PRECISE BIOMETRICS

MASTER THESIS PRECISE BIOMETRICS

Image preprocessing for fingerprints

Fingerprint sensors of different hardware designs generate many different types of noise characteristics. Quantifying and filtering of this noise is one of the key components in a biometric fingerprint authentication system. This master's thesis is targeted at developing methods to quantify and preprocess noise, using noisy fingerprint image databases for training and evaluation. The master's thesis students are free to attack this problem in any way they choose. One approach is to investigate machine learning for noise filtering, as is done in some recent research on noise filtering of normal camera images and evaluate this against a standard filtering method of choice.

Keywords: Noise filtering, Image processing, Algorithm development, Machine Learning, Deep Learning

Fingerprint database augmentation

Development, training and parameter tuning of fingerprint authentication algorithms for new hardware sensors is often limited by the size of databases. A fingerprint authentication system is designed to have a very low False Accept Rate, and this requires training and evaluation fingerprint image databases to be reasonably large, which is hard to combine with the fast iterations of modern hardware development. However there is often fingerprint databases available from different configurations of the sensor as well as "clean" fingerprint databases with near perfect quality. In machine learning and deep learning it is standard procedure to augment databases for training. This master's thesis aims to augment the very hw specific databases in order to avoid having to collect multiple very large databases during development of new fingerprint sensors.

Keywords: Algorithm development, Machine Learning, Data augmentation

Points of interest

Image keypoint detectors and descriptors are used widely for matching content in images. This can be used for creating panoramas, 3D point clouds, object tracking, duplicate image detection, image search, the list goes on. The quality of the keypoints and the descriptor is crucial for any application. The quality of the keypoint detector is determined by the reproducability of the keypoints position, scale and orientation and the quality of the descriptor is determined by how well it discriminates between correct matches and incorrect matches in the system it is used. This is a very active field of research and multiple papers have shown ways to optimize the keypoint detector and/or keypoint descriptor using machine learning. This master's

thesis aims to build upon these ideas and optimize components of the keypoint detector and/or descriptor for new domains. Of special interest is how to optimize this for images of wildly varying quality.

Feature based finger print matching

Various more or less specialized methods are used for fingerprint matching. However, feature based matching algorithms developed within the field of computer vision are becoming increasingly important. Those algorithms pick out informative points in the candidate images and create abstract “feature descriptors” of the image content around each feature point (key point). The feature descriptors of the candidate images are then compared and a decision is made as to whether they are similar enough to describe the same object. Feature based matchning is used extensively in numerous vision based applications including inter alia object recognition, robotic mapping, image stitching, 3D modeling, gesture recognition, video tracking and individual identification. Computer vision is one of the most active research fields in information technology today. Feature detection and description algorithms is right at the heart of this research, and there is great progress and a fast evolution. This master's thesis aims at catching and testing some aspect of this progress with our current algorithm.

Example1: The accuracy of feature based image matching depends to a large extent on the robustness of the feature detector and descriptor, i.e. how good it is at finding and describing keypoints. Improve the keypoint accuracy using some new ideas.
Example2: Some “classical” feature based algorithms are SIFT, SURF, BRISK, FREAK and ORB. Study and pick out some new exiting ideas and algorithms and test it with our infrastructure.

Keywords: feature points, interest points, key points, feature detection, detector, descriptor, image matching, featurebased matching, inlier, outlier, false reject, FRR, false accept, FRR, fingerprint matching.

Fingerprint matching using data from different sensors

Most operations in an automated fingerprint recognition system starts with a digital representation of the fingerprint impression, usually an 8/16-bit grayscale bitmap.

The major part of current fingerprint imaging devices needs the finger to be physically placed on the sensor area for the impression to digitized using capacitive/optical/ultrasonic/thermal technologies.

The fingerprint recognition software is designed to handle different types of distortions, rotations, displacements, translations that are introduced when the finger is physically placed on the sensor array.

A different approach is to capture the fingerprint impression in a contact-less way using an ubiquitous camera.

Fingerprint impressions from a camera do not have the typical distortions from a contact device but will have other problems that need to be handled.

Such issues include focus, lighting, segmentation, capturing angle etc.

This master thesis aims to investigate and develop a method for using an ubiquitous camera on a mobile phone to capture photos or video streams of fingerprints to be used in automated fingerprint system.

Performance and interoperability with impressions from dedicated contact-fingerprint sensors is evaluated using different standardized and proprietary fingerprint matching algorithms.

Multi-modal biometric authentication

Biometric authentication, for example on mobile phones, has largely been focused on using one mode of biometry at a time. Examples include fingerprint sensors, iris scanning, face scanning (2D and 3D), voice recognition, palm pattern or vein pattern. Each mode has its own pros and cons with respect to: usability, biometric performance, robustness from spoofing, hardware cost and feasibility.

By using multiple modes of authentication the system performance could be improved. This master's thesis aims to investigate how to best combine different modes so that system performance is optimized, both in terms of security and usability.

Keywords: Algorithm development, Statistics, Analysis

Palm print recognition system

Most mobile phones today are equipped with a biometric sensor, e.g. a fingerprint sensor or a face scanner that allows the user to conveniently get access to his/her phone without the need to enter a password. While these sensors adds to security and convenience they also add to the production cost as well as puts limitations to the form factor of the phone. At the same time, all mobile phones today are equipped with a high resolution camera that could be used as a biometric sensor itself, e.g. by capturing the palm print of the user's hand.

This master thesis aims at developing a palm print recognition system based on the current algorithm that Precise uses for fingerprint recognition, including capturing and registration of the palm print, extraction of palm print features and matching of the extracted features.

Keywords: Algorithm development, Image processing