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Person Identification using Dental X-Ray Images of Maxillary Bone for Dental Biometrics

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Abstract: Dental Radiograph based human bio-metric information is the latest research area in the biometric identifier domain. Human identification is becoming one of the major worldwide issue now a days. Dental biometrics is the leading biometric technique to identify individuals on the basis of their dental characteristics. Dental Features of the person are naturally unique. They can be used to authenticate humans exactly or almost to the maximum possible similarity. In order to achieve our desired mentioned goal, dental biometrics automatically analyzes dental radiographs, stored in a database through some described processing. Here, we used efficient workable method to authenticate humans correctly and identify them properly, which is based on dental work information extracted from the dental data. The method used here comprises of some processing stages that processing stages include preprocessing, feature extraction, KNN classification etc. This whole part is implemented in Matlab software for easy identification. The results obtained by using this identification system are very encouraging. Accuracy rate obtained by the system is 92.03%.

Keywords: Dental biometrics, Radiographs, KNN classification, Accuracy rate

I. INTRODUCTION

The word “biometrics” came from Greek and we can divide it into two roots: “bio” means life and “metrics” – to measure. Biometrics measures biological characteristics for identification or verification purposes of an individual. Since IDs and passports can be forged, more sophisticated methods needed to be put into place to help protect companies and individuals[1]. Forensic human identification is crucial and a big issue world-wide. At present security conditions, biometric identification is the most promising way to authentic humans with highest accuracy rate. A lot of research has been done in the field of different biometric modalities like Finger-print, Iris, Hand-Veins etc to identify humans. Within these various modalities, Dental Biometric has leading edge over others. Because of reason a lot of dental biometric characteristics have been associated with maxillary bone. Iris-scan are some individuals are difficult to capture. Also the iris can be easily obscured by eyelashes, eyelids, lens and reflections from the cornea. There is also a lack of existing data which deters the ability to use for background or watch list checks. Face recognition also has disadvantages that come along with it. The face can be obstructed by hair, glasses, hats, scarves, etc. Also changes in lighting or facial expressions can throw off the device. A third disadvantage related to face recognition is that people’s faces change over time. In order for face recognition to be accurate “images are most accurate when taken facing the acquisition camera and not sharp angles. The users face must be lit evenly, preferably from the front”. This is not always possible and can be very hard to do in some environments. The field of biometrics has got so much importance from few years because it is an interesting and a different way to identify humans than that of traditional authentication systems previously developed like passwords. Under various circumstances e.g. disasters conventional biometric characteristics like fingerprints etc, may not be able to work because of their incompatibility in such cases .In this case, dental features are considered a useful tool for of human identification. In order to achieve our desired mentioned goal, dental biometrics based on maxillary jaw structure automatically analyzes dental radiographs, stored in a database through some described processing. Recent mass disasters, terrorist attack and the Asian Tsunami, have highlighted the significance of dental identification systems. The maxilla is a name for the upper jaw, and it is made up of several bones stuck (or fused) together, and sits in front of and just below the cranium. It is attached to the cranium and forms the cheeks, the nose, and the roof of the mouth.

II. RELATED WORK

Dental profile based biometrics is the most secure biometrics that remains safe and unchanged throughout the life and even after expiry of a person. It has been observed that the dental radio graphs are permanent forever and do not vary with age.

Geetanjali Sharma [3] proposed system in which biometrics is the study of methods for measuring physical or behavioral traits of an individual that can be used for uniquely recognizing or verifying that individual’s identity Biometric methods are divided to physical and behavioral methods, which in turn can be divided into invasive and noninvasive methods. Invasive methods are those that

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require the cooperation of the individual in order to acquire data needed to compare his biometric features to the ones stored in a database. Noninvasive biometrics does not require the cooperation of the individuals; in fact data capture may be done without their knowledge. Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of one or both of the irises of an individual's eyes, whose complex random patterns are unique, stable, and can be seen from some distance.

Aparecido Nilceu Marana1, Elizabeth B. Barboza, João Paulo Papa, Michael Hofer and Denise Tostes Oliveira [6] proposed the development of Automated Dental Identification Systems (ADIS) is a necessity. Automating dental identification methods will enhance the process of human identification in catastrophic events where the use of biometric identifiers such as face and fingerprints may not be possible. A typical architecture of an ADIS is composed of three main components: dental record preprocessing, search and retrieval, and image comparison. In the first phase, the query radiograph is preprocessed in order to enhance its contrast, remove its noises, and select the areas of interest.

The segmentation of the teeth and the normalization of the image regarding discrepancies in scale, rotation and illumination are also carried out at this stage. Next, a template (or model) image is retrieved from the database and is registered with the query image, for matching. In the following, decision making phase, the features extracted from the teeth on both images are compared by using a proper distance function. The system output is, in general, a score proportional to the probability of both radiograph images being of the same individual.

