

An Introduction to Biometrics



Julian Ashbourn

In the Beginning

- ❖ Did ancient civilisations use biometrics?
 - ❖ “Nechutes, son of Asos, aged forty, of middle size, sallow complexion, cheerful countenance, long face with straight nose and a scar upon the middle of his forehead...”



Afterwards

- ❖ Alphonse Bertillon 1853-1914
 - ❖ A fascination with anatomical measurement within the context of criminology
 - ❖ Bertillon developed a complex system of measurements and photography which came to be widely used ~ Anthropometry
 - ❖ A pioneer of the criminal mug-shot

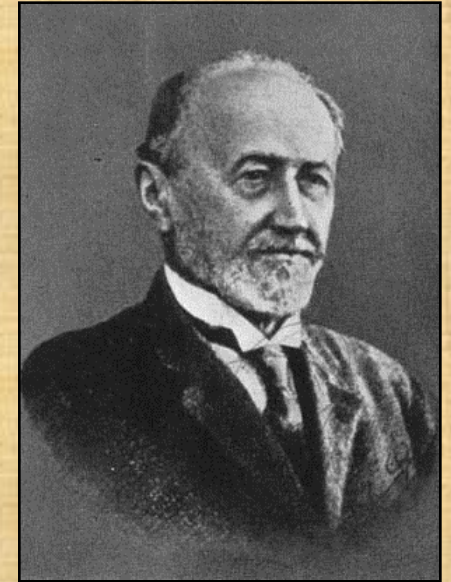


Biometrics and Eugenics

- ❖ Karl Pearson, statistician and protégé of Galton formed a biometric laboratory at the University of London in 1907
- ❖ The journal 'Biometrika' becomes influential (particularly in the USA) as the concept of eugenics becomes political
- ❖ The Carnegie Institution create the Centre for Genetic Research and in 1910 the Eugenics Record Office founded at Cold Spring Harbor in the USA where 'intelligence tests' are initiated
- ❖ US psychologist Henry Goddard submits an influential study on the 'Inheritance of Feeble-mindedness'
- ❖ By 1931, 27 US states had enacted sterilisation laws
- ❖ By 1941, 36,000 individuals in America had been sterilised under these laws
- ❖ Germany and Switzerland pick up the thread of 'eugenics'.....

And Evolves

- ❖ Juan Vucetich 1858-1925
 - ❖ Developed a system of fingerprint classification based upon Galton's ideas, for the Argentine police
 - ❖ First positive identification by fingerprints in a criminal case (Francisca Rojas)
 - ❖ System widely adopted by police forces in many countries
 - ❖ Galton-Henry system adopted by Scotland Yard



Interim Conclusion

- ❖ The idea of using a biometric for identity verification purposes is hardly new
- ❖ What has changed is the prospect of automation within the information age

