Effects of Social Problems and Human Factor on Biometric System Reliability

ESR 6

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Biometric System Reliability

- Introduction
- Time Effects
- Stress and Fatigue
- Ethnicity, Gender
- Habituation
- Illness
- Nationality
- Conclusions
- ??

Introduction

- Biometrics depend on what you are,:

A. Society effects: aging effect is different for people of different race or dietary culture.

B. User interaction: Different languages with different handwritings .

- the user is key to providing the biometric sample.

A. The ease of interaction with machines significantly influences final effects.

B. Subject's capabilities, habituation and trust to the technology.

Time Effects

- age factors:
  - age-related impairments in biometric characteristics (Old age)
  - namely aging of biometric data (Template)

"False Acceptance Rate of handwriting-based biometrics is higher for Older indivisuals." [14]
"Effects of aging on voice: Less efficient respiratory system (Speech slows down) [15], Less flexible larynx cartilages [16], Changes in pitch [17, 18], Shakiness in the voice [19]".
"For Older.: pen dynamics (e.g., velocity, acceleration, pen lifts) decrease in magnitude [4-6]"

Time Effects

- age factors:
  - age-related impairments in biometric characteristics (Old age)
  - namely aging of biometric data (Template)

"Young population provides higher quality fingerprint samples than an elderly population" [8]
"error rate of a fingerprint biometric system increases for an older population" [7]
"The face identification of a younger population is more difficult than for an older population" [9], and older people are easier to recognize than younger ones [10].
the iris are primarily the result of the physiology of pupil dilation mechanisms and pupil dilation responsiveness decreases with age:
Fairhurst and Erbilek reported on age groupings of "<25," "25–60," and ">60." [1]

Time Effects

"elderly participants experienced more timeouts than younger for completing the experimental tasks on an ATM." [20]
Ziefle and Bay [21] in their study on the usability of mobile phone menus concluded that:
"With age, spatial abilities decrease in precision and quickness".
"Users form younger age group completed the task more than another group for first time." [26]

"Elderly participants explored the interface as fast as younger ones but they lacked accuracy [22]"
"long time usability for elderly must be focused on assisting with visual and physical impairments by increasing contrast, font size or making buttons easier to press." [23]

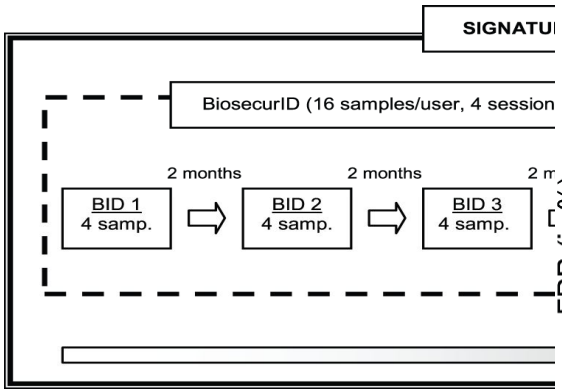
Time Effects

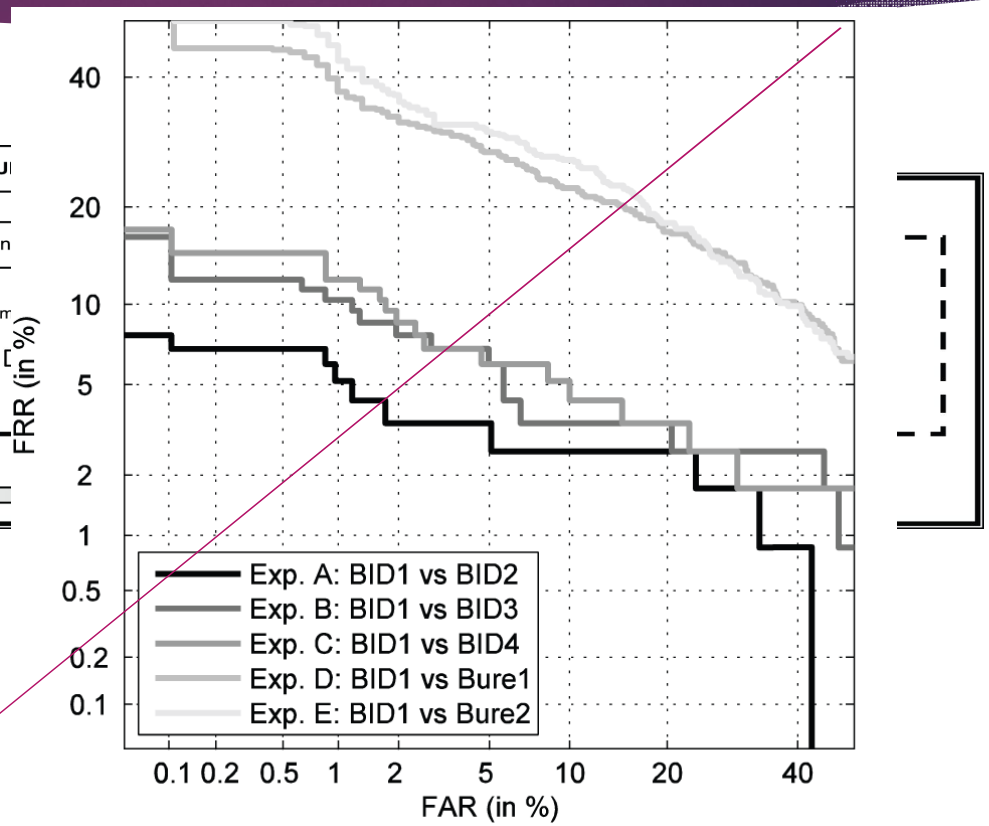
- The time lapse between when an individual's reference template is constructed and when the system is o
influence on the biometric system perfo

  Face Recognition Vendor Test usec
  individuals. The results show that the
  with increasing time lapse [36].
  "2 months after the reference data
  higher than the first sessions EER (= (
  [37] (handwriting)
  Maiorana and Campisi (2017), 3 ye
  Same trend for eye movement bio
  months) [42]
  Galbally et al. [43] reported evalua
  for 15 months.

