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Criminal Identification Based on Androgenic Hair Pattern Using KNN-Clustering Method

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***Abstract*—**This paper is implemented in order to identify the criminals in forensics based on the androgenic hair pattern of the criminal particularly in Low-resolution images. The Proposed paper is more dependable than the existing forensic techniques to identify criminals. The paper is implemented in five stages; in the first stage the input images and the database images are obtained after which the database images are trained through the algorithm to get the trained images. In the second stage pre-processing of the images is done in order to convert the image to grey scale and remove noise using thresholding method. The Third stage the image is passed through a Gabor filter to detect the edges in the image, this is followed by the Fourth phase where KNN clustering method is used to obtain the region of interest followed by the application of the bilateral filter in order to enhance the image. In the final stage the indifferent value calculated from the input image is matched with all the indifferent values of the trained images to identify the criminal.

Keywords*—Androgenic, Gabor filter, KNN clustering,Thresholding.*

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I. INTRODUCTION

Criminals these days are identified based on their face, finger prints, blood features, tattoos and blood vessel pattern but in all the above cases if the obtained image does not contain a proper view of the particular feature which is being used to identify the criminal then the criminal remains unidentified, [6] such cases include culprits in Pornography, Terrorists, gunmen in masks and other cases where only the androgenic part of the criminal is shown. Some statistics about child sexual offenses show that the U.S. Customs Service estimated that around 100,000 websites involve with child pornography. [6]From 2002 to 2008 in Canada alone, approximately 30,000 child pornography cases were reported .The U.S. Bureau of Justice Statistics concluded that the low prosecution rate of child sex exploitation offenders was mainly due to inadmissible or weak evidence. Though the U.S. Bureau of Justice Statistics defined neither inadmissible evidence nor weak evidence clearly, our forensic partners in two countries showed many child pornographic images and videos, which have only non-facial body sites of pedophiles and victims to the last author. In addition to child sexual offenders, terrorists also make use of this identification difficulty. It is worth mentioning that tattoos are prohibited in extreme Islamic terrorist groups. [3]Once they wear face masks, there is currently no way to identify them. Numerous masked terrorist images are available on the Internet some masked terrorists even accept interviews from media.[2] Recent Medical developments have shown that every human being has a particular androgenic hair pattern and remains same after reaching puberty. The aim of our paper is to identify the criminal based on the androgenic hair pattern particularly in low resolution images. The process of identifying the criminal is improvised when this method is used as it is more efficient than other forensic method. Particular methods used in this paper such as the use of Gabor Filter, KNN-clustering method and bilateral filter solve the problems involving different background of the trained image and the input image and also reduces the processing time with more noise filtering capability. Real time images which are obtained in the crime scene have large quantities of noise and have very less resolution which make it difficult of the investigating team to process the image using primitive techniques, such constraints can be resolved using histogram thresholding, KNN-clustering and bilateral filter combined in one process.