Dental features have been widely used for forensic identification purposes. With the large number of cases that need to be investigated by forensic odontologists, a move towards computer-aided dental identification systems is necessary. MajaOmanovic and Jeff J. Orchard [8] proposed an automated scoring and ranking method that can be used to augment other text-based methods such as WinID. Given a postmortem (PM) radiograph with a marked region of interest (ROI), they searched the database of antemortem (AM) radiographs to retrieve a closest match. To express the degree of similarity/overlap between two radiographs, they used the weighted sum of squared differences (SSD) cost function. In 90% of the identification trials, our method ranked the correct match in the top 10%. In all trials, the correct match was among the top 22%.

III. PROPOSED METHODOLOGIES

Dental Radiograph based human bio-metric information is the latest research area in the biometric identifier domain. So in a general block diagram of Human identification system, dental radiograph of patients are collected for dental identification system.

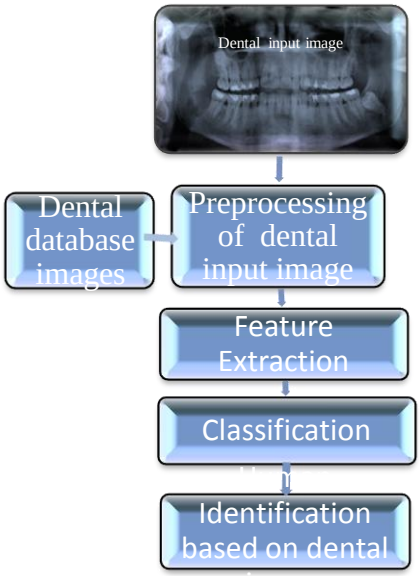

Fig1:block diagram of system

A. Pre-processing

The dental image source is the x-ray diagnostic center. The presented work is primarily focuses on to the feature extraction from the dental radio graphs and not on how the x-rays are performed on dental part of the body. The dental images may be in jpeg format and converted to gray scale format. These radiographs firstly preprocessed for filter out unwanted background noise present with radiographs accordingly resizing is done for proper information extraction of maxillary bone. Then next step of preprocessing consist of separation of region of interest. Pre-processing of the biometric data sample has been done, then an algorithm is defined which will extract the unique and desires features derived from the biometric sample and converts it into biometric data for measuring the properties for making a form of database so that it can be matched to a reference template in the database

B. Feature Extraction

After preprocessing feature extraction is performed, the objective is to implement a system which has biometric identification method based on dental biometric calculation on dental data. For best features extraction and accurate matching results the quality of image should be noticed and evaluated properly to get desired results. The features we have extracted for teeth color images are intensity features.

Human being naturally contains these features. For the purpose, we used algorithm, using morphological image processing techniques on gray scale image.Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors.

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C. Classification

Various approach we may consider pixel based separation, texture analysis etc. Here texture analysis is used. The original LBP operator labels the pixels of an image with decimal numbers, which are called LBPs or LBP codes that encode the local structure around each pixel According to feature of images, image is classified by using various types of distance like Euclidian distance, Hamilton distance etc. is considered. Here we used KNN classification, In KNN classification, the output is a class membership. An object is classified by a majority vote of its neighbours, with the object being assigned to the class most common among its k nearest neighbours (k is a positive integer, typically small). If k = 1, then the object is simply assigned to the class of that single nearest neighbour. Radiograph from database selected and this radiograph are preprocessed, segmented and contour extracted from it.

D. Matching Stage

In performing the matching stage, the biometric data are compared with the template data present in the database as a reference giving a level of matching similarity. The identification of humans on the basis of biometric data depends on the scored level of similarity resulted in the matching stage. Finally the decision making is done on the basis of similarity level and human recognition is done.

IV. RESULTS

In order to make a statement about the performance of the proposed method, various tests have been performed. A stable feature extraction and classification stage is important for the matching stage is created out of the results of the classification methods. We have tested performance of our proposed system on Matlab 8.1 version R2013a,64bit and LAPTOP-7NI9RC7A and processor used is Intel® core™i3-5005U CPU.

A. Identification of Person

Let's consider for the dental image. All steps will be same as done for the previous dental image. We get the following results:

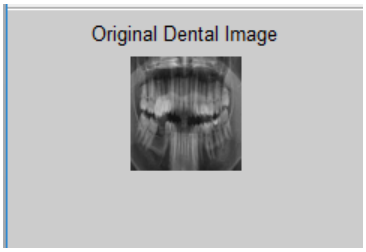

Fig2: Original Dental Image

Pre-processing of the biometric data sample has been done by using algorithm, and it is defined which will extract the unique and desires features derived from the biometric sample. Here we used morphological operations in preprocessing stage

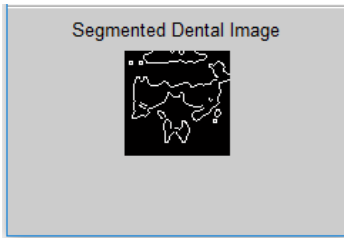

Fig3: Preprocessed image

According to feature of images, image is classified by using various types of distance like Euclidian distance, Hamilton distance etc. is considered. Here we use a method for classification is KNN classification.KNN is a instance based learing. Then from database equivalent image is generated.

