Dental Contour Matching By various Algorithms For Human identification

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Abstract—*Dental biometrics is used to recognize persons in the forensic domain. we presented an automatic dental image segmentation using various algorithms and presented graphs using histogram in mathematical morphology. This work presents an automatic method for matching dental radiographs. In this we take human teeth radiograph of perfect matching is derived by comparing abstracted data in tabular form. All the derived data are compared by using Thresholding & more matching. Samples are to be consider as perfect data & come to optimized result for human identification*

Index Terms— input image(query image), reference images(general images), canny, thinning, isef

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I. INTRODUCTION

Edge detection is a basic operation in image processing, it refers to the process identifying and locating sharp discontinuities in an image, the discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. It is a very important first step in many algorithms used for segmentation, tracking and object recognition [1]. There are an extremely large number of edge detection operators available, each designed to be sensitive to edges, typically it reduces the memory size and the computation cost[2] the edge detection algorithms are implemented using software. In this paper we use canny algorithm to use edge detection. And also get much more information for the human identification by using dental radio graph. When any road accident or any other thing which happen in real time. So any how any teeth of the which happen in real time. So here we using teeth contour comparision with query image(input image) & general images (reference images). Comparision is made by different thinning factors.

In this paper we are taking e1 image as input (query image) and this image match with other reference(general images).here e1x, e1xx images are with noise and with more noisy image respectively.

II. CANNY EDGE DETECTION

We can derive the optimal edge operation to find step edges in the presence of white noise, where "optimal" means

- Low error rate of detection
  Well match human perception results
- Good localization of edges
  The distance between actual edges in an image and the edges found by a computational algorithm should be minimized
- Single response
  The algorithm should not return multiple edges pixels when only a single one exists.

Canny algorithm was made by J Canny in 1986.
In the algorithm is shown in the figure in this the first step is image smoothing this is use for noise removing from the image. There is low pass filter is there. Then next is gradient filter is there. The equation for

one dimension filter is $G(x) = e^{-x^2/2\sigma^2}$

two dimension filter is $G(x) = e^{-(x^2+y^2/2\sigma^2)}$

in this the Gaussian curve is shown in the figure. In this the curve line is circle.

