UNIVERSITÉ DE GENÈVE

Digital Security for Physical World

Slava Voloshynovskiy

University of Geneva
Switzerland

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CeBIT

Outline

- Physical object security
- Why not traditional security?
- Proposed solutions for
  - Object recognition
  - Design verification
  - Object identification
- Benefits

Global Scope of Counterfeiting

PMMI™
The Association for Packaging and Processing Technologies

Global value of counterfeit goods annually
$1.5 trillion

Counterfeit is increasing
3% per year
worldwide

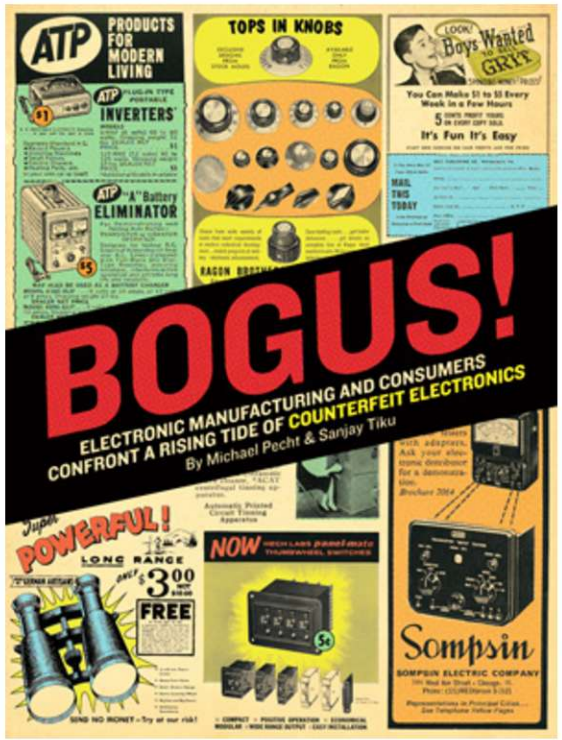


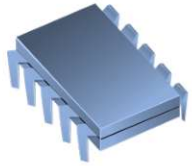
Photo Collage: Laura Azran

ID docs

Certificates

Banknotes

Electronics



Luxury objects

Art objects

Packaging

Risks of counterfeiting

- Danger for life
- Market loss
- Damage of brand reputation

Restraints

- Inefficient authentication technologies
- High cost of track and trace infrastructure
- Lack of awareness for product originality

Global anti-counterfeit packaging market 2020 - $143 Billion

Authentication packaging technologies:

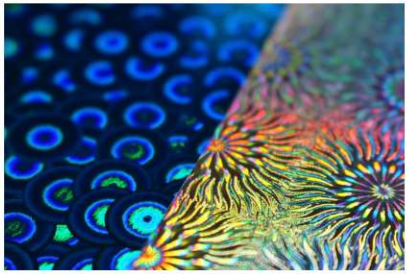
- Security Inks and Dyes
- Holograms
- Watermarks
- Taggants

Track and Trace packaging technologies:

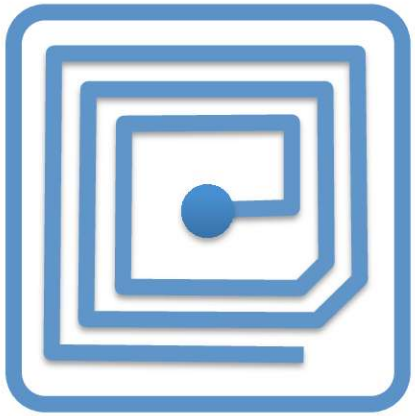
- Barcodes
- RFID

Why not “traditional” security?

Main restrictions of existing security technologies for physical objects:



- **Proprietary technologies** (rare or expensive materials, inks, holograms, etc.)
  - **obsolete** and **easy to clone** by modern means
  - **expensive** for mass markets
  - **special equipment/special knowledge** are required