Time Effects

- Galbally, Experiment:



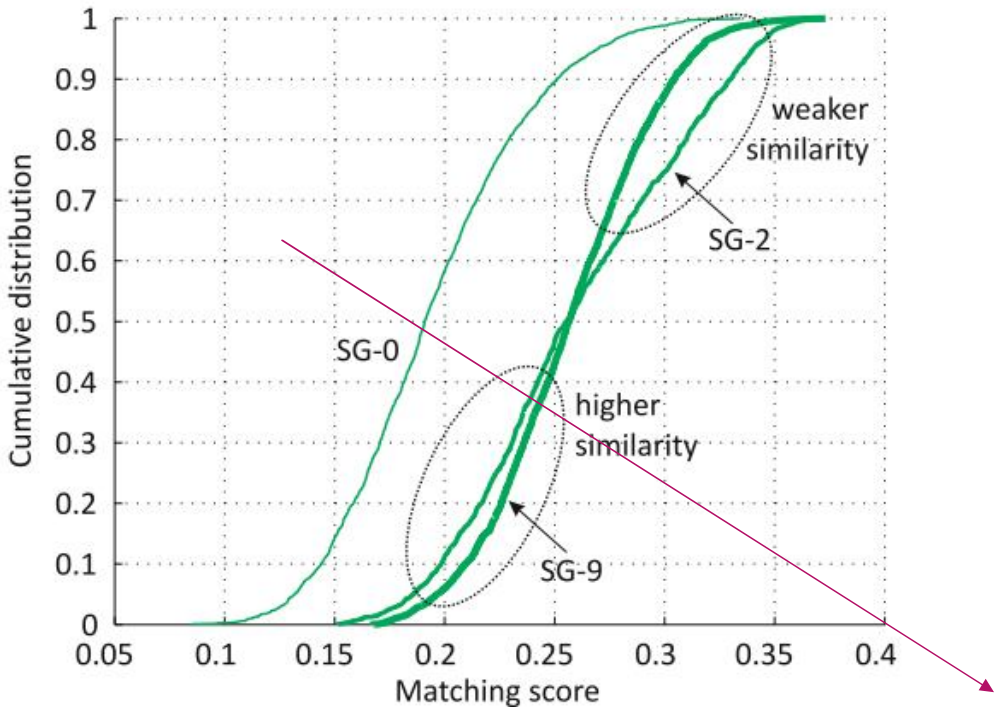


Darker gray: better performance

Time Effects

- In [73] a detailed analysis of fing
  out on a longitudinal databa
  Police, comprising data from 15.
  over a minimum 5-year time span.

4 yrs. time lapse and 1 year time lap
effect of aging on iris recognition sy
study by baker, 2013 [34].
"Significant increase in average Ha
with a 1 year time lapse."
Czajka [35], reported up to 14 % of
average genuine scores for 5 to 9 y
comparison with previous ones.



Significant change

Time Effects

- Short time Effects:
- Czajka et al. (2017) [44] reported "the daily fluctuations have an impact on iris comparison scores."
- In their experiment, the data from 18 individuals in each 2h during the day taken from Canadian border control has been used. They concluded "that the changes during day in both pupil dilation and eyelid opening are statistically significant."

Is time passing effect age and gender dependent?

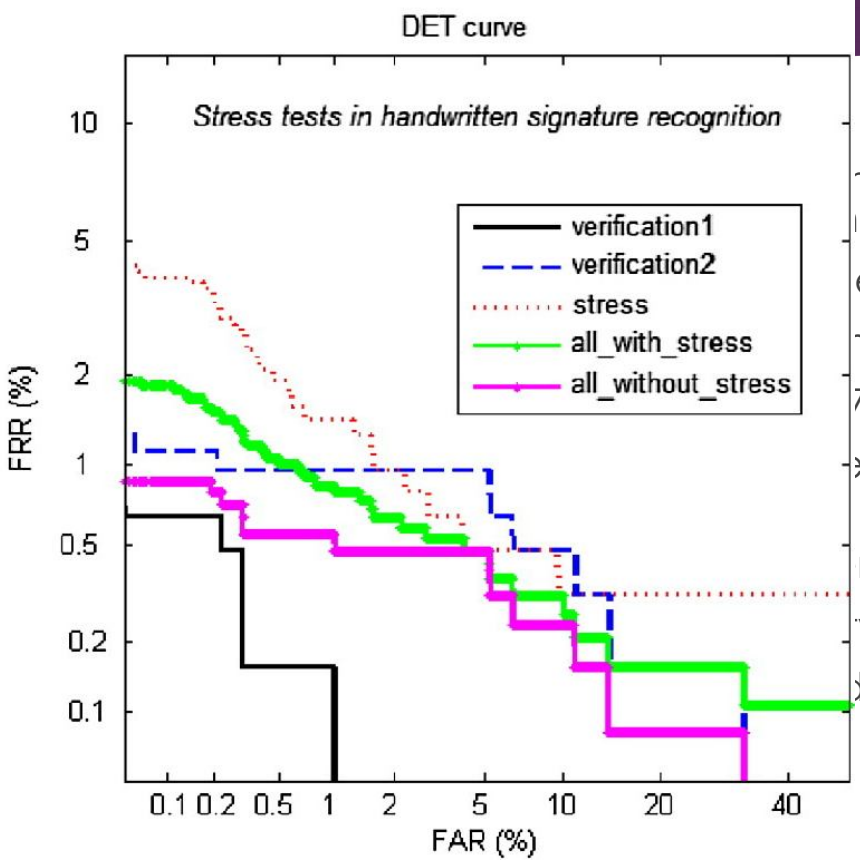
- Yes: The equal error rate (EER) increases from 4.61% at an ageing difference of 0–1 years to 32.74% at an age difference of 51–60 years. Their results show that the effect of aging is different for different age groups [44].
- Yes: "over the three year interval, there is an approximate relative increase in EER of 60% for females and 80% for males [45]"

