A Survey on Techniques for Identification and Classification of Weapons based on the wound patterns in Forensic Perspective

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Abstract

The digitized forensic procedures have revolutionized many researchers to analyze the crime investigation and identify the weapons in homicidal cases. In this paper we present survey on various weapon recognition techniques contributed by many researchers in forensic department. It demonstrates an unmistakable straightforwardness between Computer Forensics and Digital Forensics and gives a brief portrayal about the characterization of Digital Forensics. It has likewise been portrayed that how the rises of different computerized legal models help advanced scientific specialists and inspectors in doing advanced criminology. Identification and classification are the techniques where object is identified based on its different morphological features and classification problem deals with associating a given input pattern with one of the distinct classes. Deciding on the method for identification and classification is often a difficult task because the quality of the results can be different for different input data.

Keywords: Classification, Forensic, Homicidal, Identification, Patterns, Wounds, Weapons.

1. INTRODUCTION

Forensic identification expertise encompasses fingerprint, handwriting, and firearms, and tool mark comparisons, all of which are used by crime laboratories to associate or dissociate a suspect with a crime. Shoe and tire prints also fall within this large pattern evidence domain. These examinations consist of comparing a known example with evidence collected at a crime scene or from a suspect. Bite mark analysis can be added to this category, although it is developed within the field of forensic dentistry as an adjunct of dental identification and is not conducted by crime laboratories. This literature provides adequate descriptions of injuries to victims, including defensive injuries, caused by knives and other sharp instruments. However, there appears to be a scarcity of information concerning the self-wounding injuries sustained by the attacker during the attack. In several instances, these injuries and the resulting physical evidence have proven of great consequence in the resolution of the case. A review of the example cases gives rise to several physical mechanisms described below whereby such wounding could, and likely does, occur. If one considers the reasons for such a scarcity of information about this type of injury to the perpetrator, several possibilities come to mind. First, most forensic articles describing wound patterns are written by medical examiners; they generally see only the wounds of the deceased victim, and not the surviving assailant. If anyone notes the wounds to the perpetrator, it probably will be the police investigator or emergency room personnel. Careful examination of a body frequently reveals the presence of well-known patterned injuries and non-traumatic impressions that prove to be extremely important in the reconstruction of a crime or accident. In addition, the more complex patterns of bite mark injuries studied by forensic deontologists have successfully led to the identification of perpetrators of vicious homicides. It is the purpose of this research to show how critical studies of an intricate blunt force injury pattern in a brutal murder led to the identification of the murder weapon. A variety of knives and other assorted implements were selected which would give a general range of the weapons frequently seen by forensic scientists in homicide and assault cases.
1.1 Developing technical procedures

Established procedures should guide the technical process of the examination of evidence. Procedures should be tested prior to their implementation to ensure that the results obtained are valid and independently reproducible. The steps in the development and validation of the procedures should be documented and include: Identifying the task or problem, proposing possible solutions, testing each solution on a known control sample, evaluating the results of the test and finalizing the procedure.

