Finanziato dall'Unione europea
NextGenerationEU

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SERICS
SECURITY AND RIGHTS IN THE CYBERSPACE

Workshop multidisciplinare su Blockchain e DLT: incontro fra accademia e imprese
7th DLT working group meeting on multidisciplinary aspects
Perugia, 27-28 novembre 2025
Sala del Consiglio
Palazzo della Provincia, Piazza Italia 11

Generating SSI Decentralized Identifiers Through Biometric Patterns: a Case Study*

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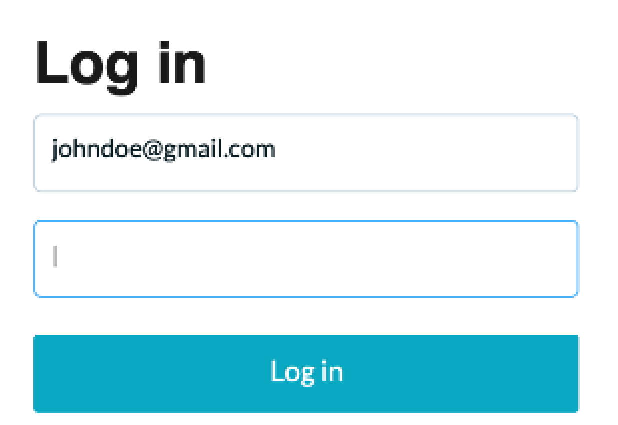
*This research activity was supported by project SERICS (PE00000014 - CUP H73C22000880001)
under the MUR National Recovery and Resilience Plan funded by the European Union – NextGenerationEU.

Outline

1. Self Sovereign Identity
2. Motivation
3. Biometric authentication
4. Proposed schema
5. Case study
6. Conclusion

Self Sovereign Identity

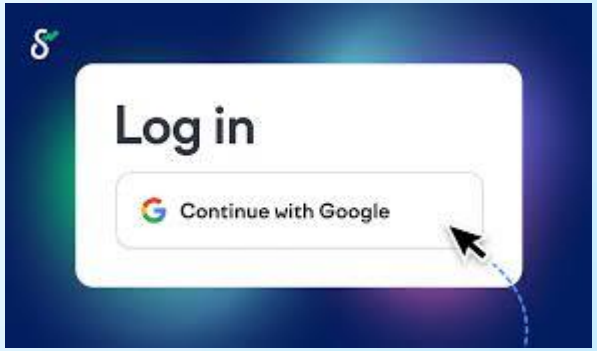
"… aims to allow individuals to control what personal data they disclose and with whom they share it …"