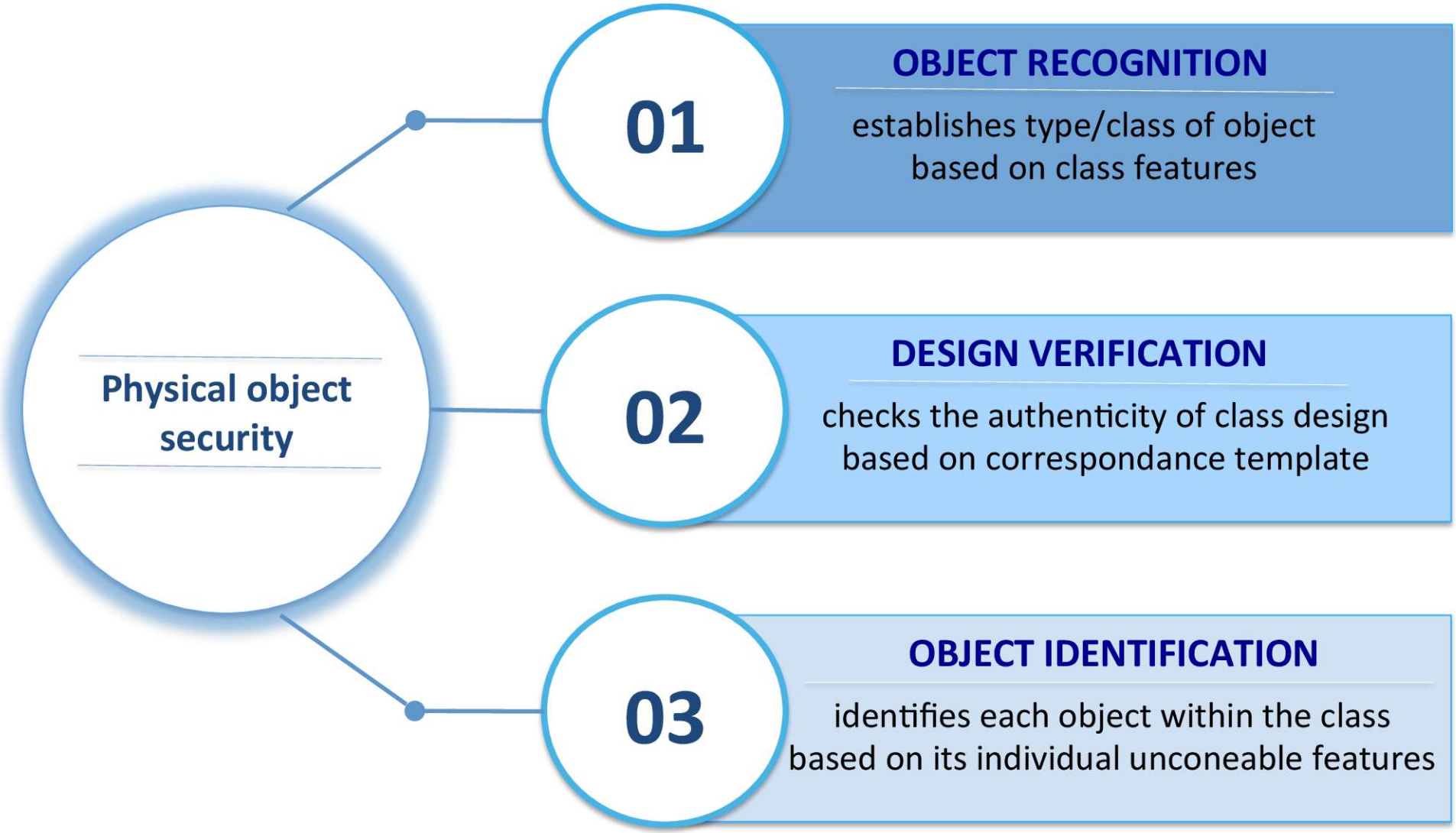


- **Crypto security**
  - very sensitive to noisy and can not be directly applied to analog/physical data

- **RFID/Connected devices/Internet of Things**
  - still quite expensive
  - serious security concerns
  - not always applicable

Requirements to modern physical object security

- **easy to verify authenticity but difficult to clone**
  cloning should economically inefficient
- **non-proprietary: based on physical-crypto principles**
  protection mechanism is assumed to be public
- **no special equipment required**
  preferably on mobile phone (in possession of everyone)
- **no special training required**
  any user can validate it
- **cheap and scalable to mass markets**
  millions or billions of products
- **non-invasive**
  products and production should not be modified


Physical object security
01
OBJECT RECOGNITION
establishes type/class of object based on class features
02
DESIGN VERIFICATION
checks the authenticity of class design based on correspondance template
03
OBJECT IDENTIFICATION
identifies each object within the class based on its individual unconeable features

Object recognition

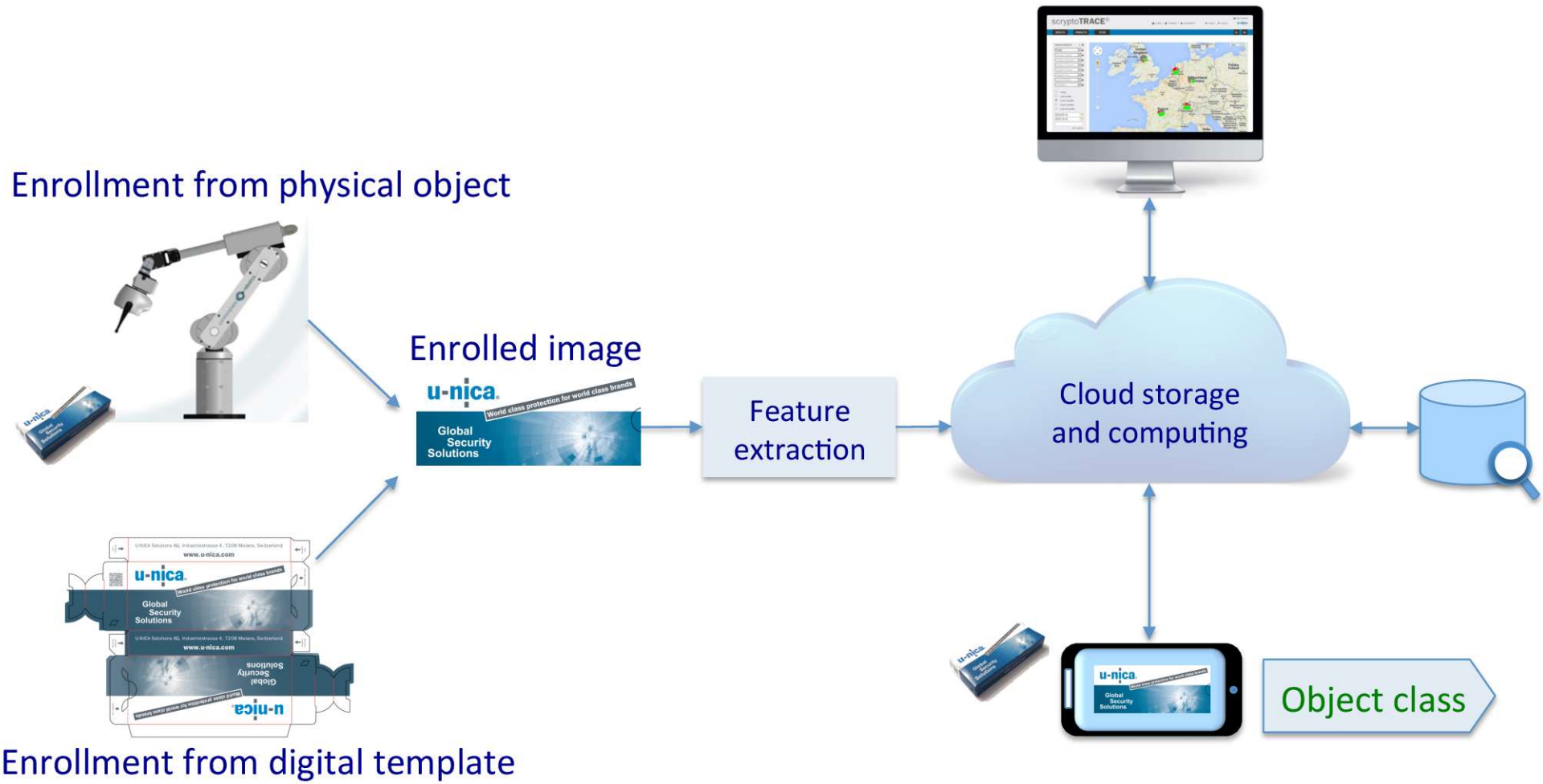
Goal

Accurately recognize each object on mobile phone

Challenges

- Billions of items
- Very similar

Object recognition

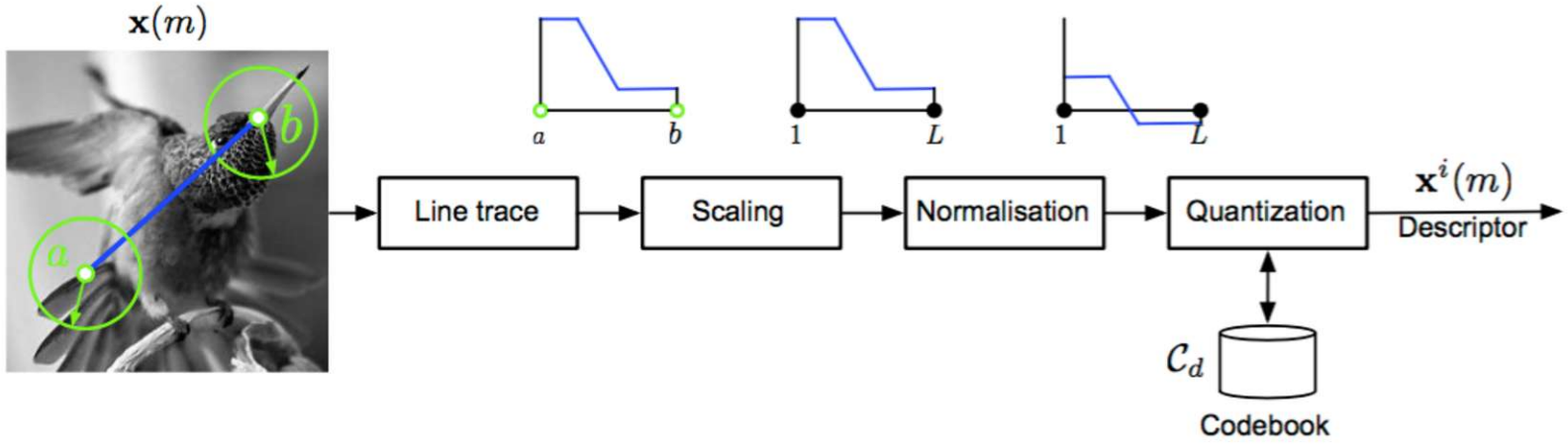


Object recognition

Image parsing

SketchPrint main idea

Extract a sketch connecting two reference points