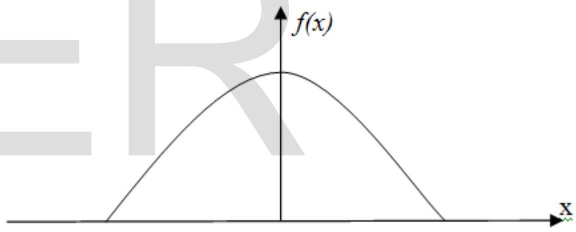

Fig.1 Gaussian curve

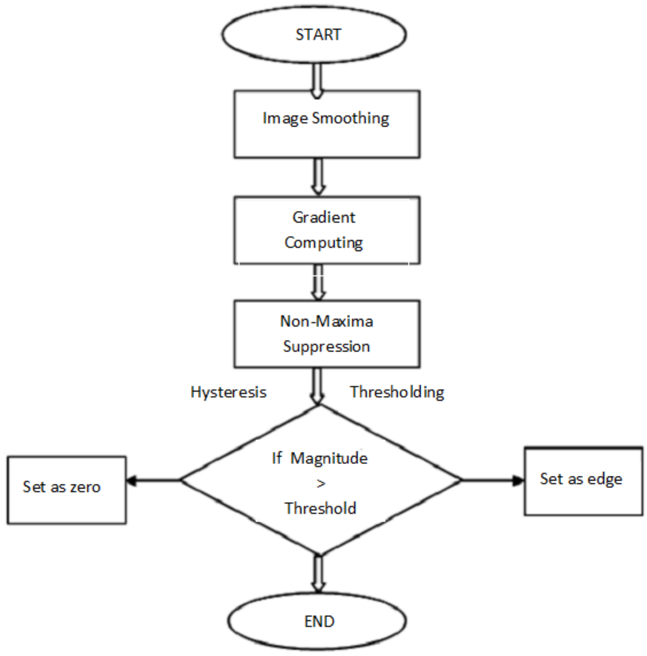

Fig.2 flow chart of canny edge detection

Issue of canny edge detection

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- **ERROR RATE:** The edge detector should respond only to edges and should find all of them, no edges should be missed.
- **LOCALIZATION**: The distance between the edge pixels as found by the edge detector and the actual edge should be as small as possible.
- **RESPONSE**: The edge detector should not identify multiple edge pixels where only a single edge exists.

To remove the issue of canny edge detector introduce ISEF ALGORITHM for edge detection.

ISEF ALGORITHM

The edge can be detected by any of template based edge detector but Shen-Castan Infinite symmetric exponential filter based edge detector is an optimal edge detector like Canny edge detector which gives optimal filtered image. Shen and Castan agree with Canny about the general form of the edge detector: a convolution with a smoothing kernel followed by a search for edge pixels. However their analysis yields a different function to optimize namely, they suggest minimizing (in one dimension):

$$c^2N = \frac{4\int_0^{\infty} f^2(x)dx \times \int_0^{\infty} f'^2(x)dx}{f^4(0)}$$

That is ISEF, the function that minimizes CN is the optimal smoothing filter for an edge detector. The optimal filter function they came up with is the infinite symmetric exponential filter (ISEF). In one dimension the ISEF is:

$$f(x) = \frac{p}{2} e^{-p|x|}$$

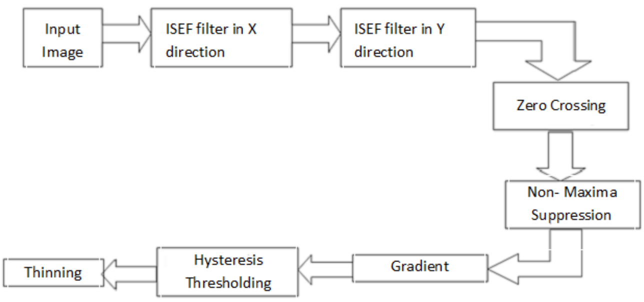

Fig.3 Flow chart of isef edge detection

First the whole image will be filtered by the recursive ISEF filter in X direction and in Y direction, which can be implement by using equations as written below.

Recursion in x direction:

$$y_1[i,j] = \frac{(1-b)}{(1+b)} I[i,j] b y_1[i,j-1]$$
$$j = 1.....N,\ i = 1...M$$

$$y_2[i,j] = b\frac{(1-b)}{(1+b)} I[i,j] + b y_1[i,j+1]$$
$$j = 1.....N,\ i = 1...M$$

$$y[i,j] = y_1[i,j] + y_2[i,j+1]$$

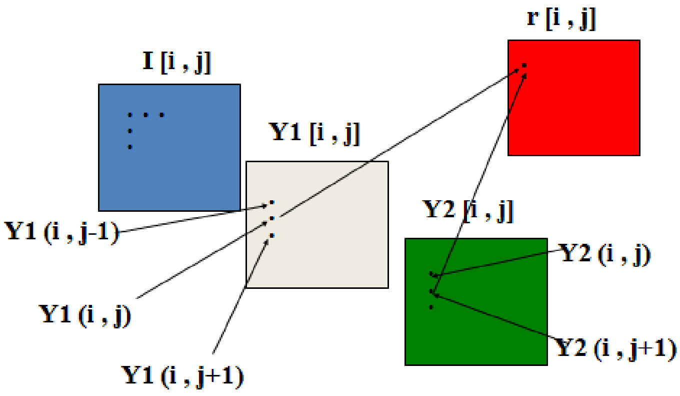

Fig 4. Recursive filter in X direction

Recursion in y direction:

$$y_1[i,j] = \frac{(1-b)}{(1+b)} I[i,j] + b y_1[i-1,j]$$
$$j = 1.....N,\ i = 1...M$$

$$y_2[i,j] = b\frac{(1-b)}{(1+b)} I[i,j] + b y_1[i+1,j]$$
$$j = 1.....N,\ i = 1...M$$

$$y[i,j] = y_1[i,j] + y_2[i+1,j]$$

b=Thinning Factor (0<b<1)

