

Conversion of Commercial Shoe Print to Reference and Recovery of Images

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Abstract

In every criminal investigation it is necessary to determine and prove that a particular person or persons may or may not have been present at the scene of a crime. For this reasons, the collection, preservation and analysis of physical evidence has become more frequent in the law enforcement community[5].

Since criminals must enter and exit crime scene areas, it should therefore, be reasonably assumed that they may leave traces of their own footwear. Criminals have become smarter and wiser by beginning to frequently wear protection over their hands to avoid leaving fingerprints, and masks over their faces to avoid eyewitness identification. However, they are rarely aware of, or make little attempt to conceal footwear. During an every day routine it is normal to see individual wearing gloves, but it's not so over their shoes. In shoe print biometrics one of the important tasks is the preparation of reference data from the available sources. But to use these images for feature extraction and recovery from data bases, it requires certain steps like conversion to gray scale, image enhancement before storage of reference image and image restoration. In this paper we have taken an example shoe image from a commercial web site and converted it to gray scale to reduce the size of storage and then enhanced the image using histogram technique and image is ready for analysis by various techniques. The simulation results are included to validate the method.

Keywords: Image processing, shoe mark, histogram, constrained least squares method, segmentation.

1. INTRODUCTION

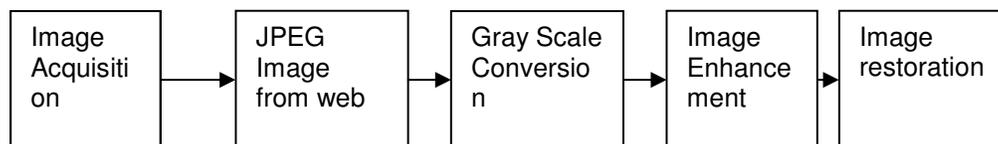
It is generally understood that marks left by a criminal's footwear at a crime scene will be helpful in the subsequent investigation of the crime. For example, shoeprints can be useful to likely link crime scenes that have been committed by the same person. They can also be used to target the most prolific criminals by allowing officers to be alerted to watch out for particular shoe marks. Also, shoeprints can provide useful intelligence during interviews so that other crimes can be brought to a criminal. Finally, they can provide evidence of a crime, if a shoeprint and suspect's shoe match[4][5][7].

Sole Mate, Foster & Freeman's database of shoeprints, proved its worth recently during the investigation of a murder of a woman in the kitchen of her Coventry home in U.K. Officers from West Midlands police station was confirmed by this database that the suspect's shoeprint has been produced by a Mountain Ridge™ shoe, unique to JJB Sports, a UK nationwide shoe retailer, and that there were two models using that particular sole, and this footwear was first available during the summer of 2002[5][7][8]. With this information, police officers were able to locate the store in which the footwear was purchased and to trace the shop's copy of the actual receipt issued to the suspect, later confirmed when an empty shoe box was found at the suspect's home.

Unfortunately, when crime scene is improperly secured or is disorganized, the search of the scene often results in this type of impression evidence being overlooked or destroyed. When this type of physical evidence is properly collected and preserved by the crime scene investigator, followed up by a detailed examination by a footwear expert, it can become an important part in proving or disproving a suspect was at the crime scene.

In shoe print biometrics, the major task is the preparation of reference data from the available sources. Normally reference shoe prints of branded commercial shoes are available in the web. But to use these images for feature extraction and recovery from data bases requires certain steps like conversion to gray scale, image enhancement before storage of reference image and image restoration[2][9]. So that many feature enhancement techniques can be used to index, identify the candidate shoe print. A shoe image from a commercial web site is taken and converted it to gray scale to reduce the size of storage, then enhanced the image using histogram technique[2]. Now image is ready for feature extraction by various techniques. The enhanced image is restored back using Wiener filter and constrained least square restoration methods so that it can be identified from the reference storage.

Section 2 gives the Block diagram. Section 3 deals with conversion from jpeg to bmp and gray scale conversion, section 4 with image enhancement using histogram method, section 5 with Image Restoration using Wiener filter and constrained least square restoration methods[1][2]. Relevant results are provided to illustrate the working of the algorithm. The block diagram is as shown below:



The raw jpg image is converted to bmp format using image converter plus then gray scale conversion is carried out using MATLAB routines. Then image enhancement and restoration are carried out.

2. IMAGE ACQUISITION:

Footwear evidence can be found in two forms, impressions and prints[3][5][7]. The impression is normally described as three-dimensional, such as an impression in mud or a soft material; and the print is described as a print made on a solid surface by dust, powder, or a similar medium.

Footwear evidence, as well as latent fingerprint evidence, is classified into three categories of crime scene prints:

1. Visible prints
2. Plastic prints
3. Latent prints

The Visible Prints:

A visible print occurs when the footwear steps into a foreign substance and is contaminated by it, and then comes in contact with a clean surface and is pressed onto that surface. This print can be visibly seen by the naked eye without any other aids. The most common visible prints are prints left on a contrasting surface, such as kitchen floor, etc..

A variety of substances, such as blood, grease, oil or water will leave contrasting prints. This type of print must be photographed, prior to any other methods being used. An electrostatic dust lifter can also be utilized when the evidence is in dust.

The Plastic Prints:

Plastic prints are impressions that occur when the footwear steps into a soft surface, such as deep mud, snow, wet sand, or dirt creating a three-dimensional impression. This type of impressions should be photographed and then cast. These types of impressions are three-dimensional because they allow the examiner to see length, width, and depth[4,6].

The Latent Prints:

Latent prints are the most overlooked print that are generally found on smooth surfaces. They can be developed by the same way as latent fingerprints. This type of print needs a variety of powders, chemicals and even forensic light sources to make it visible in order to properly be collected. In most cases these prints should also be photographed prior to any recovery process.

However one of the sophisticated methods has been chosen for the investigation and is taken for the comparison with the known set of patterns that are collected from 50 shoes. These prints are scanned into images at a resolution of standard set of *dpi* values.

The commercial database gives shoe prints in JPEG/JPG format and to run our program we need it in *.bmp format and hence use image converter plus to convert from jpg to bmp.

The image used for the current study is shown in fig 1



FIGURE 1: Image considered for study

The gray scale conversion is carried out using the MATLAB routines *rgb2ind* and *ind2gra* [1][10]. The output of such a conversion is shown in figure 2



FIGURE 2: Gray scale image under study

3. IMAGE ENHANCEMENT:

Since various conversions are done on the image to carry out meaningful feature extraction it is essential we do image enhancement. In this study we used the histogram technique to carry out the image enhancement[2,6].

The following are the features of the histogram algorithm:

- x0: Converted JPEG input image into *.bmp as a gray level image
- y0: histogram equalized image, each pixel has 8 bits
- L: [0 to L-1] is the number of gray levels. Default L = 256

Algorithm:

1. Compute the histogram, and then equalized histogram of x0 which is the input image
2. Point-wise gray-level transform according to equalization

The following MATLAB routines were used *hist*, *round*, *reshape* in this algorithm

A MATLAB program was written and the output of this stage is given in figure 3 and figure 4.

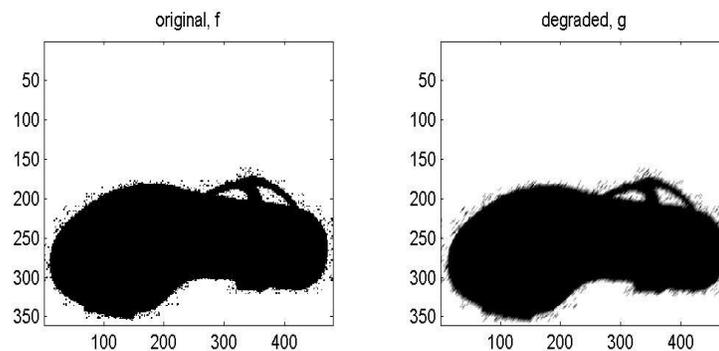


FIGURE 3 Enhanced Images

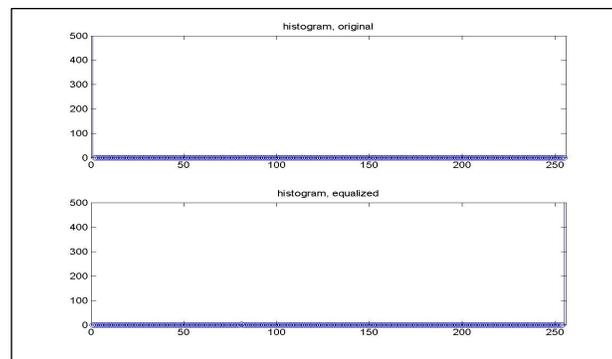


FIGURE 4: Histogram values

4. IMAGE RESTORATION:

We carried out the image restoration to understand whether the enhanced signal can be retrieved back from the data base also for carrying out meaningful Feature extraction method. We applied Wiener and Constrained Least Squares method.