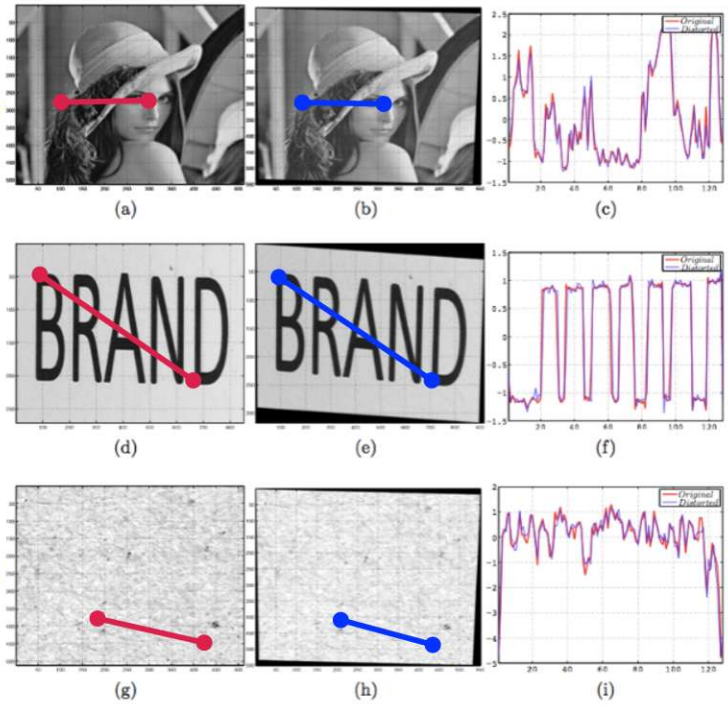
Object recognition

SketchPrint

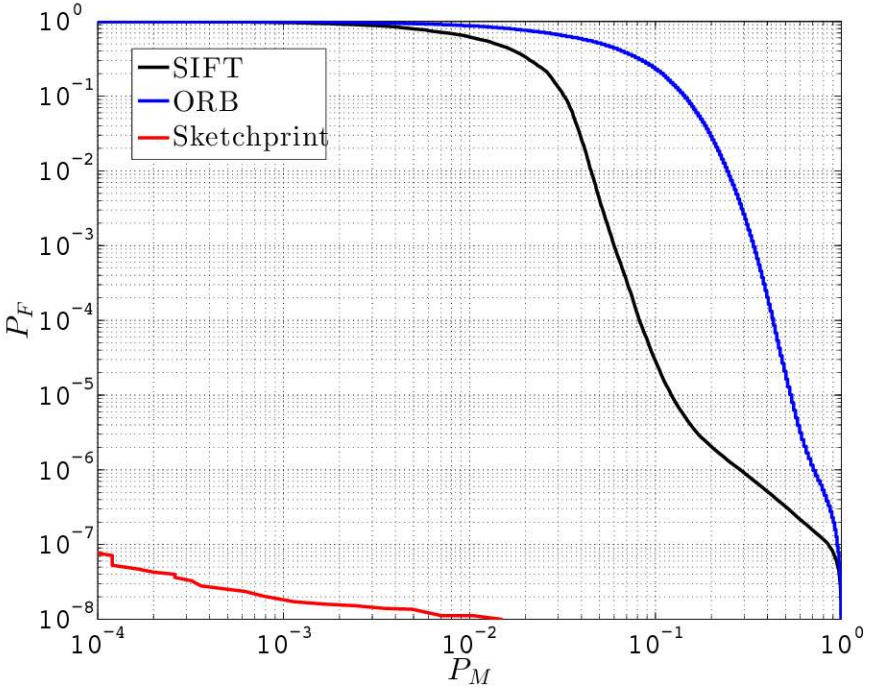
Natural images

Text & logos

Random images



Performance



Object authentication

Given: a package

source: originalideas.info

Question:

- Is this package authentic?

