Advanced Generation of Spoofs Artefacts into Synthetic Fingerprints

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Motivation

At present, fingerprints are the most widely used biometric feature for security in biometric systems

The weakest feature of a fingerprint is the high risk of forgery due to its leaving on many surfaces and relatively simple methods for the forgery production

The motivation for this work was to enable generation of realistically looking images of synthetic fingerprints with the artefacts of forgeries

Generated images can improve the development of testing algorithms for forgeries detection, or can be used in training of dactyloscopic experts who detect forgeries only based on their knowledge and experience

Approach

Artefacts of fingerprint forgeries were analyzed from the images in the databases provided by the research group STRaDe (Security Technology Research and Development)

Two artefacts were chosen for this work, **areas of papillary lines with lower clarity and** defect in material, specifically **crack**

Methods to generate those artefacts **were designed** and then **implemented** in C++ with the use of OpenCV graphical library, results were tested by **proven decrease in fingerprint quality and similarity score** before and after artefacts generation (in 9 datasets each containing 250 images of generated forgeries)

Generation of a graphic design of artefacts was realized as **a pseudo-random generation of graphical primitives** affected by the parameters of generated artefact

Lower Clarity

Occurs, for example, in a forgeries created from latex

In a forgery, these are areas in which there is a **thinner layer of material,** due to the **uneven distribution**

Artefact occurs during scanning, when the papillary lines in the thinner areas are captured with lower clarity
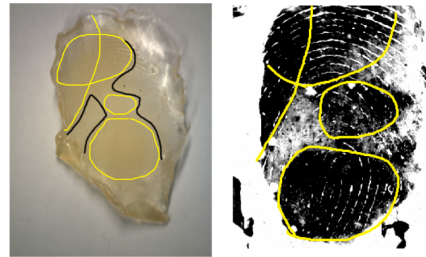
Crack

Occurs, for example, in a forgeries created from materials Cernit, Kato (polymer clays) or wax

There is a **different, typical crack in each of this materials**, due to it, **three types of crack** were specified and implemented in this work (named as *straight*, *zigzag* and *arcuate*)
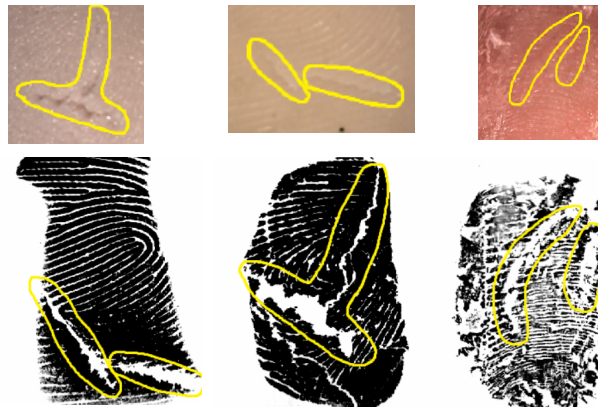
Results

Images below show the **comparison between images from the databases** with forgeries containing given forgeries artefact (1st and 3rd column) **and images generated in the generator** created in this work (2nd and 4th column)

The generator allows to generate each artefact in two modes, **random generation and user conditional generation**
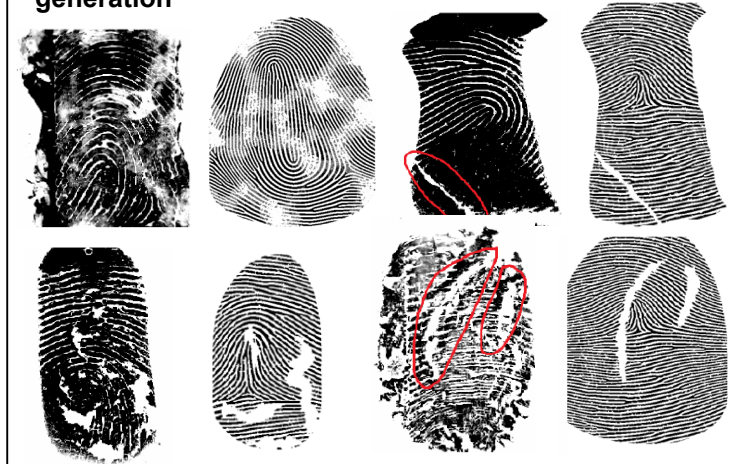
- user conditional generation was used to create these images
- this work was created as an extension of a bachelor thesis in which three artefacts of forgeries were implemented, cropping to an unnatural oval shape was also used to create this images to achieve more realistic look

Annotations

The generator makes possible to create also annotations of generated artefacts in the form of **black and white map of what has changed**

Annotations enable to create **training sets for the neural networks** or to **verificate the correct detection of artefacts**