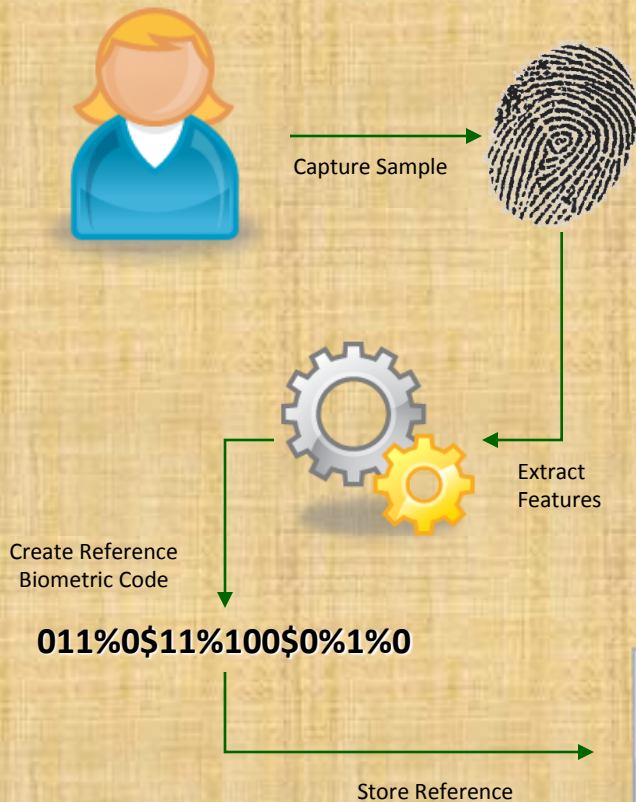


Modern Principles of Operation

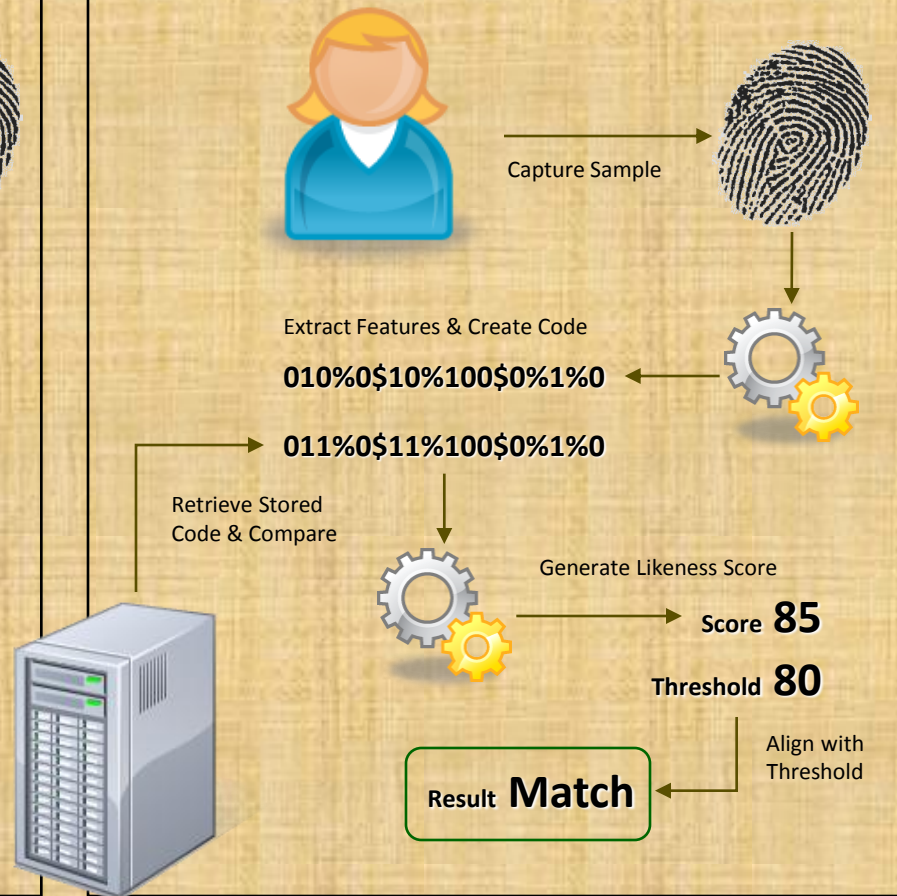
- ❖ How does it all work?
 - ❖ Determine features to be matched
 - ❖ Extract features and create biometric reference
 - ❖ Extract features from live sample and match against reference creating a 'statement of likeness'
 - ❖ Determine a match or non-match according to the alignment of the statement of likeness against a pre-defined threshold
 - ❖ Thresholds may be adjustable in order to manipulate realised performance

