A Machine Learning Access for Person Identification using Dental X-Ray Images

Pratik S. Meshram, Dhanashree K. Parate, Chetan B. Jawale, Akshay V. Yewate, Netra Lokhande

Abstract*: Dental radiographs do a great deal of work on the evidence of criminal classification. Science deontology is used in crimes that deal with the evidence of a person's separation related to dental exposure. Due to the advances in data design and the need to evaluate more cases by legal professionals, it is important to use a human evidence framework. Dental radiographs can be classified as biometric if there are no alternatives to body biometrics, for example, palm, finger, iris, face, leg print, and so on. The human body seen using dental radiographs is best under certain conditions when there are no biometric alternatives because the teeth and bones are treated like skin tissues and tissues found in the human body.

***Keywords*: CNN, Dental Radiographs, HoG, KNN.**

I. INTRODUCTION

Teeth are fragile parts of the human body and are formed inside the mouth, which is further protected from decay after the killing of any major victim. Appropriately, evidence-based dentures are one of the most reliable tools used for evidence of human differentiation. Typically, a person has 32 teeth when all teeth have 5 planes, which means that inside the mouth there are one hundred sixty dental planes with few conditions. If we use dental biometric as a proof-of-concept tool, combining adjacent teeth requires a large amount of time and specific information, after which, PC assistance for virtual evidence is needed. The human tooth has its distinctiveness depending on the unique characteristics of all the teeth. These excellent features contain dental structures for example tooth structure, crown and root morphology, dental pathology, and dental alignment. All through the element removes certain inconsistent details of the teeth, for example, the form, the subtlety, the shape and size of the tooth, and the rest of the dental radiograph images.

Manuscript received on July 12, 2020.
Revised Manuscript received on July 22, 2020.
Manuscript published on July 30, 2020.

* Correspondence Author
Pratik Shiva Meshram, Student, Department of Electrical Engineering, MIT World Peace University, Kothrud, Pune, India.
Dhanashree Keshao Parate, Student, Department of Electrical Engineering, MIT World Peace University, Kothrud, Pune, India.
Chetan Bhairu Jawale, Student, Department of Electrical Engineering, MIT World Peace University, Kothrud, Pune, India.
Akshay Vyankat Yewate, Student, Department of Electrical Engineering, MIT World Peace University, Kothrud, Pune, India.
Dr. Netra Lokhande, Department of Electrical Engineering, MIT World Peace University, Kothrud, Pune, India.

At present they are separated by a dental form since they have been continuously identified by certain dental structures. This item takes on an important role in Post Mortem's [1], [6], [8], [10] distinguishing evidence, and Dental bio-metric also.

Dental-based biometry is a highly-proven geometry of the remaining parts being protected and elevated throughout life and most spectacularly after a person is killed. Dental biometrics can be thought to be repaired at 8-10 years of age and then, later, unchanged. Examples of teeth can be classified as standard biometric if there is no physical biometric, for example, palm, a distinctive mark, iris, face, leg print, and so on. Dividing evidence using a dental radiograph and image has been deemed best under certain circumstances in the absence of unique biometrics. Teeth and bones are saved as the most sensitive and earthy tissue found in the human body, showing no compromise in the unchanged energy laws, temperatures up to 1100. Besides, it holds large biometric structures for a considerable period due to flexibility and rigidity. It manages protection from the rot and even some basic conditions just like most human disasters, for example, a wave, a bomb impact, a crash, a major fire or traffic accident, and so on.

II. LITERATURE SURVEY

Hong Chen and Anil K. Jain [1] played the Dental Biometric function: Matching and Alignment of Dental Radiograph. "The proposed paper consists of two main sections: insert extraction and coordination and the third section is subject ID." Vijaykumari Pushparaj, Ulagnathan Gurunathan, and Banumathi Arumugamuse [2] work on the structure and skeleton-based shape extraction similar to that proposed for maintaining dental images. The Task Structure Model with the Regular Level Set procedure with explicit equalization and Gaussian filtering is used for explicit extraction by SBFRLS estimation from the SBF task. The shape is governed by the structure and skeleton-based philosophy. Hajj Said, E.H. Nasser, and Gamal Fahimi [3] apply a section to the teeth. They propose a mathematical morphological approach in terms of tooth separation, and the separation of teeth from dental radiographic images is a strong step toward the success of highly automated PM detection. They provide a simple grayscale suspension contrast to improve the performance of dental separation.