1. Existing System

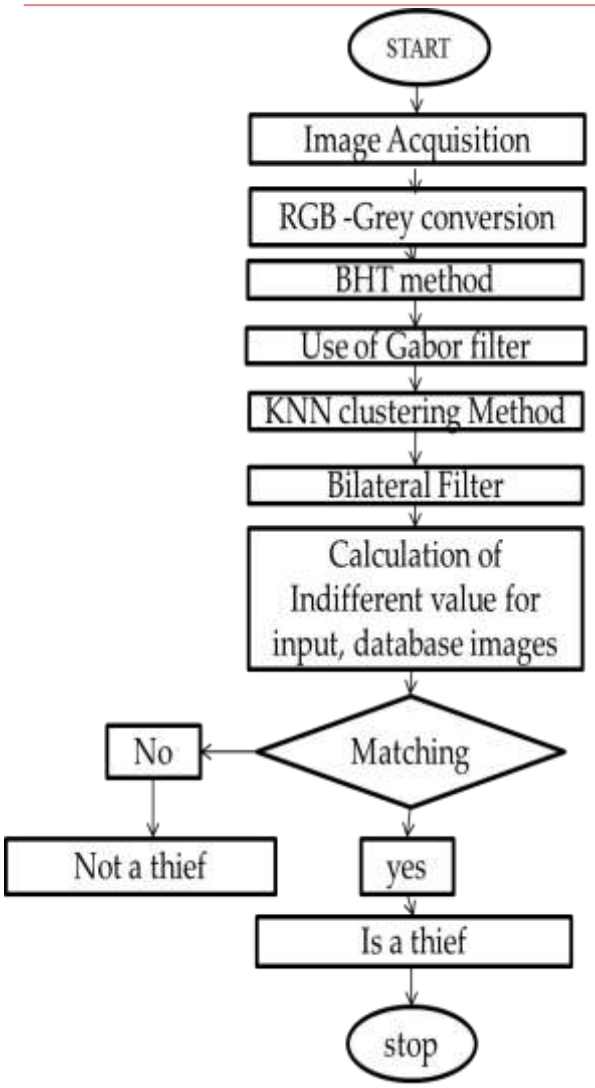
The Existing system involves the use of the combination of Otsu thresholding method in order to remove the noise in the image followed by the use of Gabor Orientation Histograms on a Dynamic Grid System[1], where the output of the [4] Gabor filter is given to the grid system which uses the weights of each pixel to develop a histogram representation of the image, [7] then the histogram of the input image and the histogram of the database images are compared to get the output, But the efficiency of the algorithm is less than the proposed algorithm as the noise filtering capability is better in the proposed system than in the existing systems.

2. Proposed System

The Proposed system uses standard image acquisition techniques and pre-processing steps where the colour image is converted to grey scale and then balanced histogram thresholding method is used to remove the unwanted noise levels in the image. The pre-processed image is then given to the Gabor filter for edge detection and detection of the hair pores on the skin, for image segmentation we use KNN clustering method to obtain the clusters of the region of interest and followed by the use of Bilateral filter to enhance the image, this combination of KNN clustering and bilateral filter is more efficient and accurate than any other existing systems. The final stage involves the matching of the indifferent value of the output of the input image to the database images. All the above steps will be represented in a GUI (graphical user interface) to make the use simpler and the output attractive enough.

Algorithm

- **Step1**: The database images and the input images are acquired.
- **Step2**: The colour image is converted to grey-scale image.
- **Step3**: The grey-scale image is normalized using BHT.
- **Step4**: The BHT image is given to Gabor filter.
- **Step5**: The Gabor filter output is then given to the KNN clustering
- **Step6**: Bilateral Filter is applied.
- **Step7**: Indifferent Mean value is calculated.
- **Step8**: The mean value of the input image and the database image is compared and output is given.



II. WORKING DETAILS OF THE SYSTEM

The Real time image of the criminal if taken using any camera then the color image is given to the system, after which the algorithm is applied to the image and using the output of the process and the trained images of the database initially acquired the paper concludes weather the person is authorized or un-authorized. This process is made even simpler and attractive for the consumer.

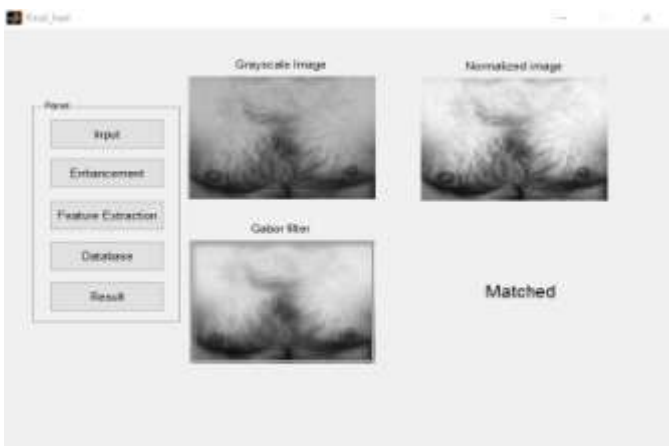


Fig-1 Graphical User Interface (GUI)

III. DATABASE IMAGES

IV. SOFTWARE DESIGN

The Software Design of the paper is divided into 5 Stages-

1. Image Acquisition

Image Acquisition is a process in which the input image (Fig.1) and the image in the data base are acquired so that the input image is processed and then compared with the database image. Therefore the database images are passed through the algorithm to get the trained images as output and then the indifferent value is calculated to match with that of the output, the number of database images can be of any number during the matching all the database images will be scanned by the algorithm.