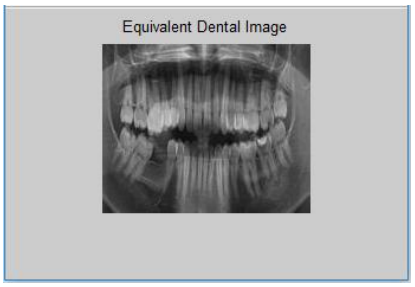

Fig4: Equivalent Image

And last stage of this system is matching, in this feature extracted from these two dental images matched with each other using KNN classification and final result is identification of person based on matching distance between these dental images

Some examples of the extended LBP (ELBP) operator, where the notation (P, R) denotes a neighborhood of P sampling points on a circle of radius of R. Formally, given a pixel at (xc , yc), the resulting LBP can be expressed in decimal form as follows: LBPP, R (xc ,yc) = P −1 P =0 s(iP − ic)2P where ic and iP are, respectively, gray-level values of the central pixel and P surrounding pixels in the circle neighborhood with a radius R, and function s(x) is defined as

$$s(x) = 1, \text{ if } x \geq 0 ,$$
$$0, \text{ if } x < 0.$$

From the aforementioned definition, the basic LBP operator is invariant to monotonic gray-scale transformations, which preserve pixel intensity order in the local neighborhoods. The histogram of LBP labels calculated over a region can be exploited as a texture descriptor. The operator LBP(P,R) produces 2p different output values, corresponding to 2p different binary patterns formed by P pixels in the neighborhood.

If the image is rotated, these surrounding pixels in each neighborhood will move correspondingly along the perimeter of the circle, thus resulting in a different LBP value, except for patterns with only 1 and 0 s. In order to remove rotation effect, a rotation-invariant LBP is proposed in

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LBPri P, R = min{ROR(LBPP, R ,i)|, i = 0, 1, ..., P − 1}
where ROR(x, i) performs a circular bitwise right shift, on the P-bit number x, i times.

The method is tested on two databases i.e. dental radiographs and colour images and the results are highly encouraging. The data set comprises dental radiographs of 19 persons comprises 38 images and colour images of 19 persons comprises 19 images. An Accuracy Rate (EER) of 94.73% dental radiographs and 89.46% for colour images found on matching the performance of dental biometric analysis. It is shown in following table and in

Table1: Matching Results

Database	Total Person	Total Images	Correctly Identified Person	Accuracy Rate
Radiographs	19	38	18	94.73 %
Colour Images	19	19	17	89.46 %

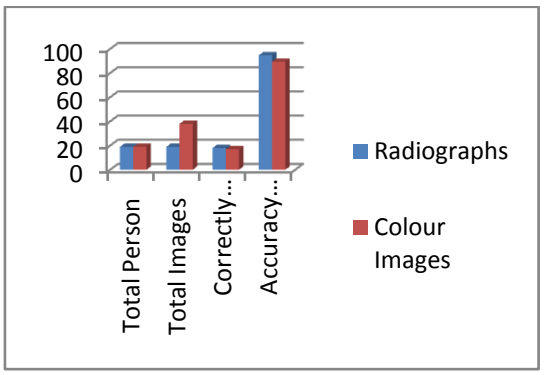

Fig5: Matching Graph

In Our Proposed Work, We will try to identify almost all persons from our database and we developed identification system based on new approach. Also created database of persons on the basis of their maxillary jaw structure.

B. Algorithm

1. Load dental images
2. Convert data into corresponding RGB to gray colour format
3. Perform preprocessing operations on persons data
4. Preprocessed data is available check the image carefully
5. After preprocessing is performed, use MLBP criteria for feature extraction
6. Extraction of feature is done and it is shown by window
7. After that apply KNN classification
8. Equivalent image is shown in figure
9. Then massage is displayed that matched data is of person
10. If again we want to find next person go for it
11. Otherwise press close, it will show massage yes or no
12. If yes it closes all window
13. If no it remains as it is

V. CONCLUSION

This Proposed method discusses an idea using the dental biometric approach for human identification using dental x-ray images to provide different identification system to the available systems. And in this different way we got the results which are highly encouraging. It is very big step forward. Dental biometrics features can not only used in forensic but for security authentication process also. Data when it is transmitted in the public networks as well as when stored on servers. The results obtained by this method are highly encouraging. Here we used database of 114 images and many of them were identified properly. So accuracy obtained by this system is near about 90%. From here it is concluded that dental structure is a reliable source of human biometric identification

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