In Simple Terms

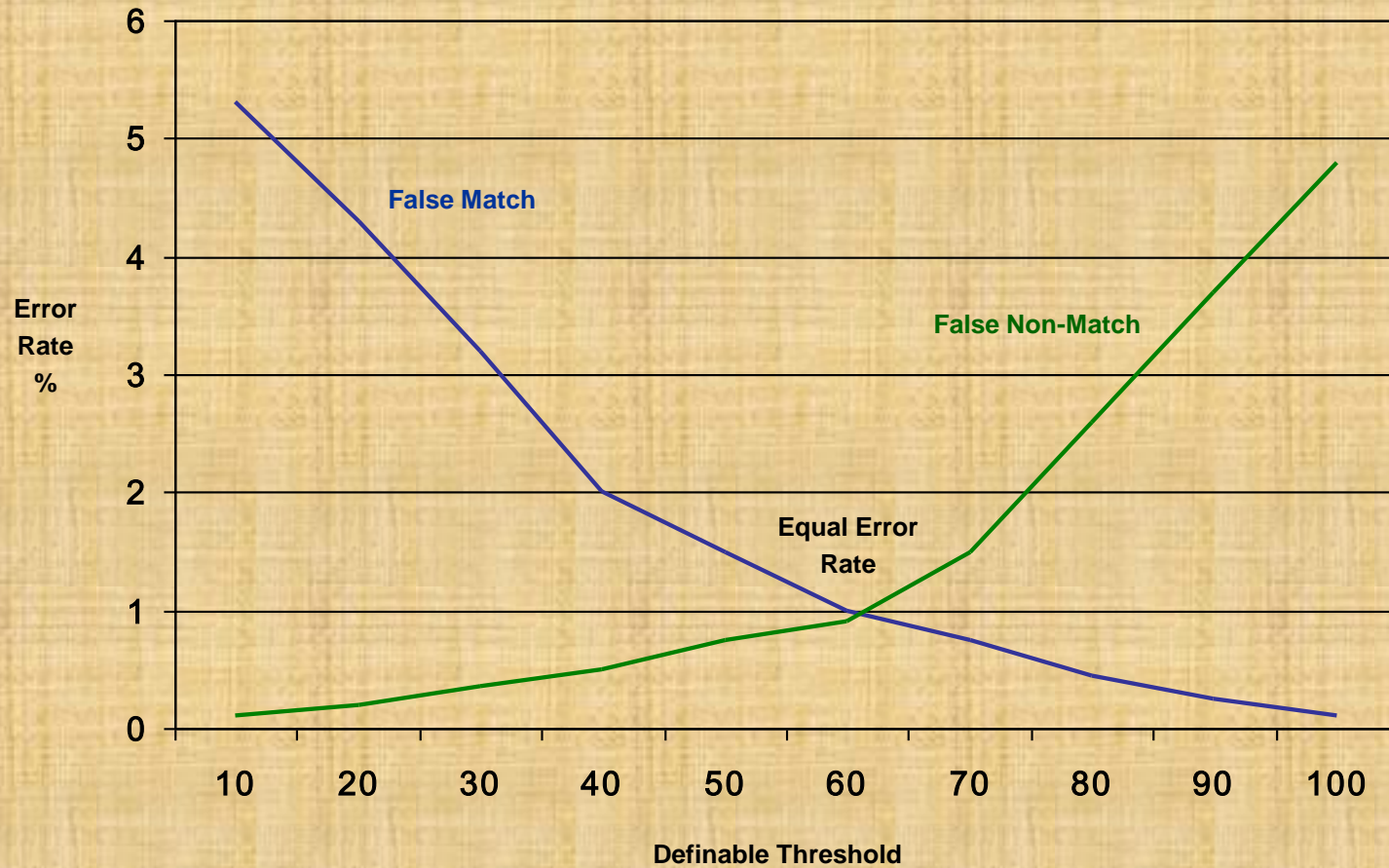
❖ Registration



❖ Live Operation



Probability of Errors



Environmental Factors

- ❖ Operational environment
 - ❖ Temperature, humidity, available light, noise levels, cleanliness, signage
- ❖ Technical environment
 - ❖ Network availability, noise, power stability, component performance
- ❖ User psychology
 - ❖ Habituated or non-habituated user, sympathetic or not to concept, disabilities, confidence, general understanding of technology

Real Performance

The screenshot shows the 'User Psychology Index' application window. The title bar includes a smiley face icon and the text 'User Psychology Index'. The menu bar contains 'File', 'Wizards', and 'Help'. A text box at the top explains the wizard's purpose: 'The purpose of this wizard is to calculate more meaningful error rates based upon user psychology under real world operational and environmental conditions. This will in turn help to develop an understanding of scalability issues'. Below this is a 'Close' button. A tabbed interface shows 'Device Details' as the active tab, with other tabs for 'Usability', 'Template', 'Familiarity', 'Competence', 'Attitude', 'Environment', 'External Pressure', and 'Conclusions'. The main area is divided into two panels. The left panel, titled 'You have chosen the following settings', lists: Usability (Good), Template Quality (Fair), Familiarity (Poor), Competence (Fair), Attitude (Fair), Environment (Fair), and External Pressure (Good). The right panel, titled 'Device Name or Type', shows 'Dreadnought 9' in a text field. Below this are two columns of data: 'Quoted FAR' (0.50) and 'Proposed FAR' (1.3572); 'Quoted FRR' (0.70) and 'Proposed FRR' (3.8); and 'UPI Values' (2.7143, 5.4286) and 'Proposed AER' (4.735). At the bottom, there are three buttons: 'Return to Start' (with a hand icon), 'Save Data' (with a floppy disk icon), and 'Calculate' (with a calculator icon).

User Psychology Index

File Wizards Help

The purpose of this wizard is to calculate more meaningful error rates based upon user psychology under real world operational and environmental conditions. This will in turn help to develop an understanding of scalability issues

Close

Device Details Usability Template Familiarity Competence Attitude Environment External Pressure Conclusions

You have chosen the following settings

Usability	Good
Template Quality	Fair
Familiarity	Poor
Competence	Fair
Attitude	Fair
Environment	Fair
External Pressure	Good

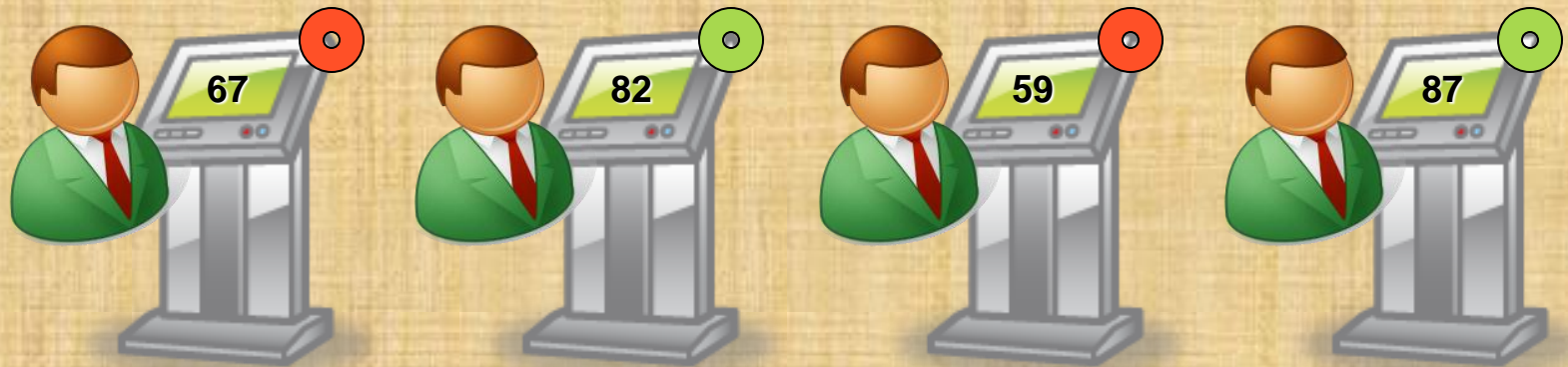
Device Name or Type

Dreadnought 9

Quoted FAR	Proposed FAR
0.50	1.3572
Quoted FRR	Proposed FRR
0.70	3.8
UPI Values	Proposed AER
2.7143 5.4286	4.735

Return to Start Save Data Calculate

Equivalence of Performance



- ❖ Who installed the system?
- ❖ Who set the threshold?
- ❖ Against what criteria?
- ❖ Who is maintaining the system?
- ❖ How often is it checked?