2. LITERATURE SURVEY

(Song Bo, 2012) has proposed a system that can automatically and accurately identify the region of a chronic wound and is capable of automatic image segmentation and wound region identification. Several commonly used segmentation methods are utilized with their parameters fine-tuned automatically to obtain a collection of candidate wound regions. Two different types of Artificial Neural Networks (ANNs), the Multi-Layer Perceptron (MLP) and the Radial Basis Function (RBF) with parameters determined by a cross-validation approach, are then applied with supervised learning in the prediction procedure for the wound identification, and their results are compared. (Hugar B.S. et al., 2012) have proposed work to determine specific patterns and distribution of defense injuries, this study was conducted on 121 homicidal deaths which showed defense injuries in 40 cases. The Image comparison technique is used in identifying the patterns on the wounds. (Hugar B.S. et al., 2012) have proposed work to determine specific patterns and distribution of defense injuries, this study was conducted on 121 homicidal deaths which showed defense injuries in 40 cases. The Image comparison technique is used in identifying the patterns on the wounds. (Gitto L., et. al., 2012) presented a peculiar case of homicide committed with a sharp instrument. The techniques used is post-mortem investigation, an unusual damage was found in the vicinity of the fatal wound to the neck, suggesting that the wound was inflicted with a great force, using a sharp object with a peculiar shape. A comparative study between the two weapons was performed in order to determine the compatibility with the abovementioned damaged. Consequently, these analyses led us to the identification of the murder weapon and the author of the crime. (Ying Bai and Dali Wang 2011) proposed this research to develop a universal model and system to effectively assess, evaluate and identify the optimal weapons from a large collection of available weapon systems that have multiple criteria based on a fuzzy multiple criteria decision making (FMCDM) model. A simple but effective weight estimation method is adopted in this paper to make this selection more objective and reliable. (Kaliszan M. et. al., 2011) presented an experiment with a knife seized as material evidence in a homicide case. A comparison of the morphological features of the stab wound of the abdomen found during XY’s autopsy and the morphological features of the wound of the abdomen resulting from the above experiment showed a similarity between their shapes and the location and size of the linear skin abrasions in the edges of both wounds.

(Suapang P., et. al., 2011), presented characteristic markings on the cartridge case and projectile of a fired bullet are created when it is fired. Different features within these marks can be distinguished, which in combination produce a “fingerprint” for a tool or a firearm. By analyzing features within such a set of tool or firearm fingerprints, it will be possible to identify not only the type and model of a tool or a firearm, but also each every individual tool or weapon as effectively as human fingerprint identification. A new analytic system based on Fast Fourier transform for identifying the specimens by the line-scan imaging technique is proposed in this paper. (Francisco Veredas et. al., 2010) have proposed a hybrid approach based on neural networks and Bayesian classifiers is used in the design of a computational system for automatic tissue identification in wound images. A mean shift procedure and a region-growing strategy are implemented for effective region segmentation. Color and texture features are extracted from these segmented regions. Finally, a Bayesian committee machine is formed by training a Bayesian classifier to combine the classifications of the neural networks. Specific heuristics based on the wound topology are designed to significantly improve the results of the classification.
3. CHALLENGES IN FORENSICS

Most of the image processing research techniques is concentrated on classifying the different print documents. Identification of printed document and photocopies is based on the techniques of Color image processing. Color image processing techniques used for identification of printing process, employed HSV color space. In this work, hue histogram is used to identify between the printed or photocopied document. Generally, the hue histograms are bi-modal and wider for photocopied documents, whereas it is uni-modal and narrower for printed document. Identification of inkjet print and laser print are done by using features of hue contrast and edge detected hue and saturation images. Inkjet print has large number of isolated dots near the strokes and it has no variation in contrast on opposite sides of the strokes, in an edge detected hue images. While laser print has less number of isolated dots, alternating low and high contrast in opposite sides of the stroke in edge detected hue images. Another distinguishing feature defined for identification of laser jet print is periodic variation in column wise intensity profile of edge detected saturation images. Generally, the printed document contains information both in form of pictures and printed text. The model must be based on existing theory for physical crime investigations, must be practical and follow the same steps that an actual investigation would take and must be general with respect to technology and not be constrained to current products and procedures, and it must be specific enough that general technology requirements for each phase can be developed. Characteristics found within a patterned injury to the skin are analyzed and the image of a suspected weapon superimposed over any potentially matching characteristics, in order to demonstrate the possible similarities or to highlight any discrepancies.