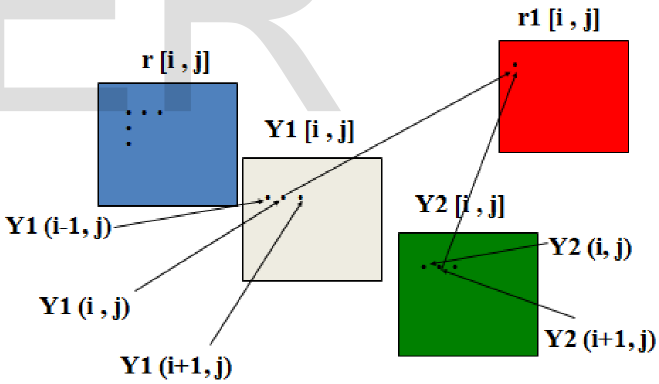

Fig.5 Recursive filter in Y direction

Image Gradient

The tool of choice for finding edge strength and direction at location(x,y)of an image, f,is the gradient, denoted by ∇f, and define as the vector.

$$\nabla f \equiv \text{grad}(f) \equiv \begin{bmatrix} g_x \\ g_y \end{bmatrix}$$

Measure with respect to x-axis. The edge magnitude is the magnitude of the gradient and the edge direction Φ is rotated with respect to the gradient direction Ψ by -90°. The gradient direction gives the direction of the maximum growth of function.

Gaussian filter

- Gaussian filter for one dimension:

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$$f(x) = \frac{p}{2} e^{-p|x|}$$

- Gaussian filter for two dimension:

$$f(x,y) = ae^{-p(|x|+|y|)}$$

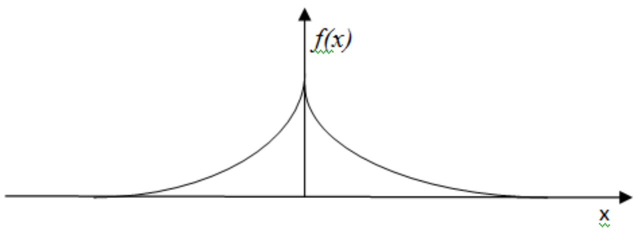


Fig. 6 Gaussian curve

III. IMPLIMENTATION

In this paper we are implement the image by change its thresholding point. We use thresholding point is 0.1, 0.2, 0.3, 0.4 and show what is change accure in this in input image and reference images and get priority for this matching here we put small idea for this. We shown below:

First we applied thresholding point = 0.4

Input image

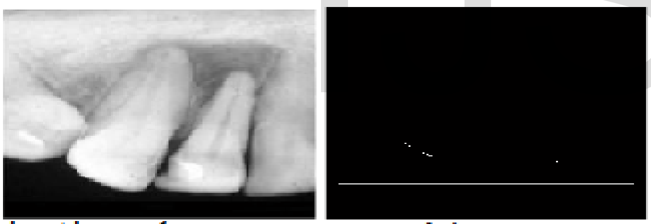


Fig.7: query image e1, canny operated e1[8]

Reference images(general images)

Fig 8: e1x with noise,e1xx with more noise,e1xxx full noise [8]

Fig 9: i1,i2,i3[8]

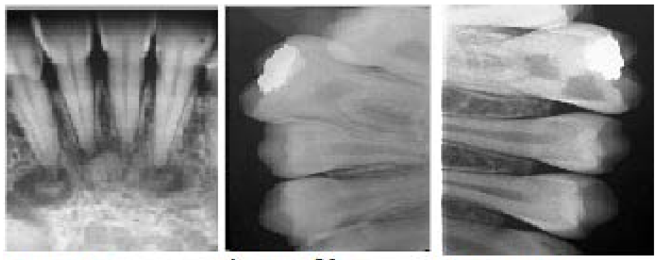


Fig 10: 2,p83,p84.[8]

In this reference images the image e1x, e1xx, e1xxx is the defected input image. So it is image as same person. Other images i1, i2, i3, 2, p83, p84 all the images are reference images.