Log in

johndoe@gmail.com

Centralized Identity



Log in

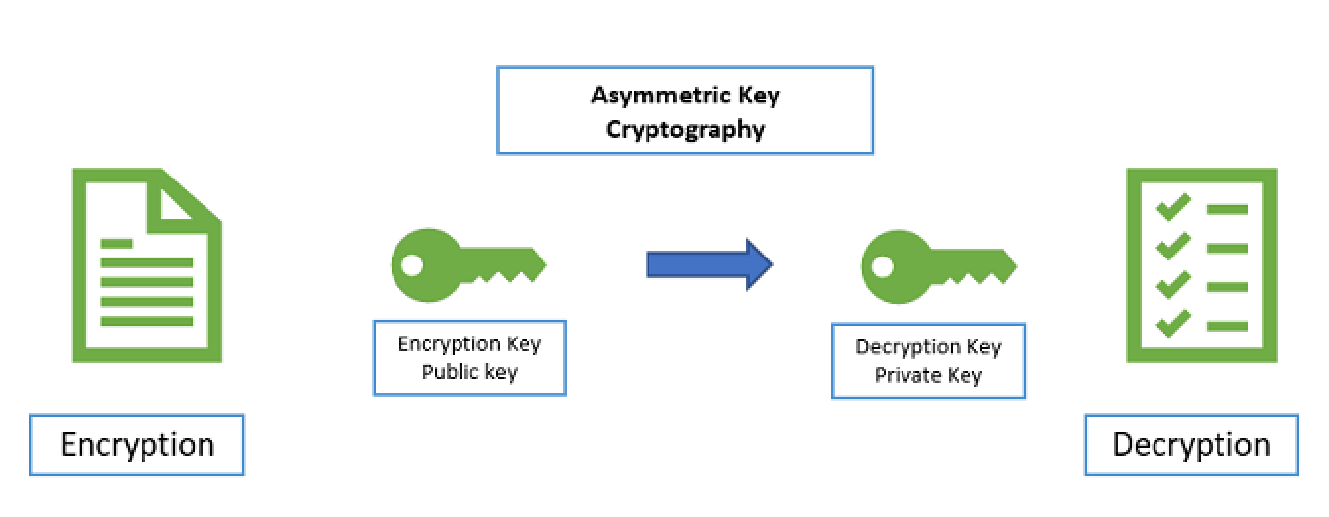
Federated Identity

SELF-SOVEREIGN IDENTITY
HOME
BANK
WORK

SSI

DIDs

A Decentralized Identifier (DID) is an alphanumeric string uniquely associated with an individual



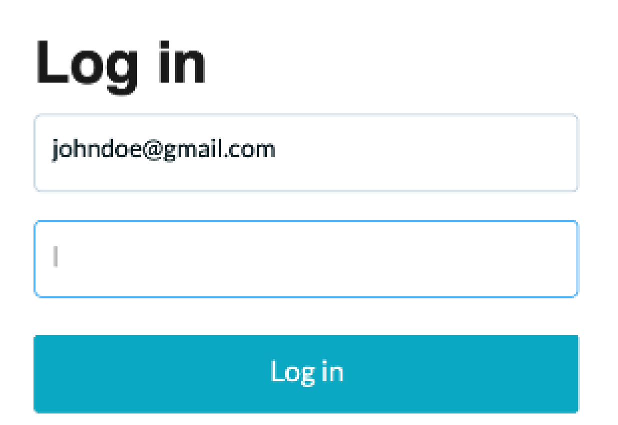
DIDs are usually derived by the public key

What happens if private key is compromised?