Stress and Fatigue

- The user may suffer a certain level of stress, such as in courts, banks or even shopping.
- Chang et al., [56] found that keystroke duration changed in the presence of muscle fatigue and paralleled fatigue-related changes measured from muscle twitch durations in the finger flexor muscles.
- Komandur et al., [57] demonstrated that mouse click duration may also be a surrogate measure for finger flexor muscle twitch durations.
- Thinking clearly is affected by fatigue. Al-libawy et al. [58] presented a non-intrusive human fatigue detection method based on smartphone keyboard typing.
- "adrenaline prepares your body to fight or flee, and one of the ways it does that is by dilating your pupils." [72]

Stress and Fatigue

- Blanco-Gonzalo
- Modaility: Hand devices
- Devices: the Sar
  - 5.3-inches, 1280 ppi (HD Super A
  - Dual Core at 1.4
  - The Android ver Sandwich).
  - stylus for signing



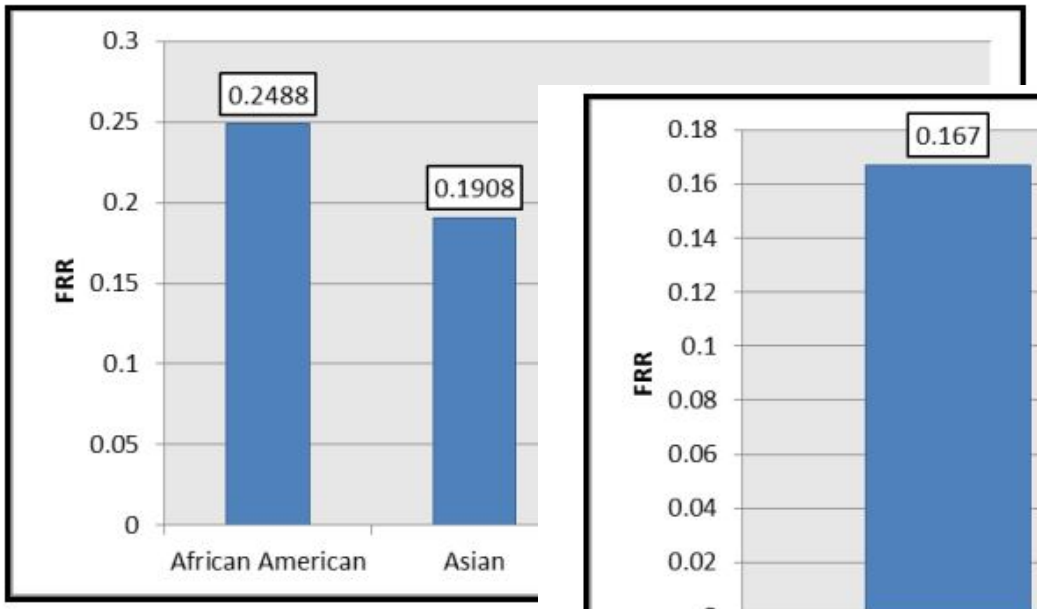
ment was divided into 2
e week apart:
enrolment and Verification 1
2 and Stress-Influence Tests
7 men and 19 women).
54 right-handed and 2 left-

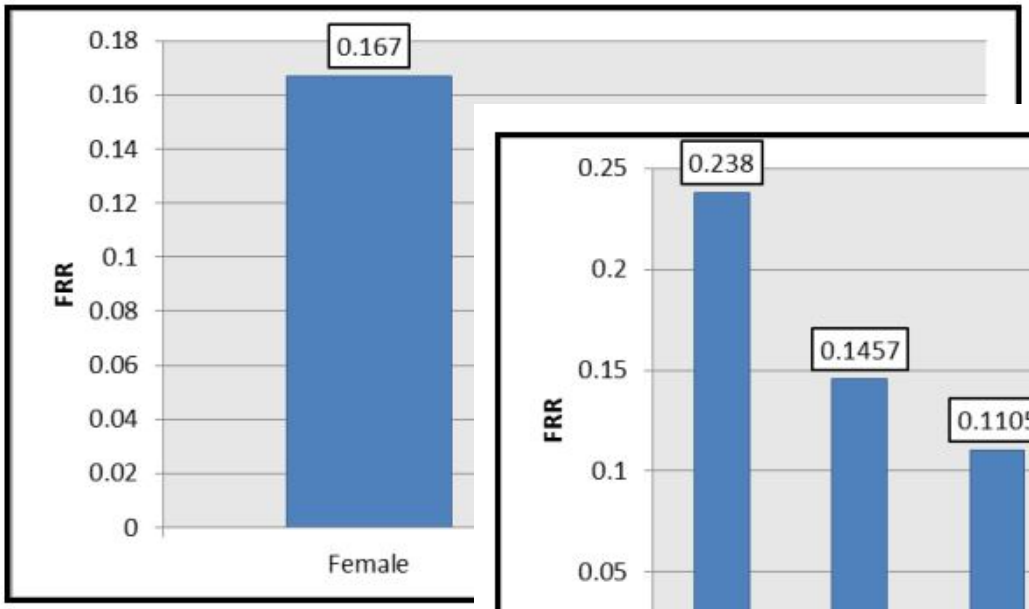
n 18 and 35 years old,
ween 35 and 50,
der than 50.

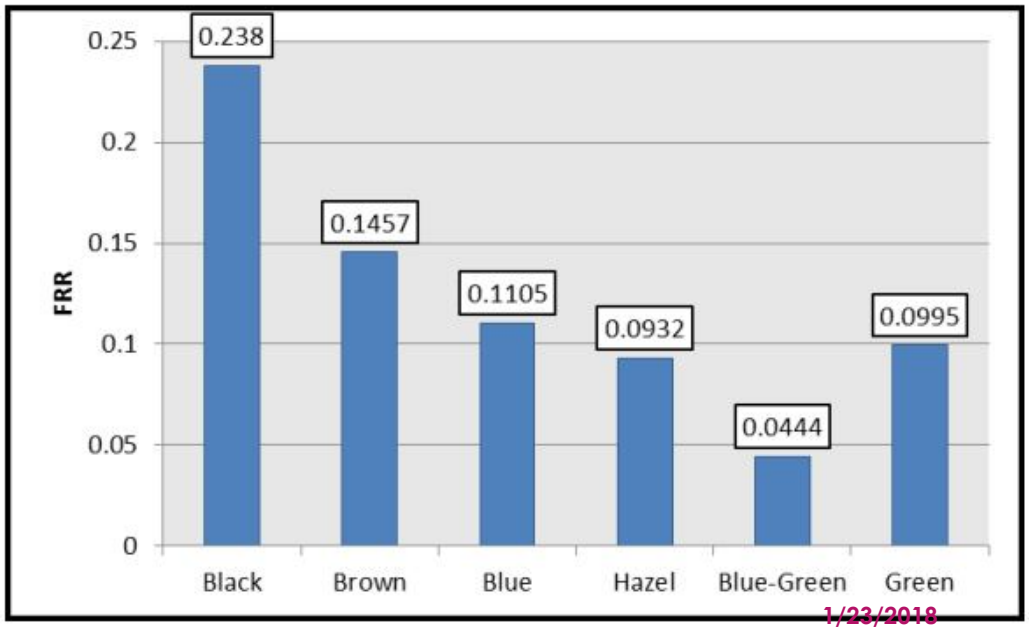
Gender and Ethnicity

- Many works are done concerned with predicting the ethnicity and the gender of a person based on analysis of features of the iris texture.
- Howard and Etter [46] has hypothesized that factors such as ethnicity, gender and eye color can play a significant role in the expected false rejection rate for various individuals across the population.
- They concluded that Asian and African American individuals with brown eyes have a distinct propensity for being incorrectly not identified by iris recognition systems.

Gender and Ethnicity







Habituation

- The handwritten signature modality in mobile devices:

1. when the signature is performed with a stylus,
2. and another when the fingertip

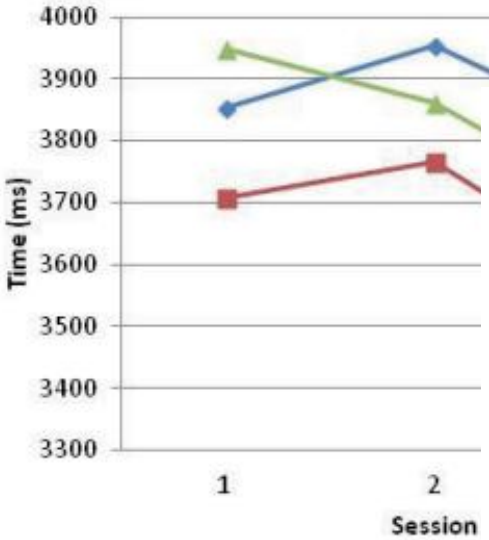
"Finger-tip-based devices are the less preferred by users because of the lack of habituation to make the signature with the fingertip. Nevertheless, results reached with some of these devices show a performance good enough, even in the line of stylus-based devices in average." [59]

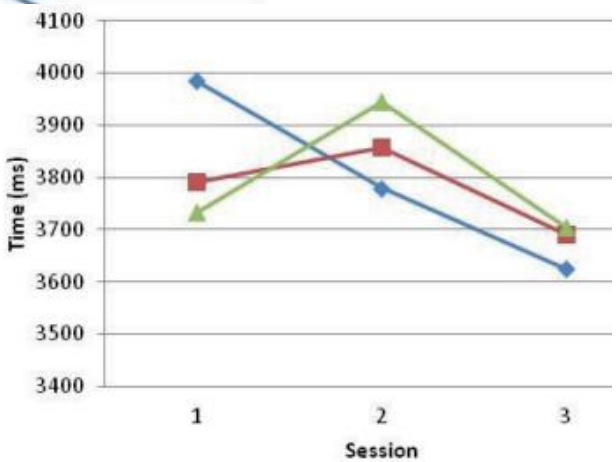
In another work by Blanco-Gonzalo et al [60] handwritten signature recognition is tested in mobile environments, for 3 different sitting positions and 3 different stylus.

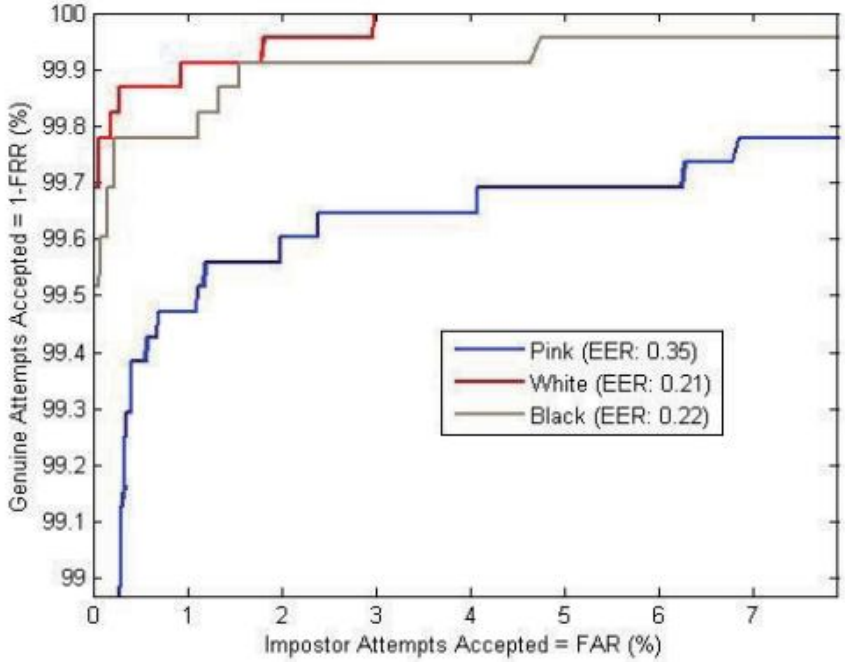
Habituation

	Pink	*White*	*Black*
S01	3.96%	0.26%	0.78%
S02	0.52%	0.93%	0.52%
S03	0.26%	0.13%	0.13%

Habituation







Habituation

01
Reference
Scenario
(All devices)

02
(HTC, iPad)

03
(Asus, HTC, STI

	S01	S02	S03	S04	S05
STU	1.06%	-	1.97%	2.43%	-
ASUS	1.97%	-	3.18%	-	-
IPAD	**7.27%**	0.49%	-	0.92%	0.6%
HTC	3.63%	2.89%	3.01%	-	1.36%

Habituation

- Smejkal et al. (2016) [70], concluded that "the quality of recognizing a signature rises with the length of the information written down (abbreviated signature, initials)".
- the use of a first signature as "practice", which would not be included in the results, reduced the variability of signatures among all participants.
- A total of 26 people took part.
- Only less than 10 % of standard signatures take the form (and therefore the length) of a short signature .

Illness

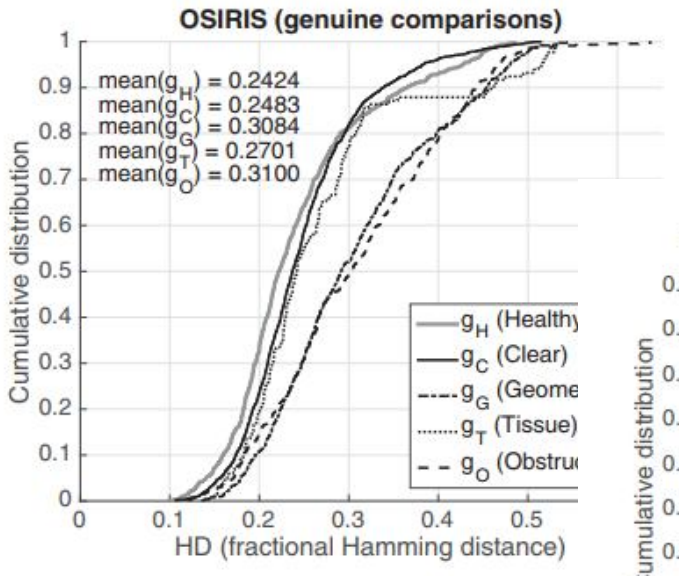
Seyeddain , 2014 [62] investigated drug-induced pupil dilation.

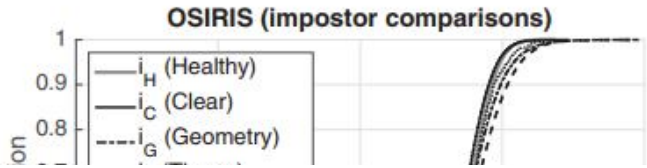
Osman, et al. [63] proposed a facial recognition system for recognizing faces after plastic surgery. They reported more than 91% verification rate, which was considered the highest verification accuracy reported so far compared with the state- of-the-art face recognition systems after plastic surgery.

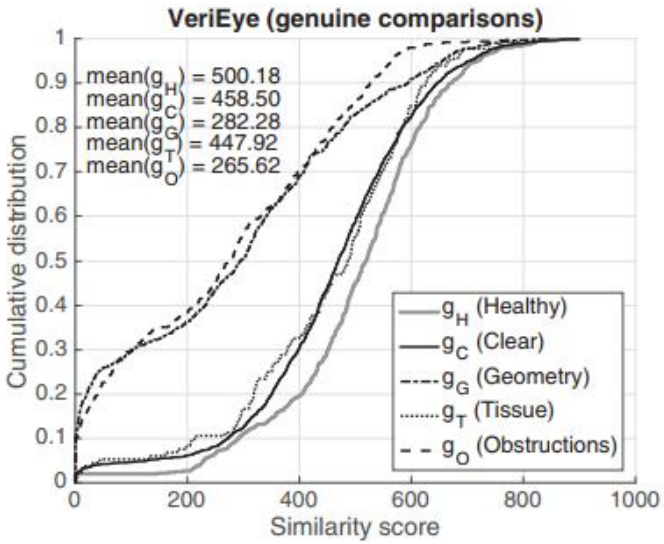
Trokielewicz, et al. [61] presented an analysis of how the iris recognition is impacted by eye diseases and an appropriate dataset comprising 2996 iris images of 230 distinct eyes (including 184 illness-affected eyes representing more than 20 different eye conditions).

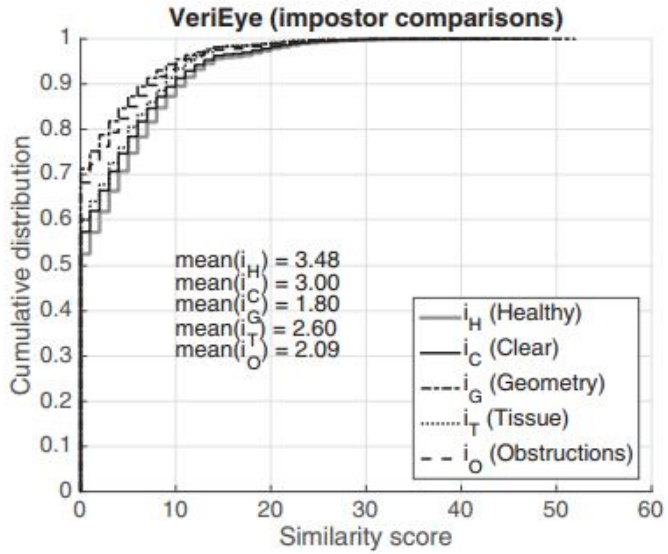
"eye conditions affecting iris geometry, its tissue structure or producing obstructions significantly decrease the iris recognition reliability"

Illness

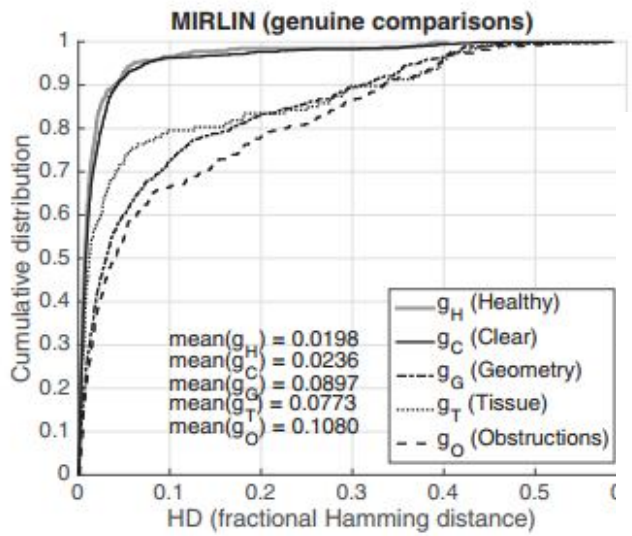

OSIRIS (genuine comparisons)
mean(g_H) = 0.2424
mean(g_C) = 0.2483
mean(g_G) = 0.3084
mean(g_T) = 0.2701
mean(g_O) = 0.3100
g_H (Healthy
g_C (Clear)
g_G (Geome
g_T (Tissue)
g_O (Obstru
Cumulative distribution
HD (fractional Hamming distance)


OSIRIS (impostor comparisons)
i_H (Healthy)
i_C (Clear)
i_G (Geometry)

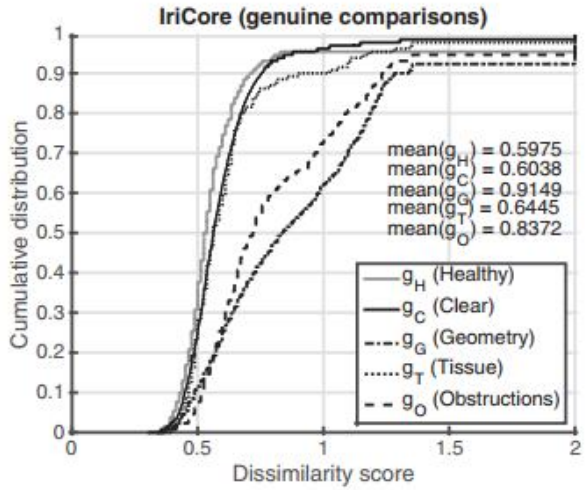

VeriEye (genuine comparisons)
mean(g_H) = 500.18
mean(g_C) = 458.50
mean(g_G) = 282.28
mean(g_T) = 447.92
mean(g_O) = 265.62
g_H (Healthy)
g_C (Clear)
g_G (Geometry)
g_T (Tissue)
g_O (Obstructions)
Cumulative distribution
Similarity score

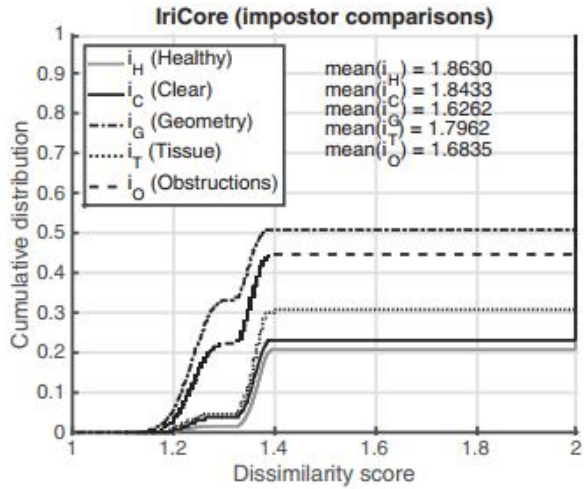

VeriEye (impostor comparisons)
mean(i_H) = 3.48
mean(i_C) = 3.00
mean(i_G) = 1.80
mean(i_T) = 2.60
mean(i_O) = 2.09
i_H (Healthy)
i_C (Clear)
i_G (Geometry)
i_T (Tissue)
i_O (Obstructions)
Cumulative distribution
Similarity score

Illness


MIRLIN (genuine comparisons)
Cumulative distribution
HD (fractional Hamming distance)
mean(g_H) = 0.0198
mean(g_C) = 0.0236
mean(g_G) = 0.0897
mean(g_T) = 0.0773
mean(g_O) = 0.1080
g_H (Healthy)
g_C (Clear)
g_G (Geometry)
g_T (Tissue)
g_O (Obstructions)


MIRLIN (impostor comparisons)
mean(i_H) = 0.4053
mean(i_C) = 0.4027


IriCore (genuine comparisons)
Cumulative distribution
Dissimilarity score
mean(g_H) = 0.5975
mean(g_C) = 0.6038
mean(g_G) = 0.9149
mean(g_T) = 0.6445
mean(g_O) = 0.8372
g_H (Healthy)
g_C (Clear)
g_G (Geometry)
g_T (Tissue)
g_O (Obstructions)


IriCore (impostor comparisons)
Cumulative distribution
Dissimilarity score
i_H (Healthy)
i_C (Clear)
i_G (Geometry)
i_T (Tissue)
i_O (Obstructions)
mean(i_H) = 1.8630
mean(i_C) = 1.8433
mean(i_G) = 1.6262
mean(i_T) = 1.7962
mean(i_O) = 1.6835

Illness

It is extremely difficult to collect a database that contains images before and after plastic surge

There is only one ch contains 1012 fac

The database ho

Illness

Drotar g
databc)
patient

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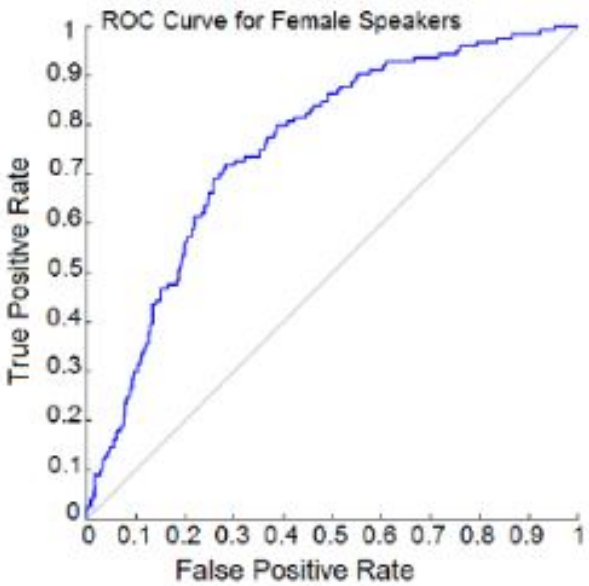
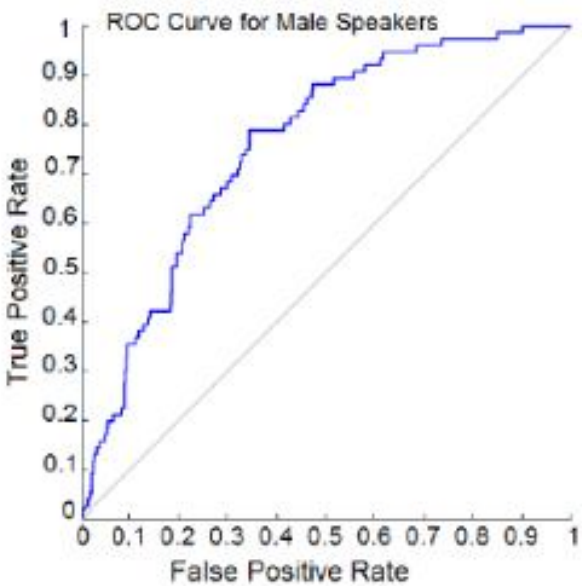




Illness

Arora et al. [67] have investigated one such challenge, namely matching iris images captured before and after alcohol consumption.

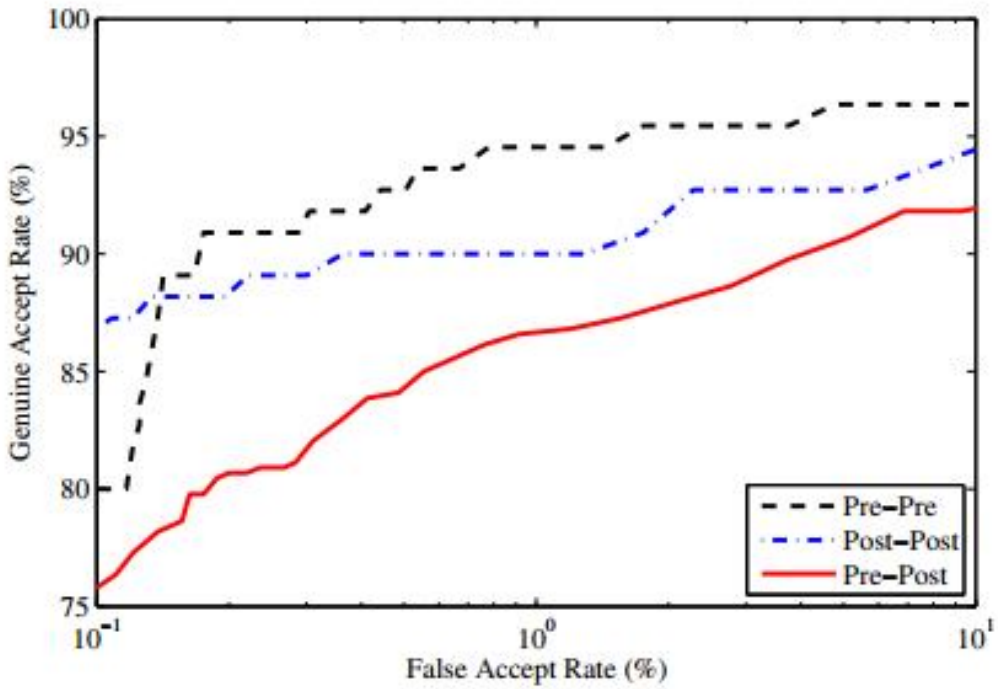
- Due to alcohol consumption, the pupil dilates/constricts which causes deformation in iris pattern, possibly affecting iris recognition performance.
- The experiments performed on the "IIITD Iris Under Alcohol Influence" database show that in matching pre and post alcohol consumption images
- the overlap between genuine and impostor match score distributions increases by approximately 20%.

Illness

- VeryEye Is used.
  - Pre-Pre: first sessions – healthy.
  - Post-Post: second sessions- alcohol.
  - Pre-Post: Comparison.

"Arora et al. [67]

This change is dynamic
and varies from person to person. "

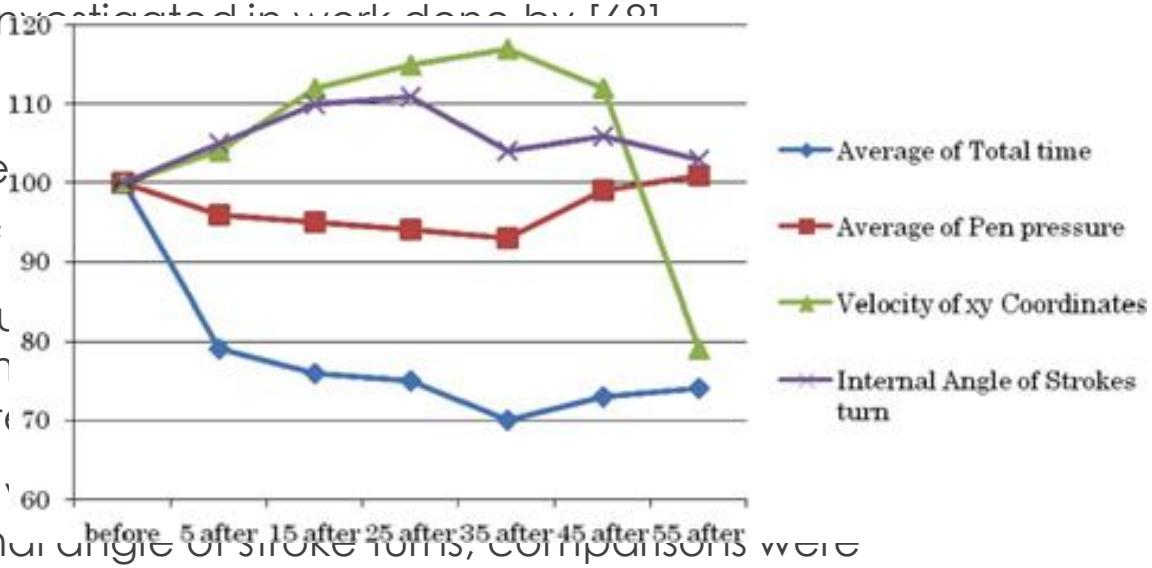


Illness

- The change in a handwritten signature before and after alcoholic intake over 30 indivisuals has been in[illegible]

- The experiment protocol was [illegible]

1. Record the signature 20 time[illegible]
2. ask indivisuals Drink 100 mL of [illegible]
3. and then Record the signatu[illegible] after alcohol consumption an[illegible] subjects using an alcohol det[illegible]



The mean total time required to [illegible] velocity of xy coordinates, Internal angle of stroke turns, comparisons were made before and after alcohol consumption.

Nationality

- We have several documents related to effect of cultural differences and nationalities on technology acceptance (not biometrics especially in mobile smartphones)
- Nothing has been done yet!

Conclusions and Future works

- Do biometrics change over time?
- The effects of aging on the accuracy of biometric recognition system?
- How does an individual's age affect the quality of a sample?
- What role does gender play?
- Can Illness influence the reliability of recognition system ?
- Is there any relationship between usability of system and users Nationality?
- Effect of the mentioned factors on performance of biometric system?
- How about mobile scenarios?

Questions??