Then we apply canny algorithm on the reference images. It is shown in figure.

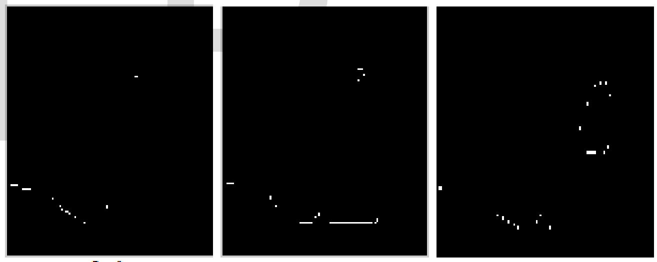


Fig 11: e1x,e1xx,e1xxx

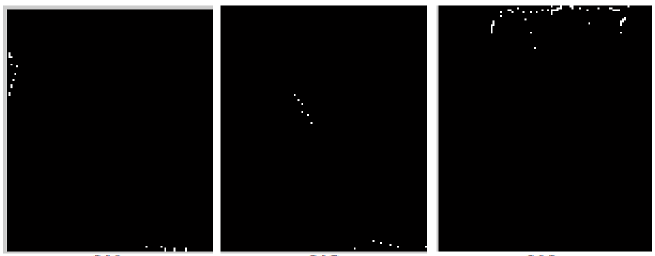


Fig 12: i1,i2,i3

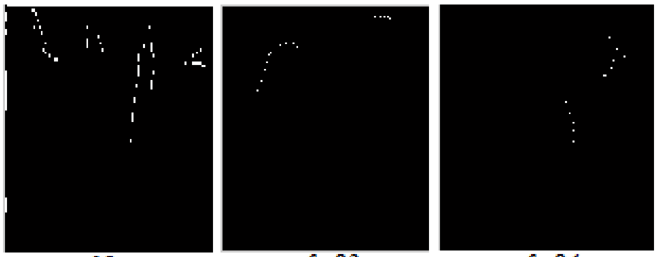


Fig.13: 2,p83,p84

Then we compare input canny image and reference canny image.