Impersonation

Our Proposal: Generating DIDs from extracted biometric features

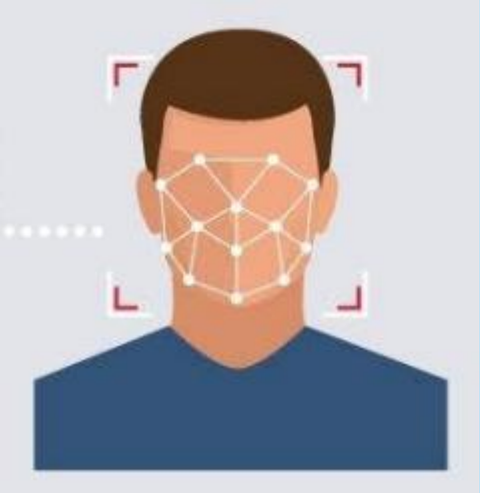
Authentication factors


Log in

johndoe@gmail.com

Log in

Enter the code
Verify



Something you know

Something you own

Something you are

Biometric authentication

Fingerprint

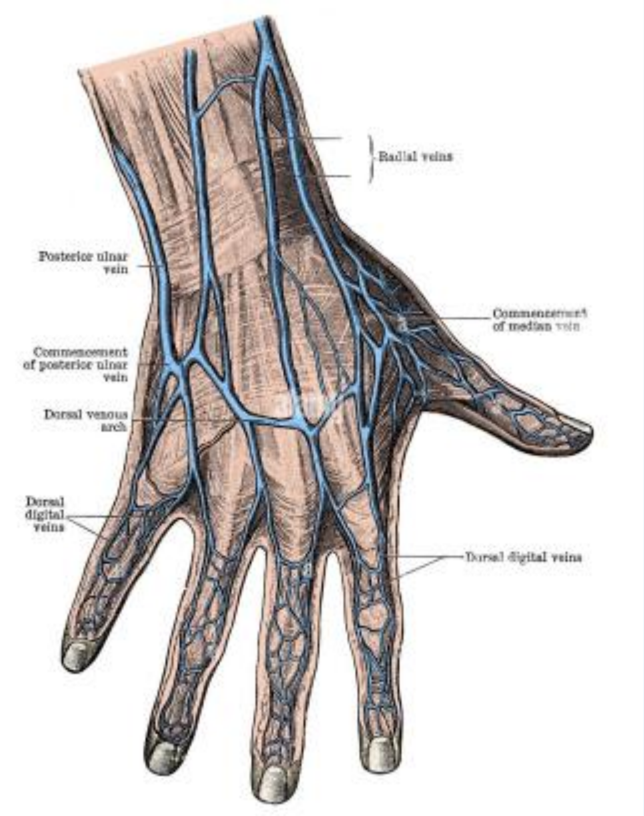
Iris

Handwriting

Voice

Palm

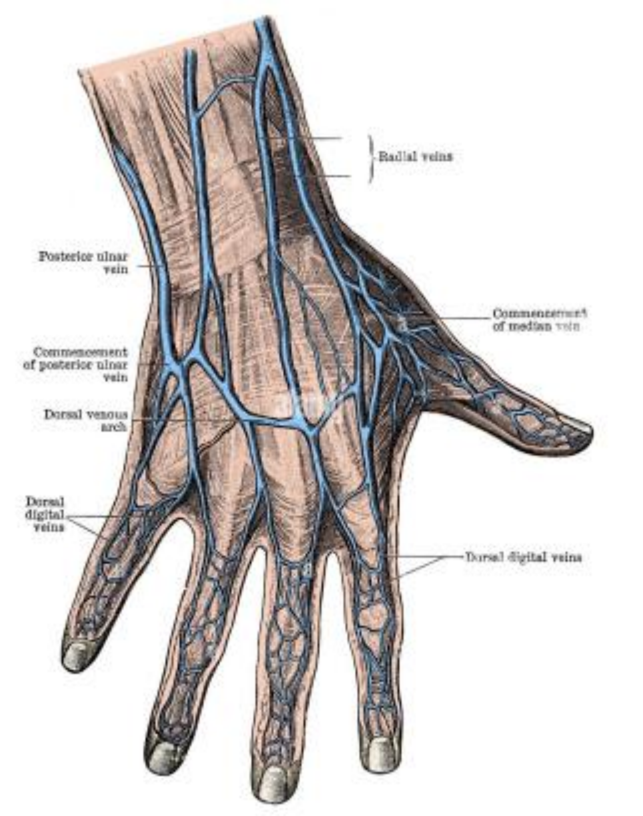
Hand-based authentication

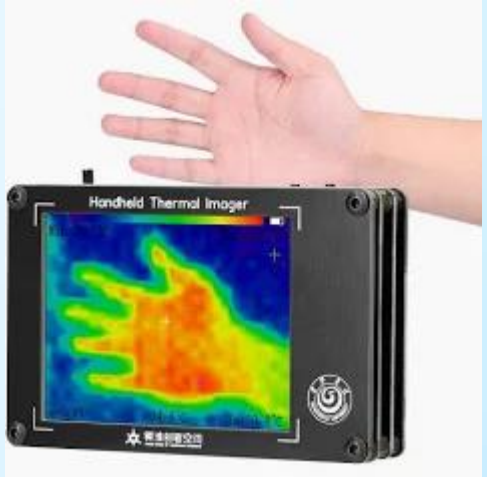


Advantages:

- 10x more unique features than fingerprint
- Hard to copy
- Contactless (no contamination)
- Universal (vs. face)
- More stable over time (than face)
- Liveness