Fig.2 Input Image

2. Pre-processing

The pre-processing of the images involve two processes where the image is first converted is converted from RGB2grey format because the RGB image is in the hexadecimal format whereas the greyscale image is in the binary format which is easy to process which is shown in the figure below then the balanced histogram equalization (BHT) is used to normalize the image in which the image pixel density is normalized to a particular value in this case the thresholding value is 0.7 the pre-processed image is then given to the image enhancement step.

Fig 3 Gray scale image

Fig-4 Normalized Image

3. Image Enhancement

Image Enhancement is done in this paper using the Gabor Filter in which the edges of the image are detected and in case of our paper the edges of the hair pores are detected. Frequency and orientation representations of Gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. The output of the Gabor filter is shown in figure 4 where the hair pores or the edge detection process takes place.

Fig-5

4. Image Segmentation

Image Segmentation in this paper takes place with the help of KNN-clustering, in which the pixels of same weight are separated or clustered together so that the region of interest is detected in the form of three clusters, the first cluster represents the unwanted portion and the background, the second represents the area where the androgenic hair pores on the skin are present and the third cluster represents the whole portion in the image which is the leg, hand or chest etc.

Fig-6 KNN-Clustering Method

5. Matching

Matching is a process in which the output image of the algorithm is matched with the trained image and the details about the authorization of that person is given in a GUI. The matching output figure is given in the figures below.

Fig-7 Dialog Box after scanning the database images

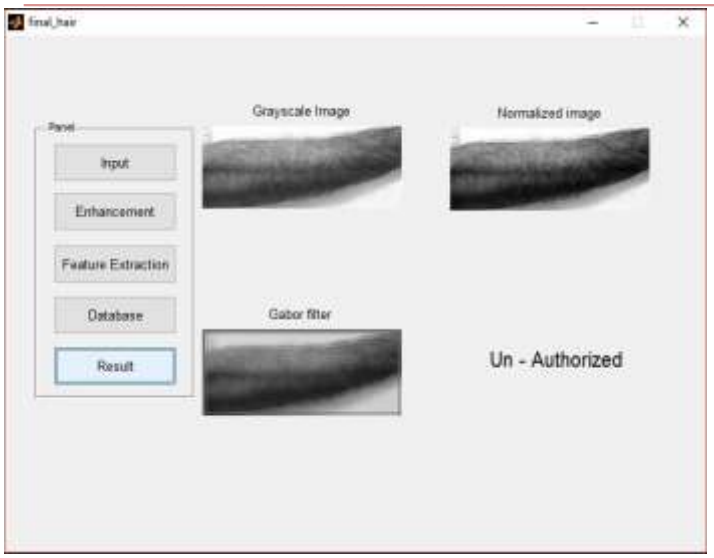


Fig-8 Final Output

Abbreviations and Acronyms

KNN - Micro-Electro-Mechanical-System
BHT - Balanced histogram thresholding
GUI - Graphical User Interface

V. CONCLUSION

This paper proposes a new way to identify criminals based on their androgenic hair pattern. The use of Gabor filter for image enhancement, KNN-clustering Image Segmentation and the Bilateral Filter for increasing the brightness and Reducing Noise makes the process to work for Low-Resolution Input Images too. The proposed method is better than existing systems in forensics such as Face Recognition, Recognition using Blood Vessel Patter, Tattoo's, skin Marks because such features in a criminal can be covered or altered but the androgenic hair pattern is unique for every human being and cannot be altered.

VI. FUTURE SCOPE

This Paper in the future has scope of improvements in the area of filtering higher quantity of noise in the image and increasing the efficiency of the algorithm and there is a scope of performing other forensic methods such as Facial recognition, Blood vessel patter, skin marks etc together with the identification using low-resolution androgenic hair pattern algorithm in one process to increase the accuracy of authorization of the criminal.

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