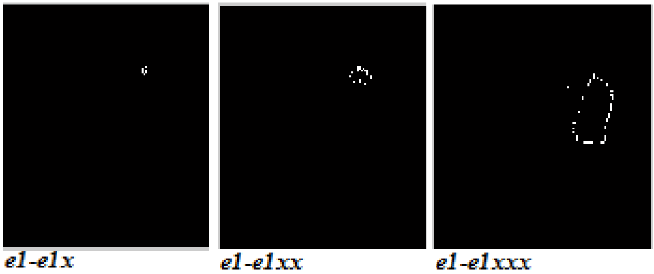


Fig 14: e1-e1x,e1-e1xx,e1-e1xxx

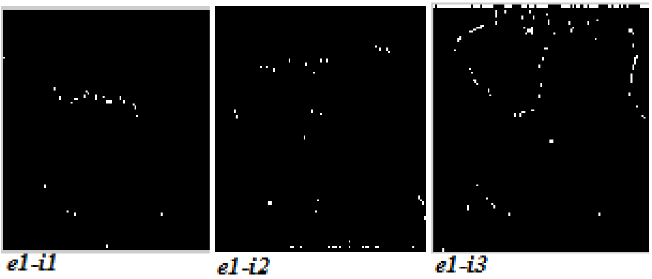


Fig 15: e1-i1,e1-i2,e1-i3

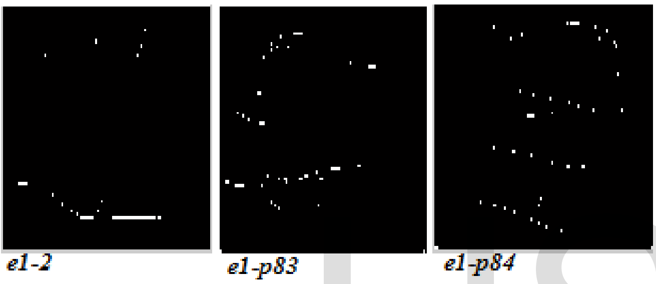


Fig. 16: e1-2,e1-p83,e1-p84

Table 1: Tthresholding point 0.4

	Maximum pixel	matching	mismatching
e1-e1x	348135	348111	24
e1-e1xx	348086	348013	73
e1-e1xxx	347749	347339	422
e1-i1	346401	344643	1758
e1-i2	346048	343937	2111
e1-i3	345318	342477	2841
e1-2	344979	341799	3180
e1-p83	345614	343069	2545
e1-p84	344787	341415	3372

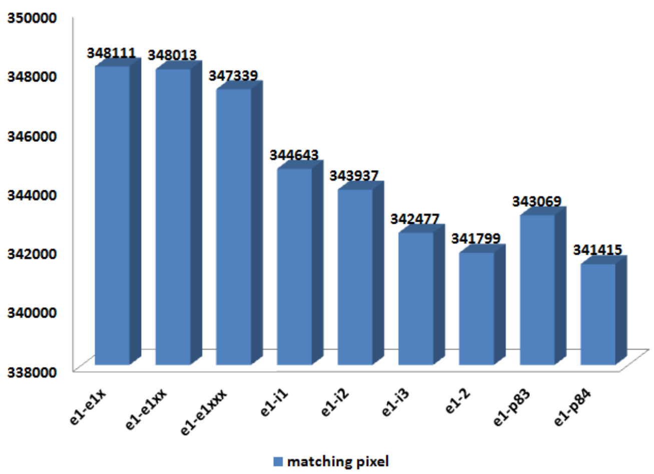


Fig. 17 Chart for theresholding point 0.4

Apply ISEF algorithm to the figure.

Fig 18: e1x,e1xx,e1xxx

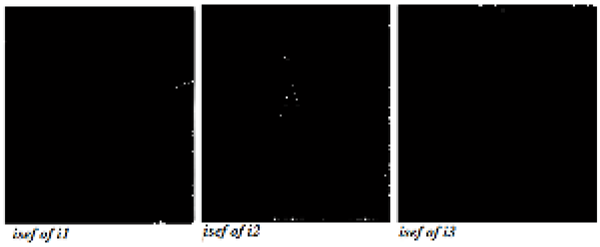


Fig 19: e1-i1,e1-i2,e1-i3

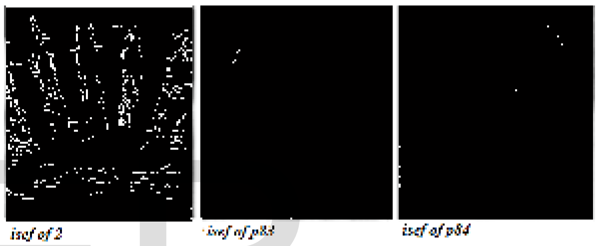
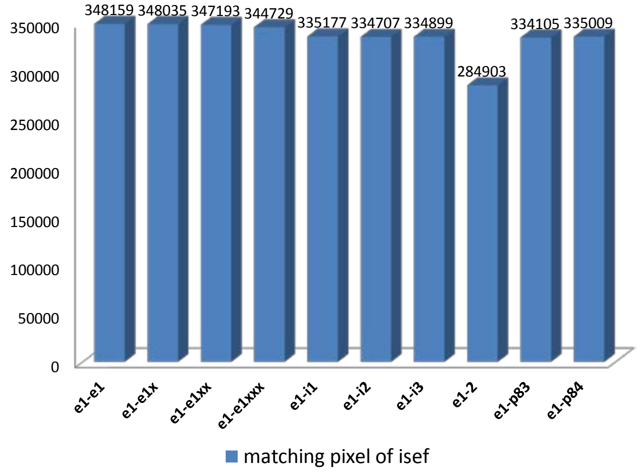


