Chiara GALDI[a], Michele NAPPI[b], Jean-Luc DUGELAY[a]

[a] Multimedia Communications Department
EURECOM, Sophia Antipolis, FRANCE
{dugelay, galdi}@eurecom.fr

[b] Management & Information Technology Dep.
University of Salerno, Fisciano (SA), ITALY
mnappi@unisa.it

Combining Hardwaremetry and Biometry for Human Authentication via Smartphones

Background

With the term "**hardwaremetry"** we indicate the analysis of hardware characteristics using mathematical and statistical methods.

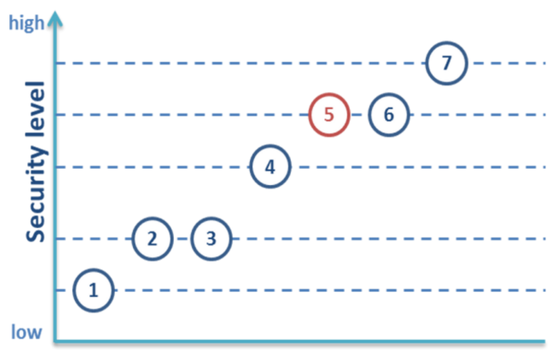
It is possible to determine which sensor captured a given photo by analyzing the **Sensor Pattern Noise (SPN).**

The **deterministic** component of SPN is mainly caused by **imperfections** during the sensor manufacturing process and different sensitivity of pixels to light due to the **inhomogeneity of silicon wafers.**

SPN can be used to distinguish cameras of the **same model.**

Combining Hardwaremetry and Biometry

We use sensor recognition in combination with iris recognition in order to provide a more secure system for user authentication on smartphones.
Authentication based on **something that the user has** (smartphone) plus **something that the user is** (iris) assures a high security level:

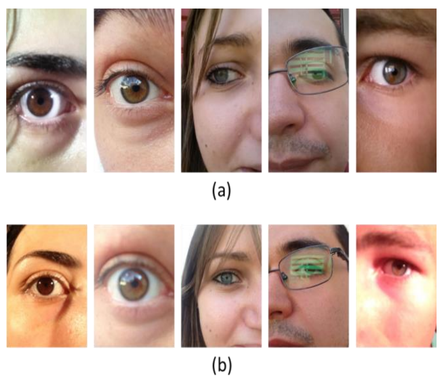


Authentication system security levels**:** (1) Something the user knows; (2) Something the user has; (3) Some-thing the user knows + something the user has; (4) Something the user is or does; (5) Some-thing the user has + something the user is or does; (6) Something the user knows + something the user is or does; (7) Something the user knows + something the user has + something the user is or does.

Data

Data come from **MICHE** database, an iris images database consisting of photos of the eyes of 75 different persons, captured with **different mobile devices** in different illumination conditions.

Thanks to this database, it is possible to actually perform the double check of iris and device identity **on a single photo and at once.**



Examples of images in MICHE database: (a) captured from Galaxy S4; (b) captured from iPhone 5.

Methods

Sensor recognition:
The SPN (Lukás et al, 2006) is computed using the following formula:

$$n=DWT(I)-F(DWT(I))$$

where *DWT()* is the discrete wavelet transform to be applied on image I and *F()* is a denoising function applied in the DWT domain.

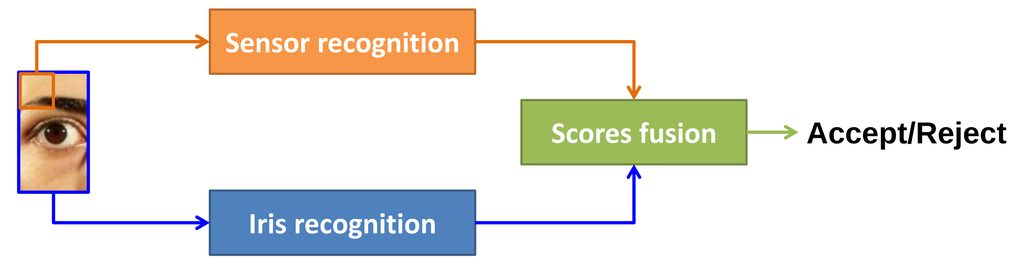
The **Enhanced Sensor Pattern Noise (ESPN)** is obtained from the SPN by filtering out the highest frequencies that are more likely to be associated with strong scene details than to the sensor pattern noise (Li, 2010).

Adapting ESPN extraction to smartphones:
Large images has to be processed by blocks of 512x512 pixel. The MICHE database contains pictures with a maximum size of 2322x4128 pixel that would require to repeat the SPN extraction about 36 times.
During our experiments we observed that using just **one block** is enough to obtain a **RR of 98%**.

Iris recognition:
The iris recognition module employs the **Cumulative SUMs (CSUM)** algorithm. This method analyzes the local variation in the gray levels of an image.

Fusion:
We perform fusion at **score level** via the weighted sum technique.

System architecture



Results

The combination device-iris recognition obtained a RR of 86% and AUC = 98%.

EER	FAR avg.	FRR avg.	AUC	RR
0.09	0.26	0.37	0.98	0.86