R. L. R. Tinoco, E. C. Martins, and E. Darus [4] work on dental differences and their importance for human identity.

This paper describes successful progressive detection by analyzing the difference in the position of the tooth, with validation using the skull-photo superimposition. Although forensic science offers advanced techniques, in this particular case, the presence of a forensic dentist in the forensic group plays a major role in detecting Canine's discomfort.

AlUniarty, Anindita Szeeth Nugroho, Bilkis Amalia, and Agus Zanel [5] work on the contribution and number of ental radiographs for a programmed human identification system.

Currently, a customized human detection proofing framework based on dental radiographs has been developed, which consists of two principal steps. The main step is to enter a database containing dental radiographs. The next step is looking to retrieve different proof results by training in the database. The two stages highlight picture handling strategies, implantation techniques, and dental radiographs, and use a good measure of the number framework to create examples. Preprocessing is the main strategy for image correction and binarization, revealing single tooth return and extraction. Subsequently, they undertook a dental grouping strategy aimed at using a vector material system to double the teeth removed in molar or premolar. Since then, a numerical process has been realized in agreement with the molar and premolar design obtained from the previous procedure.

Surendra Ramteke, Rahul Patil, and Nilima Patil [6] started working on the “State of Art Automated Dental Identification System (ADIS)".This is a paper review of new mortgages after using dental records which means that the Automated Dental Information System (ADIS) can be used by the law to locate the wrong people and to see the victims of major disasters (e.g. earthquakes, tsunamis, aircraft, etc.) using dental X-ray’s data. For PM identification, forensic deontologists rely heavily on dental radiographs, among other types of records (e.g., oral images, dental models, and CAT scanning) to match the morphology of unnamed dental implants to select those chosen by missing individuals. This paper presents new methods and techniques in which the Identification of post comparisons of post mortem images (PMs) with dental records of people of Antemortem (AM) population was lost to find related records.

Martin L. Tangel, Chastine Fatichah, Kaoru Hirota, and Fei Yan [7] performed dental filtering with a Basic Radiograph Based on the Impact of a Multiple Fuzzy Attribute. "This paper presented radiographical dental separation based on many interesting features, where all teeth alone are analyzed based on several factors such as location/circumference and width/height ratio. without the distinction of the theory (in the case of an uncertain object), which is why a direct and auxiliary result can be obtained because of its uncertain tooth-holding ability.

Anil K. Jain and Hong Chen [8] used dental X-ray imaging to identify a person to establish a victim identification process using image identification techniques and pattern recognition techniques. We described the post-mortem radiograph, examining the details of the antemortem radiographs to repeat the closest match with a superior overview of other noteworthy features. In this paper, they work with dental implants as a feature of similarity. The semi-automatic mining method used to report the problem of old tooth damage caused by poor image quality. The method presented includes three phases: radiographic segmentation, pixel segmentation, and contour segmentation. The probabilistic model is used to describe the distribution of object pixels in an image. The recovery results in a database of over 100 images are encouraging.

Rohit Thankiand Deven Trivesi [9] introduced a new complaint as one of the most personalized tooth based on dental image matching in the automated dental identity scheme consisting of two key sets: Feature Exposure and Feature Comparison. Here they offer a new tool for personal evidence based on dental statistics and image printing algorithms. In this paper, first, we applied the ISEF algorithm to a database of dental images and identified nonspecific features such as contour, prosthesis, cupid number, etc. Few on radiographs. Thereafter applied the numerical limits to the images of the colored teeth and then the similarity of the images of the various teeth was used and using this evidence to show that human identification can be easily eliminated based on dental images. Shubhangi Dighe, and Revati Shriram [10] who practice the improvement, classification, and comparison of dental radiographs used in dental biometrics in this AM radiograph compared with the PM radiograph to find unknown individuals. Dental biometrics consists of four steps such as preoperative dental radiograph analysis, segmentation, feature extraction, and comparison of ante and post-monograph. Separation is a technique used in mining imaging that can be compared to the size of a tooth. These materials are used to compare two radiographs and based on these comparisons; individuals may have been identified. In this paper, some parts are used to build my teeth and similarly to extract a tooth. This work provides a comparison of two radiographs based on histogram data, tooth area, and dental function. For classification and similarity, we use an improved set of rules.

Wang Xinzui, Dong Ningning, and Li Huanli [11] are analytical scaling techniques to transform calculations that distinguish the highlights of a dental image completely. Currently, search for all scales and positions of images [4] using Gaussian processing divisions to detect the influence of horizontal focus on non-scaling and direction. Also, select the focus keys depending on their durability rating and the complete model is suitable for positioning and measurement throughout the application area. And besides, pass at least one edge to certain key points according to the mounting rules of the image. Finish measuring the slopes of the pictures near a specific point around each point. Then use KNN (K-nearest neighbors) calculations to link highlights. In addition to many tests and related to other partial extraction techniques, this method can detect the highlights of the dental model and provide some of the available 3D model dental components.

III. PROPOSED SYSTEM

The block diagram of the proposed scheme is shown in Fig.1. The proposed system model works for two types of dental images one is a photograph and another is radiograph, so there is a possibility to select the type of image first for which the user desires to practice the system. In this module, there is a description for processing step-by-step radiographs of the teeth.

International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-9 Issue-2, July 2020

A. Database

The images of dental radiographs are collected from the dental hospital.

This database comprises the image radiogram of the 10 people. The distribution of the dataset is as displayed in TABLE I. All information is disseminated in training and testing. The data are distributed as 80% of the training images and 20% of the test sessions over time.

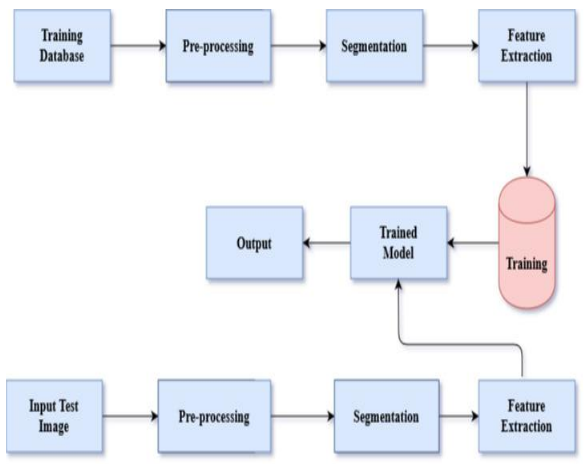

Fig. 1. Block Diagram of the proposed system

B. Pre-processing

The various steps to success are described by the following points [2], [5].

- **Resize input image**

Initially, the selected feature photos are of any size, so it is necessary to maximize them at the correct size because the calculation is important for the same size images at the right size. This detail image was resized to 150x150 Where A is the detail image and B image is the size image.

- **Convert shading image to grayscale image:**

In the current new product, almost all acquisition and image processing methods use shade. In this way, we also used a shading filter gadget to examine images. The shadow image includes a programming network and three-dimensional elements. The edit string contains x, y to prepare the image dimension. The shading grads are named after red (R), green (G), and blue (B). The processes currently provided are on grayscale images, and in this way, the images that are evaluated or captured as color are first converted to green using the corresponding condition:

Table- I: Database Distribution

PERSONS	DATABASE DISTRIBUTION		
	TOTAL IMAGES	TRAINING	TESTING
1	199	149	50
2	199	149	50
3	200	150	50
4	202	152	50
5	202	152	50
6	199	149	50
7	201	151	50
8	199	149	50
9	197	148	49
10	202	151	51

$$Gray = 0.299 \times R + 0.5876 \times G + 0.114 \times B \quad (1)$$

where, R, G, and B are the intensity values of red, green, and blue channels.