3.1 Image Acquisition and Preprocessing

Digital evidence, by its very nature, is fragile and can be altered, damaged, or destroyed by improper handling or examination. Examination is best conducted on a copy of the original evidence. The original evidence should be acquired in a manner that protects and preserves the integrity of the evidence. First step for weapon classification is image acquisition. Image acquisition includes taking image of the wounds present on the victim body with a digital camera at a proper distance without damaging to the area of interest. After image is obtained some pre-processing is needed. This stage includes grayscale conversion, image segmentation, binary conversion and image smoothing. The aim of image pre-processing is to improve image data so that it can suppress undesired distortions and enhances the image features that are relevant for further processing. Color image of wounds is converted to grayscale image. Variety of changes in atmosphere and season cause the color feature having low reliability. Thus it is better to work with grayscale image. Once image is converted to grayscale it is segmented from its background and then converted to binary. Using one of the edge detectors its contour is detected. Then certain morphological features are extracted from its contour image.

3.2 Feature Extraction

Selection of a right feature plays an important role in object tracking. Generally the features are chosen manually by the user depending on the application domain. In general, the most desirable property of visual feature is its uniqueness so that the objects can be easily distinguished in the feature space. Feature selection is closely related to the object representation. For example, color is used as feature for histogram- based appearance representation, while for contour based representation, object edges are usually used as features. Many tracking algorithms use a combination of these features. The common visual features are listed as below:
**Color:** The apparent color of an object is influenced primarily by two physical factors, first is a spectral power distribution of the illuminant and second is surface reflectance properties of the object. In image processing RGB (red, green, blue) color space is usually refer to represent the color.

**Edges:** Object boundaries usually generate strong changes in image intensities. Edge detection is used to identify these changes. An important property of edges is that they are less sensitive to illumination changes compared to color features. Algorithms that track the boundary of the object usually use edges as the representative feature. Because of its simplicity and accuracy, the most popular edge detection approach is the canny edge detector.

### 4. METHODOLOGY

From the available literature, it is observed that – with the aid of chemical reaction and some mechanical/electronic tools, forensic analysts were used to identify the murder weapon based on the wound. Hence there is huge scope in formulating computerized techniques for the following reasons:

I. Computer forensic is a science of acquiring, preserving, retrieving and presenting data that has been processed electronically and stored on computer media and according to Department Of Justice, computer forensic includes formalized and approved methodology to collect, analyze and present data in a court of law.

II. Computer forensic is needed due to the complex nature of electronic media. Traditional forensic science technique will not work in recovering and compiling computer based evidence. The nature of electronics evidence is such that it poses special challenges for its admissibility in court.

III. The purpose of the examination process is to extract and analyze digital evidence. Extraction refers to the recovery of data from its media. Analysis refers to the interpretation of the recovered data and putting it in a logical and useful format.

IV. Actions and observations should be documented throughout the forensic processing of evidence. This will conclude with the preparation of a written report of the findings.

To meet these challenges, it is imperative to follow proper forensic procedures. Proper forensic procedures and techniques go hand in hand with good forensic tools. Hence Image processing and pattern recognition techniques, will contribute significantly for the same. This work proposes a process model for digital investigations that meets the requirement of law procedures in identification and classification of weapons used in homicidal cases. The model must be based on existing theory for physical crime investigations, must be practical and follow the same steps that an actual investigation would take and must be general with respect to technology and not be constrained to current products and procedures, and it must be specific enough that general technology requirements for each phase can be developed. Characteristics found within a patterned injury to the skin are analyzed and the image of a suspected weapon superimposed over any potentially matching characteristics, in order to demonstrate the possible similarities or to highlight any discrepancies.

### CONCLUSION

Keeping in mind the end goal to be uncovered or acknowledged in the court, computerized proofs must be exact and precise and its respectability ought not be ruined by imprudence. The procedure of computerized legal sciences is to help the advanced criminological examination and specialists in reproducing the confirmations the relationship of advanced criminology needs to frame a rule for the quick advancement of advanced scientific methodology so proofs can be effortlessly illustrated, analyzed and prepared. Still there is a scope to examine and determine the weapons used in homicidal cases with respect to wound patterns in the world of digital technology.
REFERENCES


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