Remark: you have never seen it or remember its design roughly…

Your thinking: well....quality of print looks OK

.....logo seems OK

.....I buy it from a reputable vendor

.....**so probably authentic!**

Object authentication

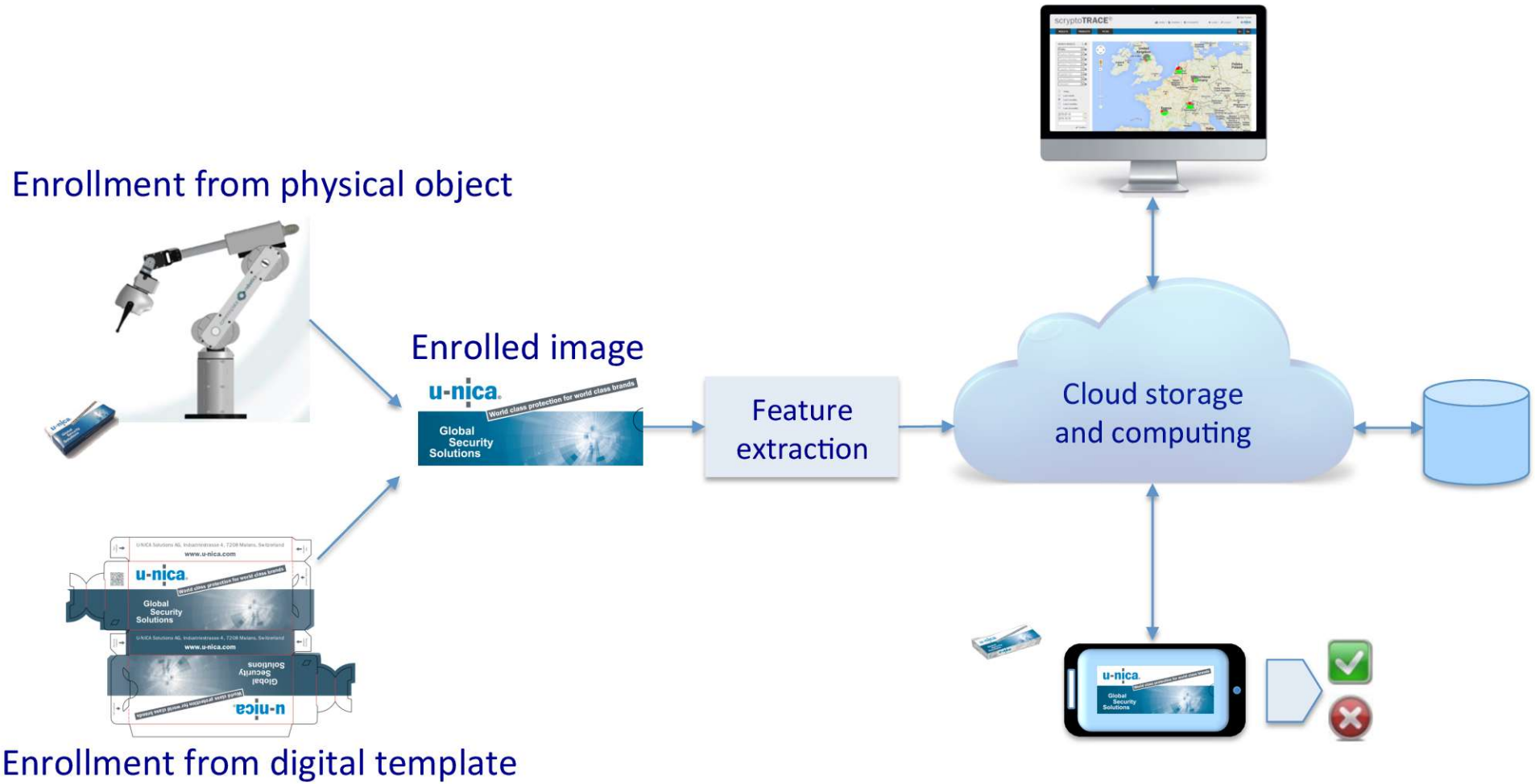
source: originalideas.info

Observation: if we know the original design, we can easily verify its authenticity.

Question:

- Can we perform the design verification automatically?
- And how accurately (say with the precision about 10-15 microns)?

Design verification



Design verification

Integral verification

Text
Graphics
Images
Microstructures
Halftoning

Original

Authentic

High quality fake

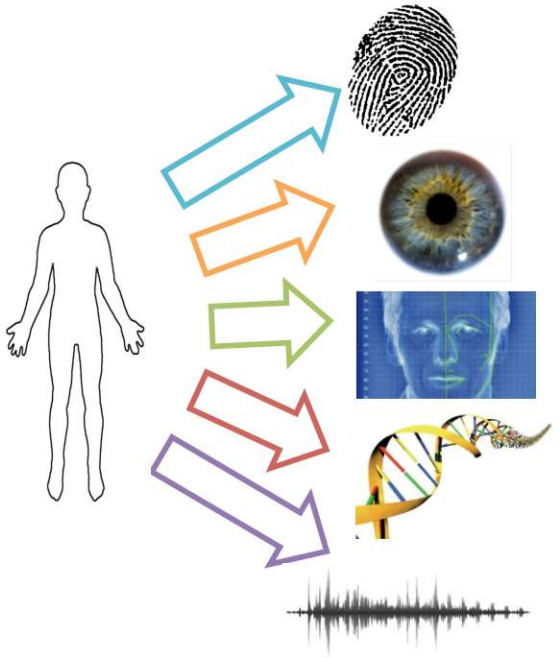
Not authentic

15 micrometers

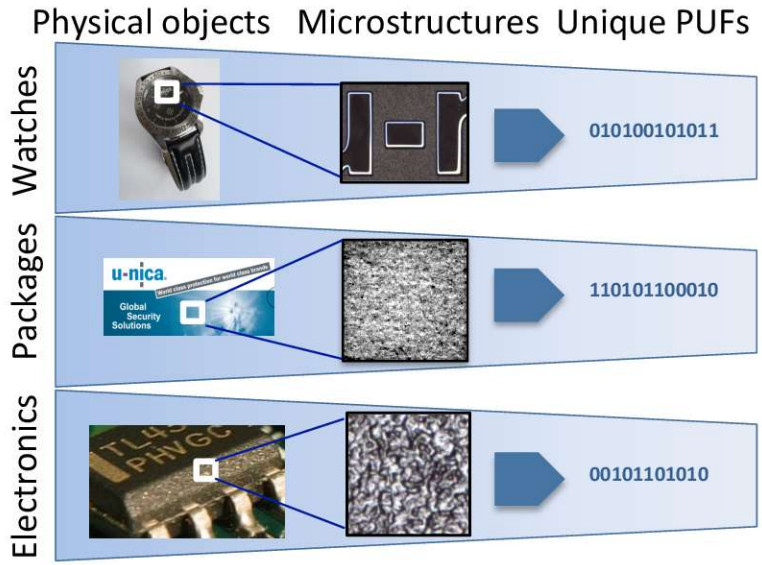
Object identification

Intuition behind physical uncloneable functions (PUFs)

Humans = biometrics



Physical Objects



All physical objects are unique like humans

Object identification

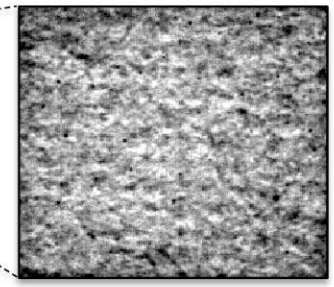
Paper microstructures =PUFs

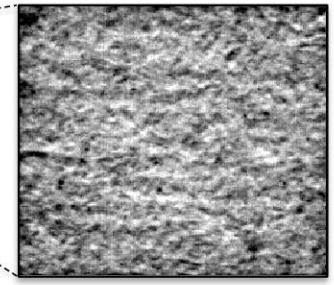
Package 1

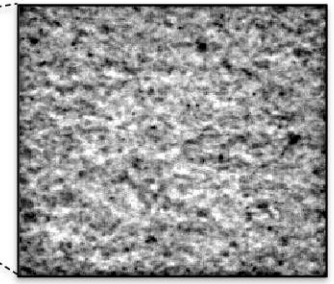
Package 2

.
.
.

