Chapter 21
Latent Fingerprint Enhancement Based on EDTV Model

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ABSTRACT

The chapter presents latent fingerprint enhancement technique for enforcement agencies to identify criminals. There are many challenges in the area of latent fingerprinting due to poor-quality images, which consist of unclear ridge structure and overlapping patterns with structure noise. Image enhancement is important to suppress several different noises for improving accuracy of ridge structure. The chapter presents a combination of edge directional total variation model, EDTV, and quality image enhancement with lost minutia re-construction, RMSE, for evaluation and performance in the proposed algorithm. The result shows the average of three different image categories which are extracted from the SD7 dataset, and the assessments are good, bad, and ugly, respectively. The result of RMSE before and after enhancement shows the performance ratio of the proposed method is better for latent fingerprint images compared to bad and ugly images while there is not much difference with performance of bad and ugly.

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INTRODUCTION

Fingerprint as one of Biometrics types is widely used in these days. It's one of the most frequently used biometrics to identify individuals and authenticate their identity. It has been used for the recognition for more than 100 years (Galbally et al., 2018). It's commonly categorized into three different categories as presented by (Jiangyang *et al*., 2013) which are rolled, plain and latent fingerprints. The process that obtained in each category is different from the rest. For instance, rolled is achieved by rolling the finger from one side to the other with the purpose of capturing all the ridge particulars. The plain fingerprint is accomplished by pressing the fingertip onto a flat surface. The last category, Latent fingerprints normally lifted from object surfaces that were touched by criminal in the crime scenes.

Biometric System Phases

The literature on biometric phases (Gupta *et al*, 2020) reported that biometric identification system contains two different fundamental phases. The first phase is enrolment while the second is recognition.

In the first phase, a sensor normally gathers the biometric data from which a set of features are extracted and kept in a database along with the individual's identity for instance name, identification number, and birthdates. In the second phase, the identity of the person is either confirmed (verification) or determined (identification). This is achieved by collecting the biometric data, extracting the same features and comparing them to the features stored in the database.

From this comparison, similarity score is produced to make a decision to whether the two sets of features came from the same person or not. The following figure 1 shows an overview of a biometric system phases.

The above figure 1 present an overview of a biometric system phases that consist enrolment and recognition. The process in each phase is clearly defined. Another study documented by (Sabhanayagam *et al*., 2018) demonstrate that all biometric systems comprises of three fundamental elements as per the followings: -

Enrollment: It is the process of gathering biometric samples from an individual. This person is known as the enrollee, and the succeeding generation of his/her template.

Templates: it can be defined as the data representing the enrollee's biometric.

Fingerprint is significant used method for identification systems which is a unique feature such as ridges and valleys where is ridge is a collection of minutiae points included core points as per discussed and mentioned on Menon, et al (2015) and within fingerprint classes as illustrated on figure 2 there are a common three structures which are Arch, Loop and Whorl

Structures Noise in Latent Fingerprint Images

According to (Paulino *et al*., 2013) the main difference between latent fingerprint images and rolled or plain fingerprints is the presence of structured noise in latent fingerprint images. We can categorize the structured noise that exists in latent fingerprints images into six main categories including arch, line, character, speckle, stain and others. The following figure 3 presents the six types of structured noise.

Based on the above figure 3 structured noise can be classified into six main categories as in the elaboration below: