One-Shot Representational Learning for Joint Biometric and Device Authentication

Email: banerj24@msu.edu
Sudipta Banerjee and Arun Ross

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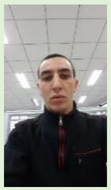
Introduction

Question: Given a biometric image, can we tell…



Who is this and which sensor/device acquired this image?

Solution: Joint biometric and sensor recognition

Application: Remote banking on smartphones (2-FA)

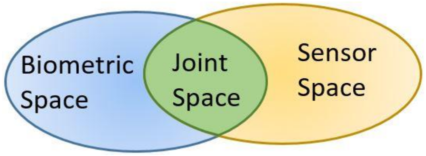
Motivation

Surge in biometrics-based smartphone verification (iPhone X) and remote banking (expected 2.3 B users by 2023)

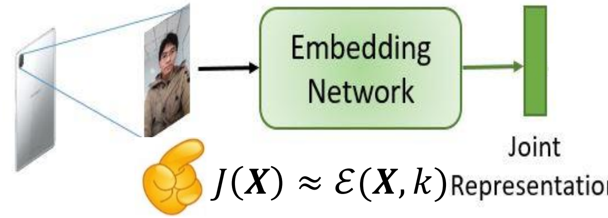
Existing methods use separate routines – Limited performance and generalizability

Proposed Method

Objective: Capture biometric-specific and sensor-specific details simultaneously from a biometric image to create a joint representation – **Joint biometric-device authentication**



$$J(\boldsymbol{X}) = B(\boldsymbol{X}) \cap S(\boldsymbol{X})$$



$$J(\boldsymbol{X}) \approx \mathcal{E}(\boldsymbol{X}, k)$$

Learns the joint representation in one-shot!

Properties of joint representation:

- Can be used for the tasks of joint identification and joint verification – Both subject and device (sensor) identities should yield correct matches
- Implicitly privacy preserving – joint template cannot be trivially de-coupled
- Lower dimensional embedding compared to biometric and sensor templates
- Will generalize to different biometric modalities and sensors (Iris-NIR & Face-VIS)

Experiments

Dataset

Modality	#Subjects, #Sensors
Iris (CASIA Iris V2)	60, 2
Periocular (MICHE-I)	75, 7
Face (OULU-NPU)	55, 6

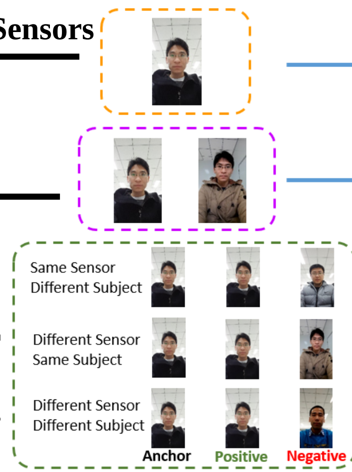
Total no. of images = 14,451

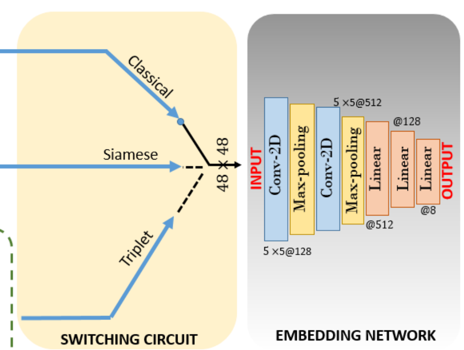
Loss

Cross-entropy loss, Contrastive loss, Triplet loss (offline and online triplet mining), Multi-class N-pair

Analysis

Used Classical, Siamese and Triplet training paradigms. Analyzed varying input resolution, distance metrics and embedding dimensionality





Baselines

Enhanced PRNU (sensor)
COTS and ResNet-101 (biometric)

Results

Siamese network with single-margin contrastive loss outperformed other training routines

Best performance on face images with joint identification accuracy 99.81% @ Rank 1 (Baseline 83.13%); joint verification accuracy 100% @ 1% FMR

Summary

Performed one-shot learning of joint biometric-sensor template for 3 modalities with promising results

REFERENCES
Marsico et al., PR 2018
Boulkenafet et al., FG 2017
Li, T-IFS 2010
Bromley et al., NeurIPS 1993