Hand Vein Patterns

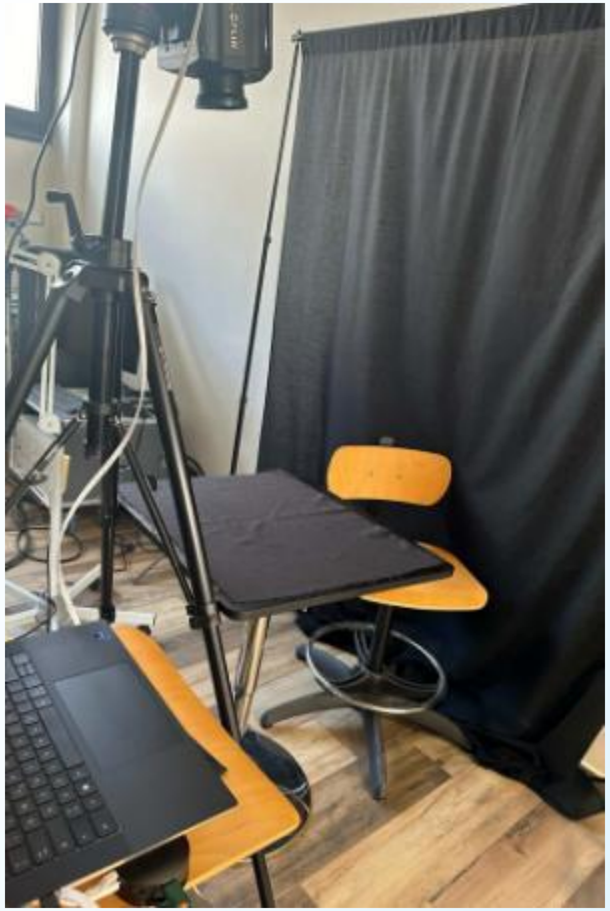




A thermal imaging camera detects the thermal energy radiated by any body (temperature)

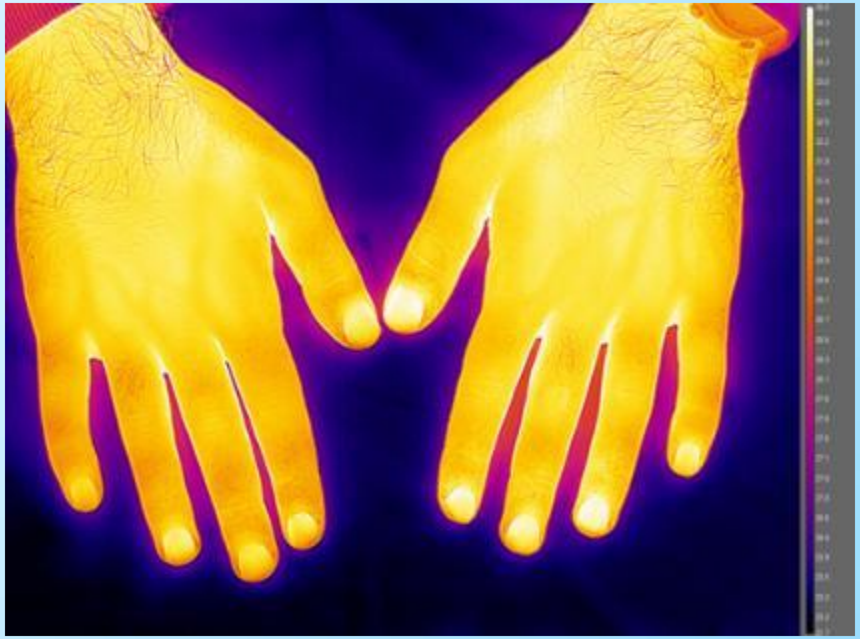
Image acquisition is non-invasive and harmless

Hand-based authentication

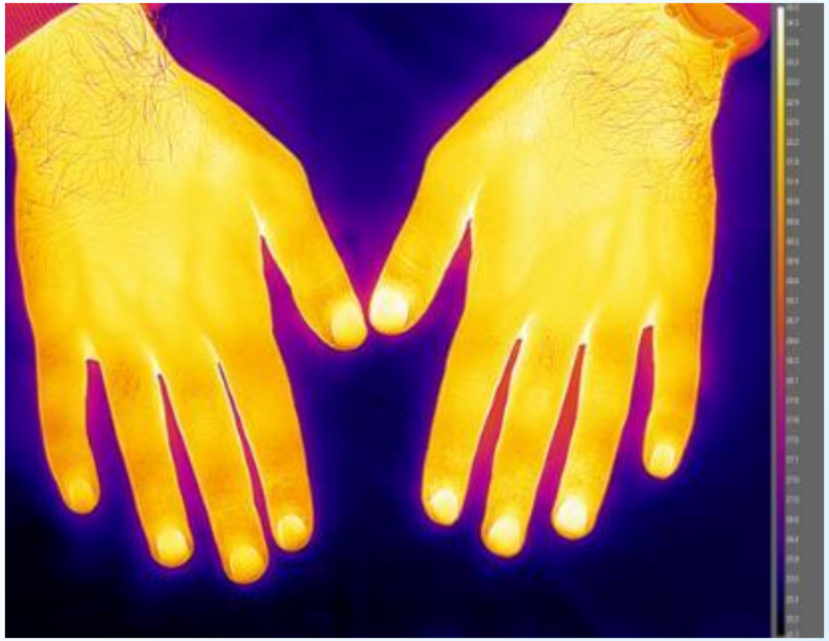


Phase 1: Acquisition

- Flir X8400sc thermal camera

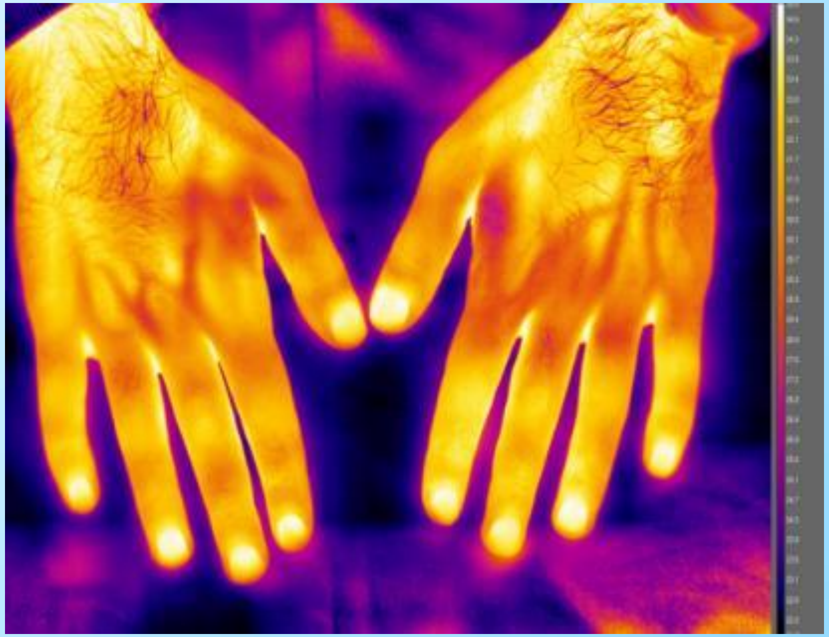


Hand-based authentication



Phase 2: Image enhancement

- Fusion2 palette
- Adaptive Process Enhancements



Hand-based authentication

Phase 4: Feature extraction

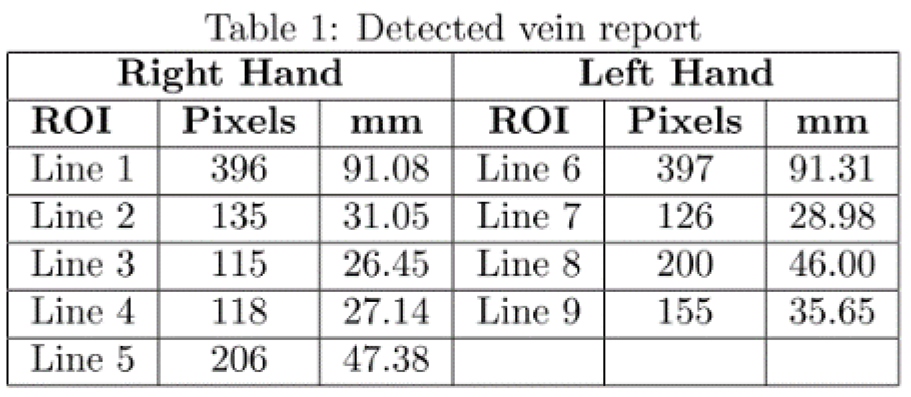
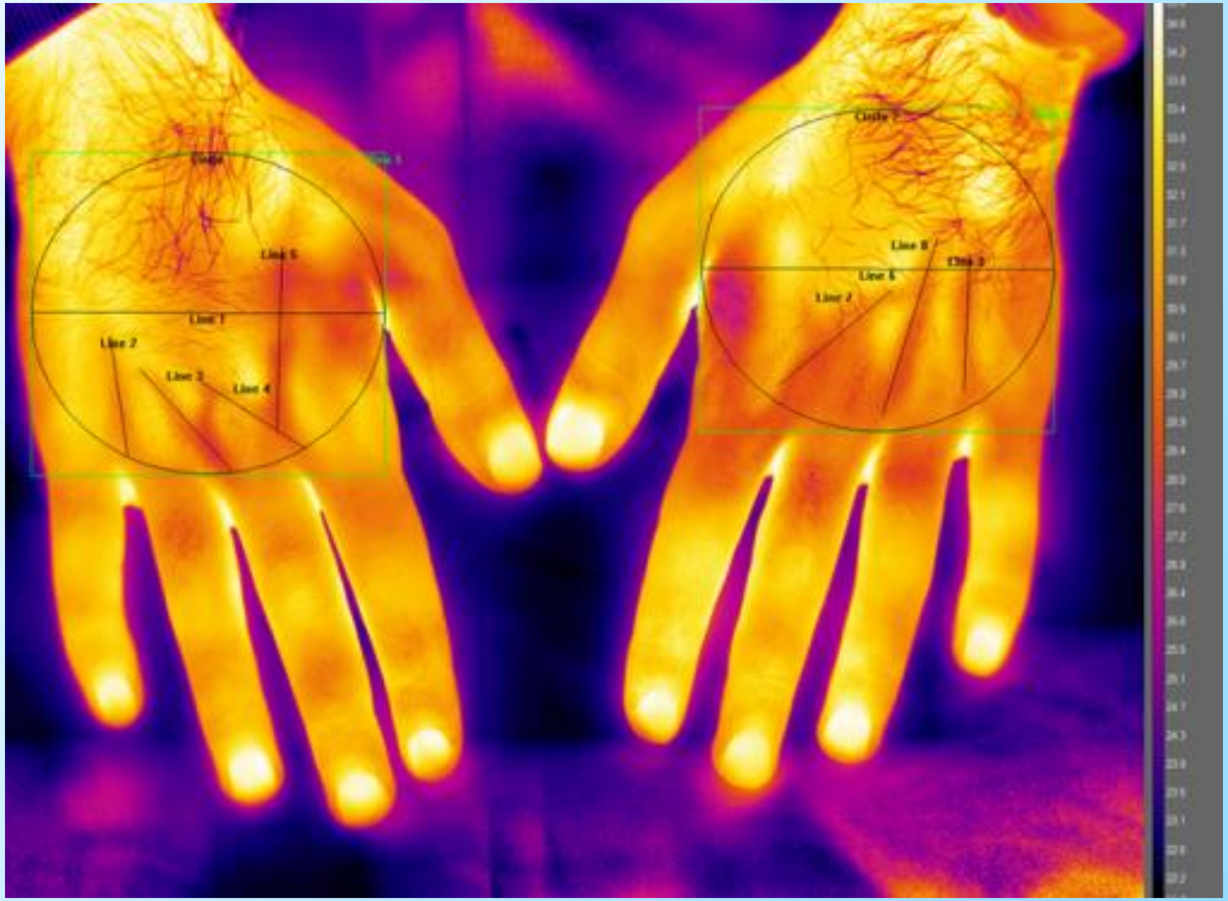