Package M





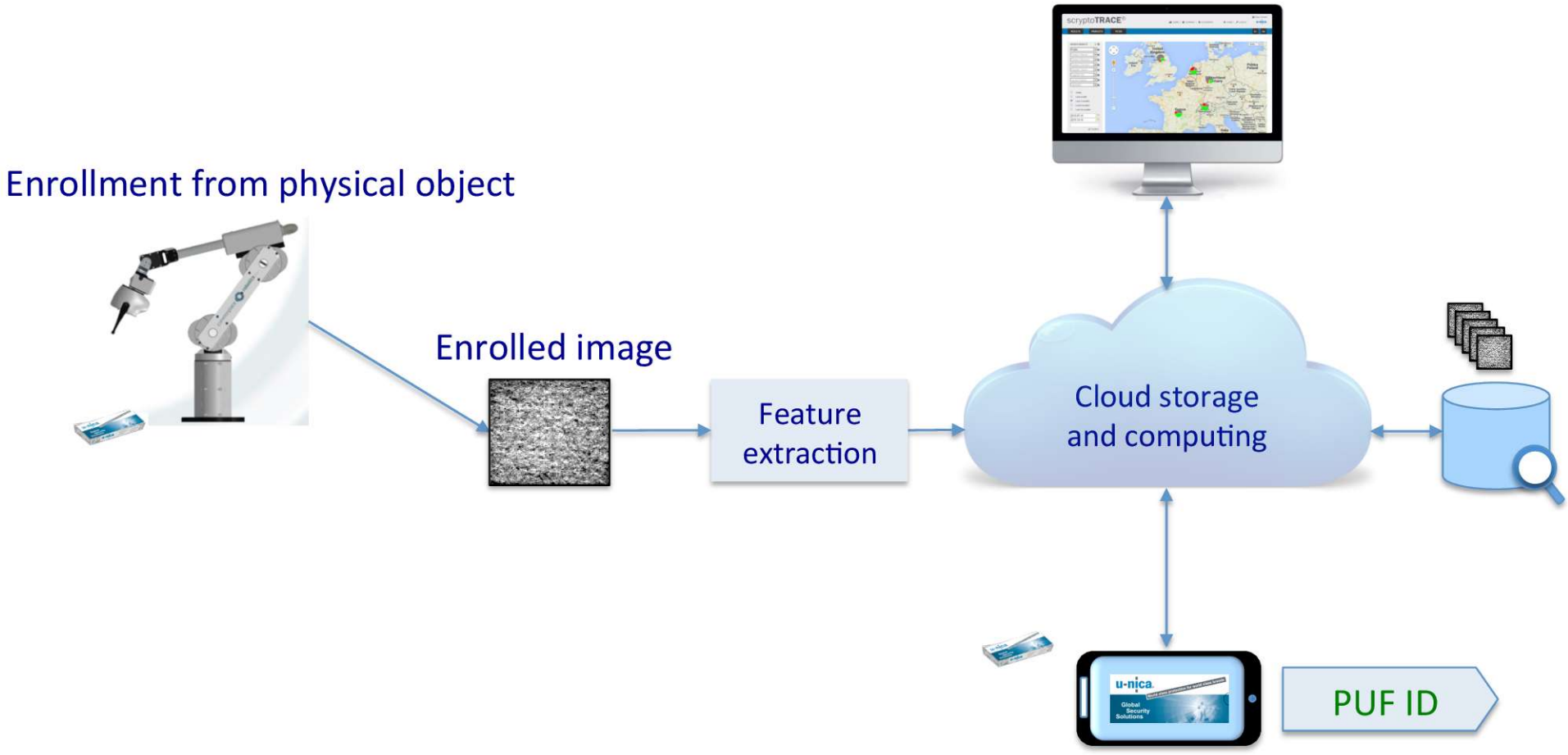


Individually unique PUFs

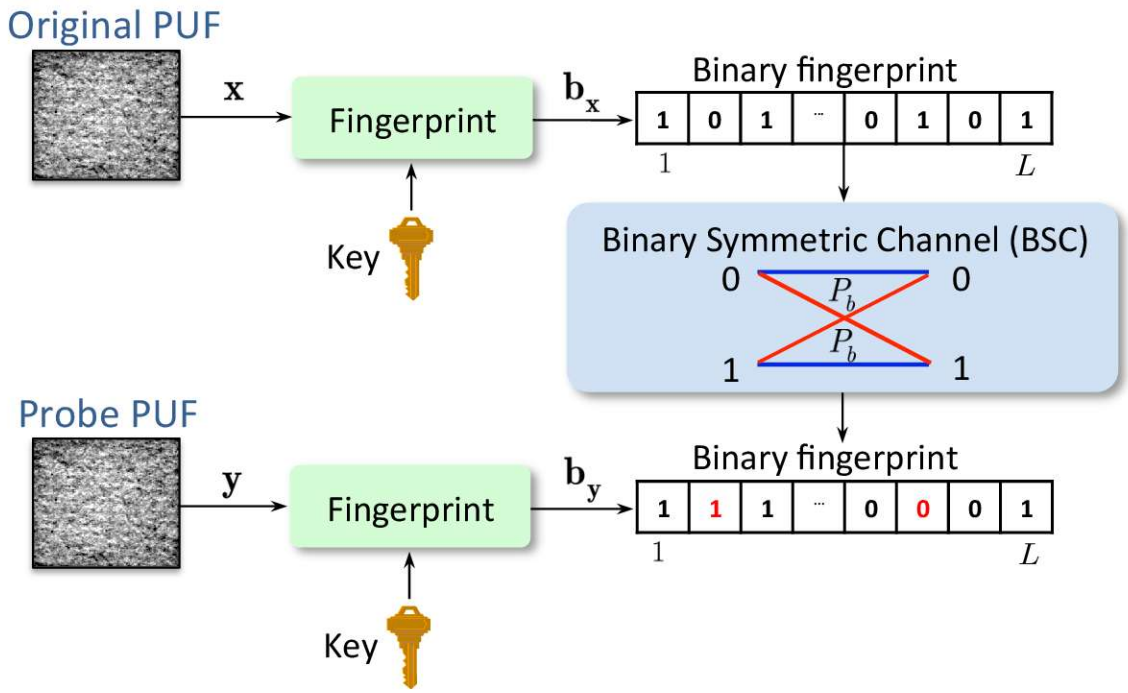
= unique identifier for Track&Trace

Visibly packages look identical

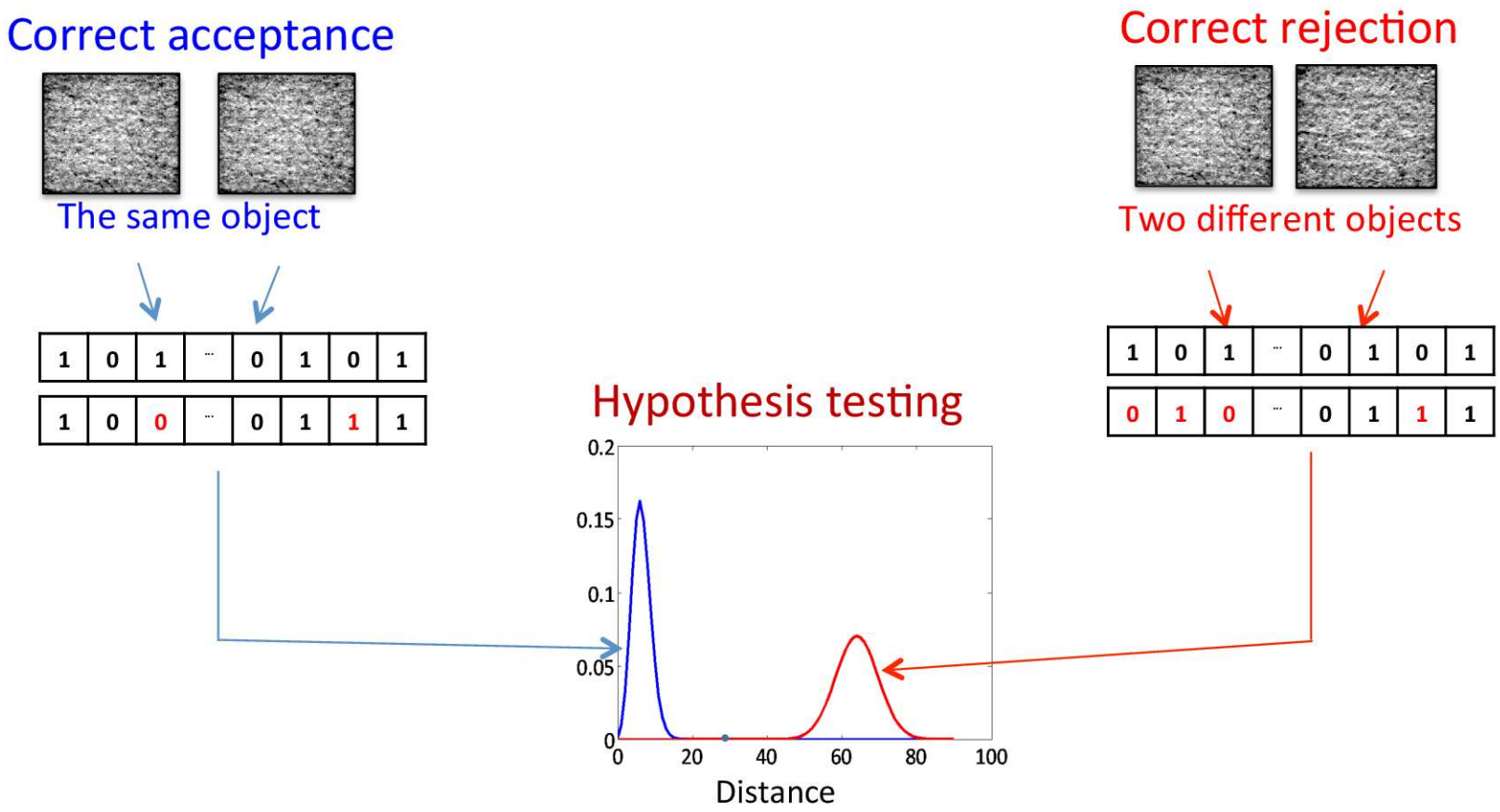
Object identification



Open issue:
Big Data (millions of objects with high-dimensional features)



Properties of PUFs: Close PUFs = close fingerprints

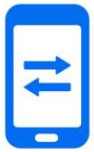


Benefits

Recognize physical objects
Direct interaction with physical objects

Detect fake objects
Prevent end user consuming fake objects

Track market activity
Tracking goods, market trends and activity



Smartphone app
Public app not requiring any special training

Real-time reporting
Dynamic reporting and visual analytics

Mobile marketing
Consumer engagement and product promotion

For more details: **Swiss Pavilion Halle 6, Stand E30**

University of Geneva

Department of Computer Science
7 rout de Drize
CH-1227 Carouge/Geneva
Switzerland

Industrial partner

U-nica Solutions AG
Industriestrasse 4
CH-7208 Malans
Switzerland

svolos@unige.ch | sip.unige.ch

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