Maintaining Equivalence

APEX Simulator

File Help

Node 1

Threshold	Average
148	70
22	46
119	56
79	54
97	54
34	56
105	54
114	58
107	48
41	65
54	56
111	59
34	68
86	69
6	61
115	58
46	65
60	61
55	58
116	74
69	70
105	
62	
15	
99	
117	
30	
14	
8	
116	
86	

Node 2

Threshold	Average
136	71
60	32
66	56
119	66
91	49
28	50
49	63
95	52
41	70
30	62
99	61
42	67
116	68
72	62
6	65
67	66
97	77
104	65
112	69
69	67
65	71
118	
59	
58	
116	
36	
102	
9	
62	
72	
97	

Node 3

Threshold	Average
151	70
99	46
115	58
30	54
19	51
95	51
98	47
22	52
111	66
92	51
94	62
69	64
20	59
68	62
80	63
65	58
86	69
76	54
97	78
86	62
105	70
11	
12	
98	
86	
95	
15	
33	
83	
96	
67	

Sample Size **Performance**

30 70

APEX

FAR		FRR
0.75	Node 1	1.75
0.7375	Node 2	1.775
0.75	Node 3	1.75

Operation

1) Select a sample size
 2) Select a performance level
 3) Click on the start button

2000

Start

Stop

Clear

Exit

Interim Conclusion

- ❖ Biometric matching is not an exact science
- ❖ System implementation may be complex
- ❖ Understanding performance is important
- ❖ True systems integration is potentially complex



