Finger Vein Recognition and Intra-Subject Similarity Evaluation of Finger Veins using the CNN Triplet Loss

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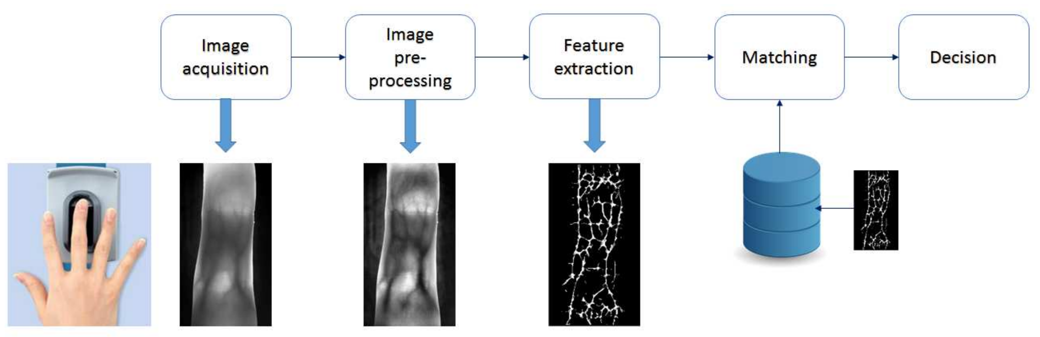
Fingervein identification

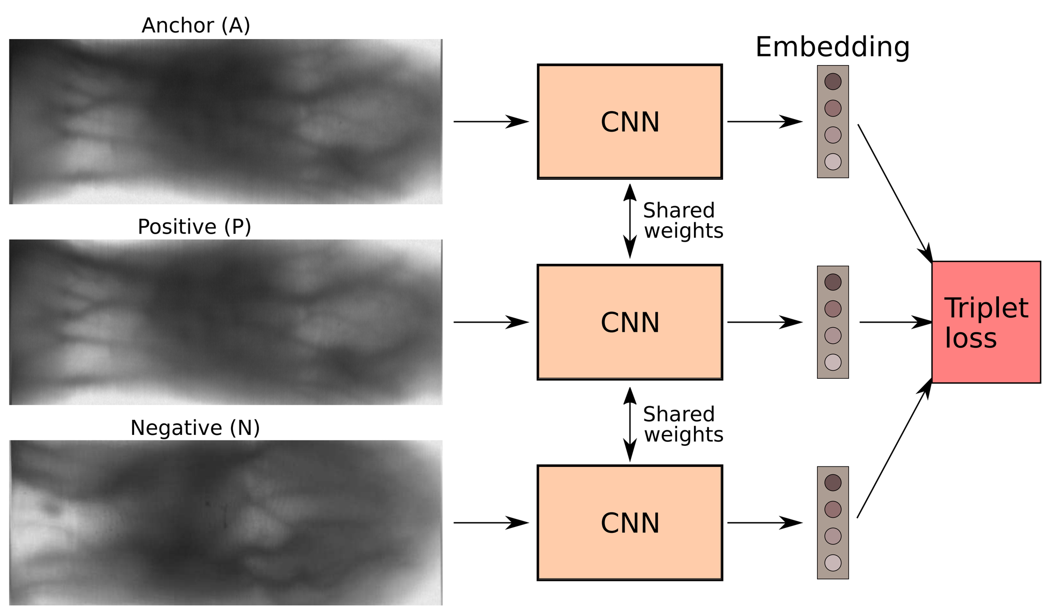
Advantages of finger vein identification

- Finger vein images are resistant to abrasion and external influences on the skin
- Liveness detection can be easily applied to prevent presentation attacks