C. Teeth Segmentation

The classification of an image is divided into categories of its elements or objects. Clinical image segmentation in 2D, cut-outs has many important applications for clinical specialists: representation and volume assessment of complexity. The photo spacing is a way to assign a word to each pixel in an image to the point where pixels with contrast marks share a visual highlight. The result of multiple image segmentation that helps with the whole image or multiple image formats (edge identification). Divorce calculations are based on one of two basic properties of the forces of esteeming disjointedness and calibration. The main stage is to insert a package into an image subject to unexpected changes in strength, for example, edges in the image, the following partition based on the image segmentation in the comparison areas is allowed in the predefined procedure. In the meantime, brush the upper jaw and lower jaw from delicate muscles.

D. Morphological Operation

The feature extraction feature is required to extract the features since the original image is converted to plural by the numerical value (Th) and then the morphological function [3] of the business image removes pixels from the object's borders without allowing objects to fall apart. Here, cv2.threshold() produces binary images from directions, dimensions, or RGB images. In this process, first, convert the RGB image to error and then use the binding method to convert the grayscale image into a bin. The grayscale pixel value is greater than the numeric value and gives that pixel as 1 and 0.

E. Feature Extraction

- **Histogram of Oriented Gradients (HoG)**

Feature extraction [7],[9] is an important step to define image data. The essence of the release of the HoG features used is, HoG explained, describing the object in the image with the edges of the durability and its direction. In this case, the image is first divided into many small cells. For each cell, the incident pixels are calculated and represented by gradients. Finally, all of the calculated histograms are organized and form the definition of HoG. Based on this procedure the following steps may be highlighted:

- Starting up
- Read Gradient Photos
- Calculate the Histogram of Gradients in NxN cells
- Block Normalization
- Calculate the HoG feature extension

The HoG feature extraction process begins with the preparation step. Larger size images begin to grow to smaller sizes in the preparation step. The gradient in image pixels is calculated using either horizontal or vertical line views. This process helps to get the points pointed to the image.

This will give us the size and angle of the limit and it is calculated as.

$$g = \sqrt{g_x^2 + g_y^2} \quad (2)$$

$$\theta = \arctan\left(\frac{g_y}{g_x}\right) \quad (3)$$

In Step 3, the first image is divided into NxN blocks of equal length. In this system, the image is divided into 8X8 equal blocks. Then the gradient histogram of each block is calculated. But the rays of the image are very visible in the depths of the earth. So, the image is normal with the 2Nx2N block. This will help to reduce the impact of the earth's impact on gradients. Finally, the display view of the entire pool is calculated by a single number.

F. Classification

KNN [11] is a simple algorithm, where the test vector calculates the distance between the training element's resources. The K value of the nearest neighbors will be calculated very close to the van of the van. This distance can be calculated using different grade metrics such as Euclidean, Manhattan, Mahalanobis, Minkowski, etc. In this way, the Euclidean distance is used to find the nearest neighbors calculated by Eq. (4)

$$d(a,b) = \sqrt{\sum_{i=1}^{n}(a_i - b_i)^2} \quad (4)$$

Fig. 2 shows a simple description of the selection of the nearest neighbors for the test sample. The test sample is shown by a green circle drawn by nearby neighbors. Blue squares in red triangles data with a unique label. If we choose K = 3 then two red triangles and one green square will be the nearest neighbor in the test sample. The KNN algorithm applies to the principle of "most wins the battle" which is why the test samples are treated as a red triangle label.
The detailed KNN algorithm is given below.