Fig.20: 2,p83,p84

Table 2 matching and mis-matching pixel in isef

Fig.	maximum	matching	Mis matching	percentage
e1-e1	348159	348159	0	100
e1-e1x	348097	348035	63	99.9822
e1-e1xx	347676	347193	483	99.8611
e1-e1xxx	346444	344729	1715	99.5050
e1-i1	341668	335177	6491	98.1002
e1-i2	341433	334707	6726	98.0301
e1-i3	341529	334899	6630	98.0587
e1-2	316531	284903	31628	90.0079
e1-p83	341132	334105	7027	97.9401
e1-p84	341584	335009	6575	98.0751



In this we compare whole image with matching pixels. So, we get matching percentage which is > 98% so , from this result we can not identified the human. To remove this issue we use only edge pixels and compare with other image edges pixels. So, we get this type of result.

Table 3 Canny result

Fig.	Original image edge	Reference image edge	Matching in %
e1-e1	759	759	100
e1-e1x	759	759	100
e1-e1xx	759	759	100
e1-e1xxx	759	555	73.1225
e1-i1	688	12	1.744
e1-i2	688	39	5.6686
e1-i3	826	0	0
e1-2	776	15	1.933
e1-p83	826	6	0.7264
e1-p84	826	427	51.6949

Table 4 isef result

Fig.	Original image edge	Reference image edge	Matching in %
e1-e1	11140	11140	100
e1-e1x	11140	11133	99.9372
e1-e1xx	11140	11126	99.8743
e1-e1xxx	11140	9685	86.939
e1-i1	40063	3414	8.5216
e1-i2	40063	2760	6.8891
e1-i3	38741	3556	9.1789
e1-2	2448	1365	55.7598
e1-p83	38741	2733	7.0545
e1-p84	38741	4973	12.8365

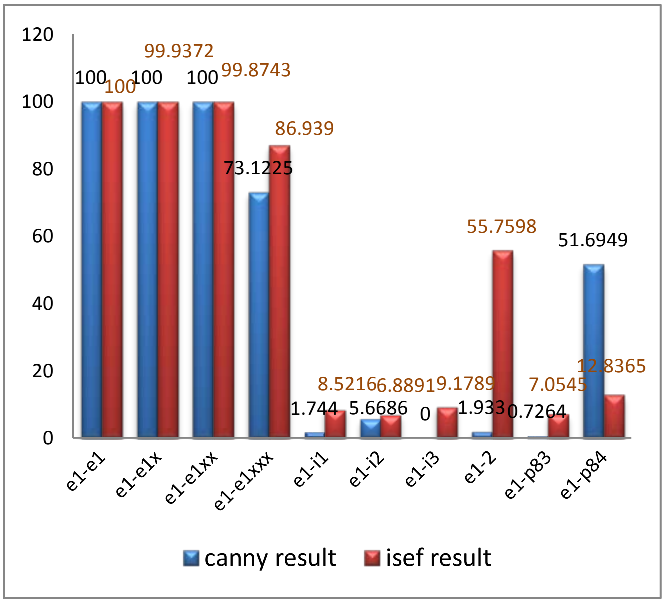


Fig. 21 canny and isef result for human identification

IV. CONCLUSION

We can conclude that the isef result is more better then canny result. Because the imae e1x,e1xx and e1xxx are distorted images from e1 so some distorted are not identify in canny algorithm but it identify in isef algorithm

And also from last chart we conclude that when 85% matching it's same person image and different person image match only 55% or less than 55%.

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