PRECISE BIOMETRICS

Master's Thesis Projects 2024

Precise Biometrics

Project 1

Title: Outpainting for Synthetic Fingerprint Image Generation

Description: When training fingerprint recognition neural networks and developing algorithms for fingerprint applications, it would often be useful to work on larger images than one has access to. This could be solved by outpainting methods, that can extrapolate and create entirely new content outside the existing image. Models like GANs or DMs can learn to understand and replicate the patterns, textures, and structures present in the training data, enabling them to generate novel and contextually relevant content that seamlessly extends the original image. The thesis's aim could be to generate a complete live fingerprint from a patch, or to enlarge an existing patch.

Project 2

Title: Template sorting for palm matching

Description: Performing a biometric 1:N matching (identification) requires an algorithm with a fast matching step, that can find the best match within a large gallery. In this thesis, the student(s) will research algorithms for matching palm prints or partial hand images for N of sizes around 1000-10000. The target is to develop an algorithm that gives a low False Non Match Rate within the top K (for example K=10 or K=100) proposals. Likely, the method will utilize CNNs.

Project 3

Title: Improve Classification Robustness through Trained Augmentation

Description: CNNs are powerful tools for fingerprint matching and liveness classification. The key to success is training them on the right data. The aim of this thesis is to set up a network to augment images to make them harder for liveness or matcher classifiers. The augmentation can be used either to improve the classifier during training or to offline generate images for future training. In both cases, the ultimate objective is to make the classifier more resilient to variations in input data and to expose weaknesses in the input data.

Project 4

Title: Orientation Field Estimation in Fingerprint Images

Description: For optimal matching performance of fingerprint images, a robust orientation field estimation is crucial. The estimated orientation field should be robust to large amounts of noise, capturing artifacts, different image cropping, and so on. The master's thesis could approach this with classic approaches, CNNs or a combination of methods.

Project 5

Title: Distillation for Improved Matching or Spoof Detection

Description: Knowledge distillation has been used in many computer vision applications for compressing large high-performance networks into smaller networks that can be deployed on edge devices. Fingerprint matching and liveness classification are two areas where small and fast networks are required. The goal of this master's thesis is to train networks through knowledge distillation and benchmark towards existing solutions.

Project 6

Title: Event Cameras

Description: An event camera, also known as a dynamic vision sensor, uses independent and asynchronous pixels. They respond to changes of brightness, not absolute level. This makes them extremely fast, with a very large dynamic range, while having a very low bitrate. The aim of this thesis is to explore possible areas in which an event camera may be used and then implement a proof of concept for one selected possible area.

Project 7

Title: Removal of Moiré Patterns in Fingerprint Images

Description: For under-display sensors a moiré pattern is overlayed on to the fingerprint image. The pattern is created by an alias between the display and the sensor pixels and is very characteristic. It changes with pressure and temperature, and it therefore becomes difficult to filter out, however the pattern has specific characteristics. The goal of this thesis is to extract and remove the Moiré pattern from the fingerprint using CNN.

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