1. Take a testing sample
2. Select the value of K
3. Calculate the distance between the training sample with training data using distance metrics
4. Sorted the distance and select the data of K- nearest neighbors
5. Assign the label to the testing sample of the majority samples.
6. If the results are not satisfactory, then changed the value of K until the reasonable level of accuracy achieved

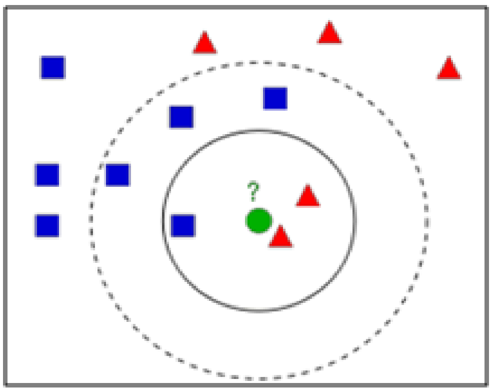

Fig.2. Classification of query image through KNN classifier

IV. RESULTS

The proposed system was developed using the Python language. Scikit-learn open-source library is a Machine developer for learning algorithms in the python. In this program, a machine learning algorithm is used from the scikit-learn library. The proposed system is evaluated using an analysis of the configurations and quantities.

A. Qualitative analysis

Visual calibration of the experiments was performed by means analysis. The correct results of the proposed program are described in this section. The input image of the program is shown in Fig.3(a). The pre-greyscale image is shown in Fig.3(b). The pre-designed image is tested on a trained machine learning model. The output images are shown in Figure 3(c).

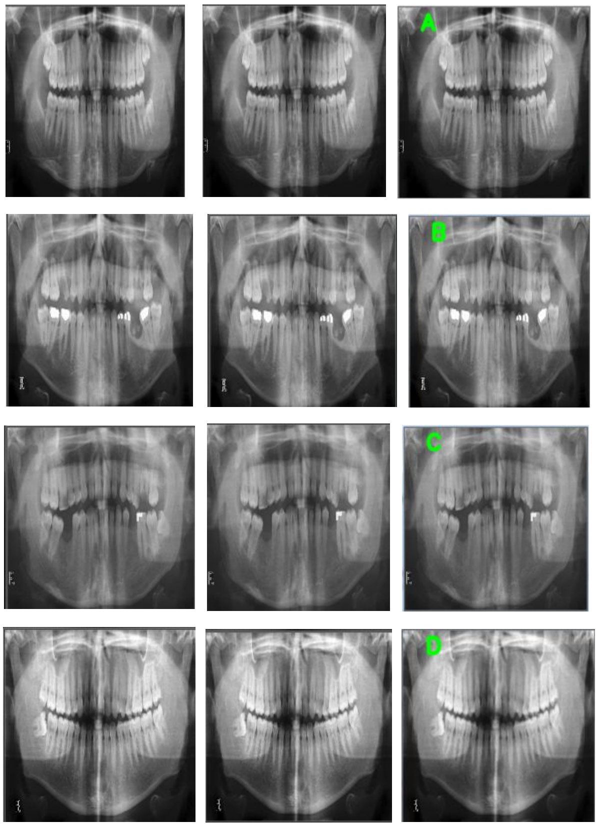

Fig.3. Qualitative analysis (a) Input Image (b) Grayscale image (c) Output Image

B. Quantitative analysis

Quantitative analysis is a statistical measure of research. The collected features were trained in different classifications. The accuracy of the different classifications is done in Table II. From Table II, this means that the KNN classification for K = 7 shows the highest validation accuracy (83%).

TABLE-II: Quantitative Analysis

DATABASE	KERNELS/ PARAMETER	VALIDATION ACCURACY (%)
SVM	Linear	8.33
	RBF	8.33
	Poly	8.33
	Sigmoid	8.33
KNN	K=1	82.33
	K=3	82.33
	K=5	82
	K=7	83
GBC	-	74.33
NB	-	62.66

V. CONCLUSION

We have proposed and executed our approach differently and got the outcome which is extremely boosting it is indeed a very big step forward. Dental work can not only be used in forensic but for security Verification purposes also it can be useful. Additional work should be done to implement the human identification system correctly, based on dental biometric.

