreground from its background. By transforming grayscale photos into binary pictures, this image analysis technique is a type of image segmentation that distinguishes things from each other. Strong contrast levels in the image perform well for picture thresholding.

E. Contouring

One of the various preprocessing methods used on digital photos to extract details about their overall shape is contour tracing. After a specific pattern's contour has been retrieved, its many qualities will be analyzed and employed as features in the categorization of that pattern. Therefore, good contour extraction will result in more accurate features, increasing the likelihood that a given pattern will be accurately classified. The feature extraction procedure, a crucial step in the field of pattern recognition, is frequently greatly improved by contour tracing.

F. Recognition Process

Reduce the number of variables in person recognition by using the statistical method known as principal component analysis (PCA). A linear combination of Eigenfaces is used to represent each image in the training set., a class of weighted eigenvectors, in PCA. The covariance matrix of a training picture collection is where these eigenvectors are found. After picking the most pertinent set of Eigen's faces, the weights are determined. A test picture is projected into the region of space covered by the Eigenfaces to conduct recognition, and the region is then classified by calculating the minimal Euclidean distance. The effectiveness of the Person Identification system was assessed through a variety of trials. the procedures carried out to process the recognition.

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G. Extraction of Principle Component Feature

From a contour image that has been processed, create a training image. Get the data set ready, then figure out the average face vector. Subtract the typical face vector from that value. The covariance matrix should be determined. Project the training sample onto the Eigen face space after determining the eigenvectors and eigenvalues of the covariance matrix.

H. Testing Image

Separate the image after reading the sample image. Find the test image's feature vector, Calculate the Euclidean distance, or average distance, between each training feature vector and the test feature vector. The sample image resembles the facial classification with the least Euclidian distance.

V. RESULT ANALYSIS

With both photos, the suggested strategy yielded a high accuracy rate. The Identification Phase is completed at a minimal processing rate, and the Enrollment Phase needs specific to store the value in the matrix form. The contouring of the picture inhibits acceptance rate, and PCA's storage of the image in matrix format also increases prevention against acceptance rate, therefore the erroneous acceptance rate is low. The rate of erroneous recognition in the recognition procedure is likewise quite low. Euclidian distance contributes to a high matching rate. The feature can be easily stored in matrix form thanks to the contouring's efficiency in tracing its bounds. For color pictures, 92% accuracy was achieved, and for radiography images, 95% accuracy. Thresholding is crucial in this situation since the intensity level varies for radiographic and color images. Because radiography pictures have more accurate feature extraction and intensity levels than color images. A certain action must be done for the procedure. If any damage or filling has been done, the picture should be properly updated. The Threshold level should be maintained to obtain the precise border.

The thresholding of the image has an impact on accuracy since it makes it easier to extract the required object from the image. Dental biometrics, as opposed to other biometric technologies, is useful for ante mortem and post-mortem identification as well as suspect and life-threatening patient identification. For mass disaster identification, dental biometric features may be gathered as a necessary type of identification. The accuracy rate is calculated using the thresholding setting and the smallest distance required to match the training image with the test image.

Table II Result Analysis

Type of Image	Thresholding Value	Accuracy Rate	Failure Rate
Color Image	200-250	92%	8%
Radiography X-ray Image	200-250	8%	92%
Color Image	80-120	45%	55%
Radiography X-ray Image	80-120	92%	8%

The level of threshold should be established before processing as Table II specifies the level of thresholding for the processing of the pictures. The intensity level will vary depending on the image.

VI. CONCLUSION

Unidentified human remains are still recognized using dental biometrics, a contemporary technique that has been available for a long. By pre-processing radiographs, eliminating attractive traits, and comparing pre- and post-mortem images of a person's teeth and dental work, identification is frequently attainable in situations when it would not otherwise be possible. Forensic dentistry plays a significant role in the identification of individuals who cannot be physically or otherwise identified. The suggested method increases identification process efficiency and helps lower the false acceptance rate by combining the contouring technique, principal component analysis, and Euclidian distance. Since the retrieved feature is correctly matched using PCA, the identification procedure is significantly more successful. Each dental surgeon has to be aware of the legal implications related to dental practice. Now that law enforcement is increasingly aware of the forensic profession, the dentist should have greater motivation to maintain accurate, legally allowed records and assist in the identification of disaster victims. This initiative would make it simpler to identify the person who is in a critical condition as well as the suspect.

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