Algorithm:

- Step 1. Load the image enhanced image I
- Step 2. Create $-1*(x+y)$ mask
- Step 3. Find FFT of I

- Step 4. Note that fft does not divide the result by mn
- Step 5. Create blurring mask
- Step 6. Generate Gaussian noise with PSNR = 30db, 60db,etc as per need
- Step 7. Fourier transform of the noiseless blurred image is obtained
- Step 8. Calculate RMS error per pixel
- Step 9. Calculate FFT of blurred+ noise image
- Step 10. Do Inverse filtering
- Step 11. Apply Wiener filtering
- Step 12. compare both filtered image we can repeat with different values PSNR values

MATLAB code was written and comparisons of the all stages of images are shown in figure 5. *Motionblur* and *fft2* are two important MATLAB functions used in this calculation. PSNR of 60 db is used and restored images were obtained with different iterations.

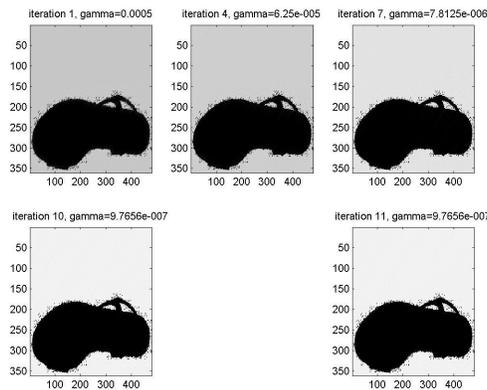


FIGURE 5: Comparison of all stages

5. CONCLUSION:

Thus we are able to demonstrate the successful preparation of raw images of the shoe print available in commercial databases. In these days of security threat it is an important activity so that security requirements of the country can be beefed up through preparation of such databases of shoe prints and these papers demonstrate one such method of preparation. The results show that our method is one of the candidates for such a database preparation along with we can use many feature extraction indexing techniques to store and retrieve from the database the identified shoe print.

6. REFERENCES:

- [1] Raefel C.Gonzalez, Richard E. Woods, Steve L. Eddins, "*Digital Image Processing using MATLAB*", 2nd Edition, May 2005.
- [2] Anil .K.Jain, "*Fundamentals of Image Processing*", Prentice Hall, 2004.
- [3] A. Alexander, A.Bouridane, Crookes, D. "*Automatic Classification and Recognition of Shoeprints*", Proc. of Seventh Int'l Conf. on (Conf. Publ. No. 465) Image Processing and Its Applications, vol. 2, 1999.
- [4] W.Ashley, "*What Shoe Was That? The User Computerized Image Database to Assist Identification*", "Forensic science Int'l, vol.82, 1996
- [5] W.Bodziac."Footwear Impression Evidence: Detection, Recovery and Examination". CRC Press, 2000.

- [6] N.Otsu, "*A threshold selection method from gray level Histogram*", IEEE Transactions on Systems, Man and Cybernetics,9:62-66,1979.
- [7] Hilderbrand, Dwayne. S , "*Footwear, The Missed Evidence*" Staggs Publishing, 1999
- [8] "*Imaging for Forensic And Security*", Springer U.S Publisher, ISBN 978-0-387-09531(print)978-0-387-09532-5(online), www.springerlink.com.
- [9] Chandra Sekhar Panda & Prof. (Dr.) Srikanta Patnaik, "*Filtering Corrupted Image and Edge Detection in Restored Grayscale Image Using Derivative Filters*", "International Journal of Image Processing, (IJIP) Volume (3) : Issue (3), 2009
- [10] W.K.Pratt, "*Digital Image Processing*", John Wiley and Sons, 1992
- [11] Ernest.L. Hall, "*Computer Image Processing and Recognition*", Academic Press, 1979