From here it is also concluded that teeth are a consistent and robust source of human biometric identification as all the human being has teeth with diverse structure. Their dental radiograph can be reserved by the use of a radiograph machine or x-ray machine. The proposed system shows an accuracy of 83% for the KNN classifier for K=7. In the future, program accuracy can be increased by using deep learning algorithms such as the Confidential Neural Network (CNN).

REFERENCES

1. Hong Chen and A. K. Jain, "Dental biometrics: alignment and matching of dental radiographs", IEEE Deals on Pattern Analysis and Machine Intelligence, vol. 27, no. 8, August 2005
2. Vijay kumari Pushparaj, Ulaganathan Gurunathan, and Banumath iArumuga, "Dental radiographs and photographs in human forensic identification", IET Biometrics 2013, Vol.2, Iss.2 pp56-63.
3. Eyad Haj Said, E.H. Nassar, D.E. Gamal Fahmy, and M. Hany H Ammar, "Teeth segmentation in digitized dental X-ray films using mathematical morphology", IEEE Transaction on Information and Forensic Security, 2006 178189
4. R. L. R. Tinoco, E. C. Martins, and E. Daruge, "Dental Anomalies And Their Value in Human Identification", an incident report from Piracicaba Dental School State University of Campinas, Department of Forensic Odontology Av. Limeira, 901 Caixa Postal 52.
5. Anny Yuniarti, Anindhita SigitNugroho, Bilqis Amaliah, and Agus Zainal Arifin, "Classification and Numbering of dental radiographs for an automated human identification system", TELKOMNIKA, Vol.10 No.1 March 2012 pp. 137 146 ISSN: 1693- 6930
6. Surendra Ramteke, Rahul Patil, and Nilima Patil, "A State of Art Automated Dental Identification System (ADIS)", Advances in computational research ISSN: 0975-3273 Vol.4 Issues 1, 2012 pp-95-98
7. Martin L. Tangel, Chastine Fatichah, Fei Yan, and Kaoru Hirota, "Dental Classification for Periapical Radiograph Based on Multiple Fuzzy Attribute", IEEE 978-1-4799-0348-1/13 2013
8. Anil K. Jain, Hong Chen, "Matching of dental X-ray images for human identification", ELSEVIER Pattern Recognition, 37(2004) 1519-1532
9. Rohit Thanki, Deven Trivedi, "Introduction of the novel tooth for human identification based on dental image matching", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 2, Issue 10, October 2012
10. Shubhangi Dighe, Revati Shriram, "Preprocessing, Segmentation, and Matching of dental radiographs used in dental biometrics" International Journal of Science and Applied Information Technology, Volume 1, No.2, May June 2012.
11. Wang Xinzui, Dong Ningning, and Li Huanli, "Features Extraction and Matching of Teeth Image Based on the SIFT Algorithm", The 2nd International Conference on Computer Application and System Modelling, 2012.

AUTHORS PROFILE

Pratik Shiva Meshram is pursuing his Bachelor of Engineering Degree from MAEEER'S MIT College of Engineering, Pune. His area of interest includes Image Processing, Machine Learning, and Mathematics.

Dhanashree Keshao Parate is pursuing her Bachelors of Engineering Degree from MAEEER'S MIT College of Engineering, Pune. Her area of interest includes Image Processing, Machine Learning.

Chetan Bhairu Jawale is pursuing his Bachelor of Engineering Degree from MAEEER'S MIT College of Engineering, Pune. His area of interest includes Image Processing, Machine Learning.

Akshay Vyankat Yewate is pursuing his Bachelor of Engineering Degree from MAEEER'S MIT College of Engineering, Pune. His area of interest includes Image Processing, Machine Learning.

Dr. Netra Lokhande, School of Electrical Engineering, MIT World Peace University, Kothrud, Pune, India.
Research and Academic Experience: 22 years.
Research Area: Image Processing, Power Systems, Power Electronics.
Number of Published papers: 32