Table 1: Detected vein report

Right Hand			Left Hand		
ROI	Pixels	mm	ROI	Pixels	mm
Line 1	396	91.08	Line 6	397	91.31
Line 2	135	31.05	Line 7	126	28.98
Line 3	115	26.45	Line 8	200	46.00
Line 4	118	27.14	Line 9	155	35.65
Line 5	206	47.38			



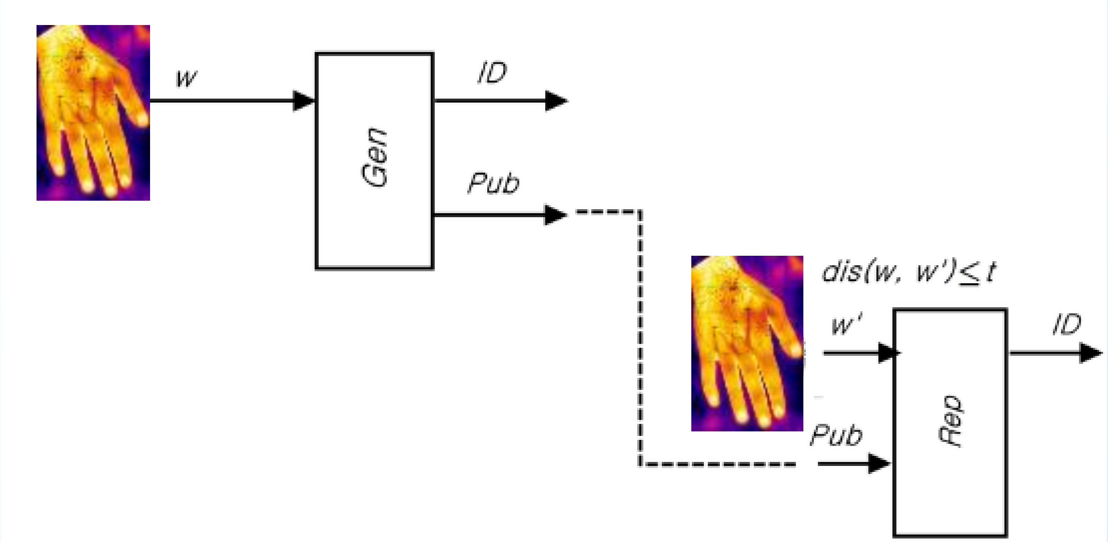
Phase 5: Classification

- As a Future work

DID generation

Biometric features slightly differ from each acquisition (blood pulse, lighting, positioning): they cannot be used as they are

Fuzzy extractors are useful tools (returns the same *k* for all inputs that differ less than a given threshold *d)*



$$(\mathrm{ID}, \mathrm{Pub}) = \mathrm{Gen}(w, t)$$

$$\mathrm{DID} = H(\mathrm{ID})$$

DID regeneration is enabled to support the SSI Pseudonymity Principle

Case study

Accesso allo stadio dotato di tornelli

Caso A: biglietto elettronico (credenziale)

Caso B: scansione della mano (biometria)

Analisi costi/benefici

Scenari di autenticazione	Simbolo	Credenziali	Biometria	Case Study
Numero di utenti	N	√		20.000
Investimento iniziale	I	√		50k€ - 150k€
Gestione	G		√	10k€ - 5k€
Percentuale di frodi	PF		√	0,10% - 0,01%
Danno medio per frode	DF	=	=	1k€
Costi totali	$C_C=I + G \times anni$	$C_C=I + G$ x $anni$	$C_B=I + G$ x $anni$	
Perdite totali	$P_C=N \times PF \times DF \times anni$	$P_C=N$ x PF x DF x $anni$	$P_B=N$ x PF x DF	
Valore Economico del Rischio	VER		$VER_B=C_C+P_C$ - C_B+P_B	

$VER_B>0$ *dopo 4,4 anni*

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