Finger vein recognition system

Triplet Loss



CNN training using the triplet loss

$$L(A,P,N) = \max(||f(A)-f(P)||^2 - ||f(A)-f(N)||^2 + \alpha, 0),$$

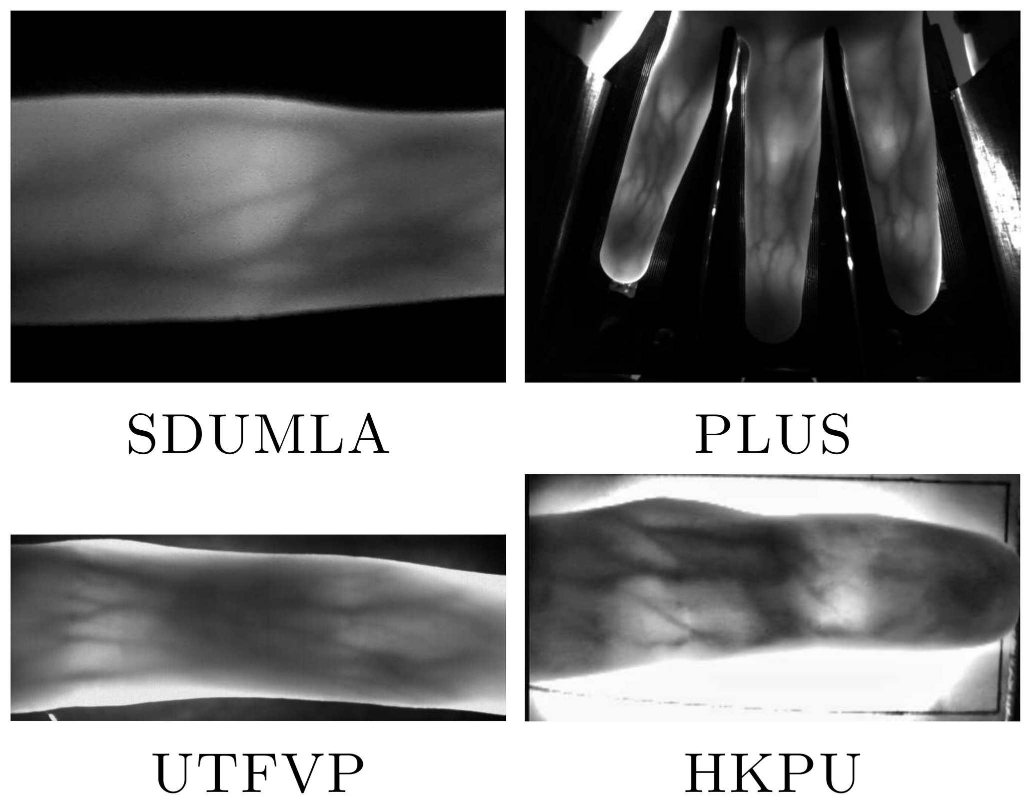
Advantage: CNN can also identify images from classes that were not used to train the net.

CNN training

- CNN architectures: SqueezeNet, Light CNN, ResNet 50
- Hard triplet selection selection: $(||f(A)-f(P)||^2 + \alpha > ||f(A)-f(N)||^2)$
- Feature output dimension is set to 256
- 400 epochs of training, starting with a learning rate of lr=0.001 (divided by ten every 120 epochs)
- We employ the *PyTorch* framework

Employed Databases

Example images from the employed datasets:



Experiments are applied to ROI extracted images. CNN input size is 224×224.

Experimental Setup

- 2-fold cross validation: Each fold consists of the images of half the subjects.
- We report the mean EER over the 2 folds
- Experiment 1: Common finger vein recognition (each finger of a subject is a separate class). The current understanding in literature is that different fingers of the same subject are unique identities.
- Experiment 2: Subject based recognition (all fingers of a subject belong to the same class)
  Object: idetify the subject of an image using finger vein images of a finger that was not enrolled but only the other fingers of the subject
- Experiment 3: Symmetric finger type recognition (images of the same finger type (index, middle and ring finger) and subject belong to the same class).
  Object: identify the finger type and subject of a finger vein image even though the considered finger was not enrolled but only its symmetric counterpart on the other hand

Results for common finger vein recognition

Methods	SDUMLA	UTFVP	PLUS	HKPU
Triplet SqueezeNet	**2.7**	2.5	2.4	3.7
Triplet ResNet	3.1	3.6	3.2	5.6
Triplet LightCNN	4.9	4.6	4.7	10.0
MC	4.0	**0.2**	0.5	**1.0**
PC	4.9	0.4	**0.2**	1.3
LBP	7.3	1.5	3.6	4.0
SIFT	5.4	1.5	0.8	1.8

Mean EER in %

Results for subject based recognition (Experiment 2)

Methods	SDUMLA	UTFVP	PLUS
Triplet SqueezeNet	22.8	26.4	23.3
Triplet ResNet	21.9	24.3	26.9
Triplet LightCNN	25.3	30.4	30.1

Mean EER in %

Results for symmetric finger type recognition (Experiment 3)

Methods	SDUMLA	UTFVP	PLUS
Triplet SqueezeNet	15.2	23.0	11.3
Triplet ResNet	16.4	20.4	10.1
Triplet LightCNN	18.2	25.5	17.1

Mean EER in %

Conclusion

- CNNs using the triplet loss function are suited for finger vein recognition
- Symmetrical fingers (same finger type but different hand, e.g. left and right index finger) share enough similarities to identify people.
- Different fingers of the same person also exhibit similarities, but not enough to identify people.