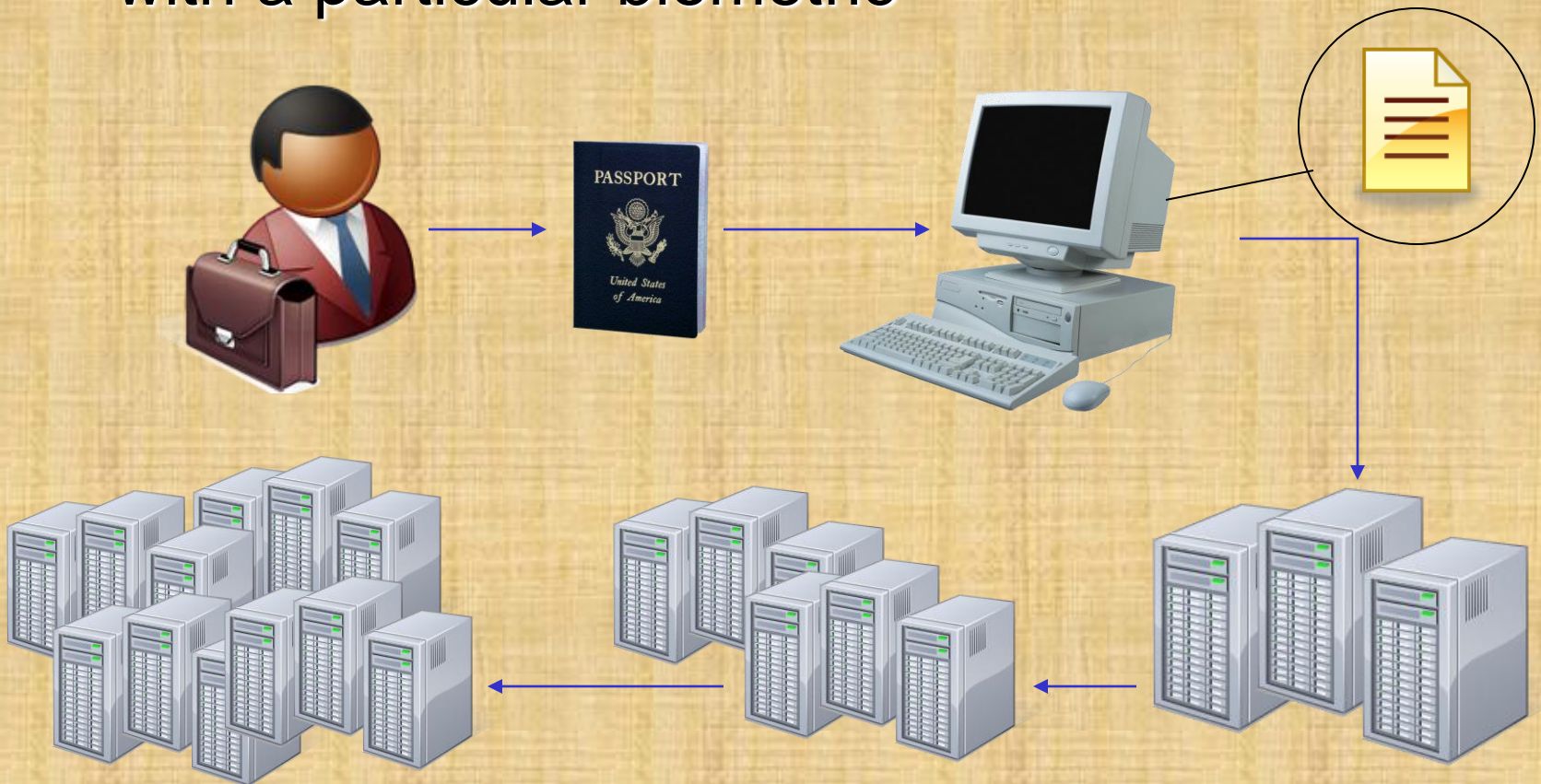
Working with Biometrics

❖ Some fundamentals

- ❖ Under what situations might it be pertinent to undertake a biometric identity verification check?
- ❖ Who does the biometric belong to?
- ❖ Who should decide how it is used?
- ❖ Who has access to data aligned with a biometric?
- ❖ Can a biometric match be repudiated?
- ❖ Should a biometric be used covertly?
- ❖ What assumptions are made around the results of a biometric identity verification transaction?

Information Alignment

- ❖ How accurate is the information associated with a particular biometric



Supporting Biometrics

- ❖ Reduced help desk calls?
- ❖ Managing templates and directories
- ❖ Enrolment procedures
 - ❖ Establishing an identity
 - ❖ Template quality
 - ❖ User instruction
- ❖ Exception handling
 - ❖ Repudiation
 - ❖ Biometric forensics



Biometrics in the Cloud

- ❖ Federated identities
 - ❖ Implications for the registration process
 - ❖ Who owns them? who services them?
 - ❖ Who maintains the directory of biometrics?
- ❖ Alignment with profiles, privileges, location, device and other factors (context based)
- ❖ Virtualised environments and identity management
- ❖ A Pandora's Box of biometrics



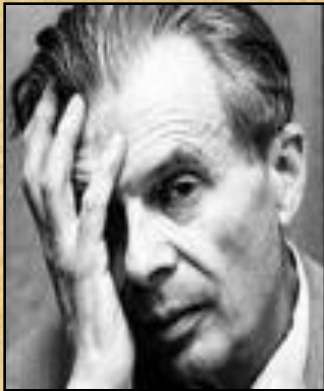
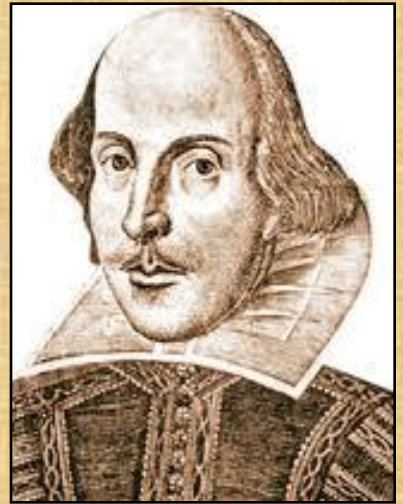
A Brave New World

❖ William Shakespeare

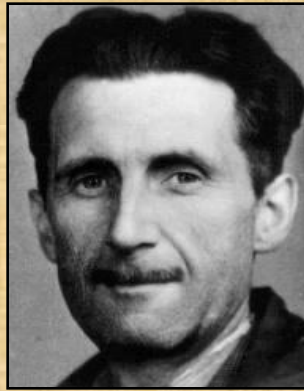
O wonder! How many goodly creatures are there here!
How beauteous mankind is!

O brave new world!

❖ Or....



Aldus Huxley



George Orwell

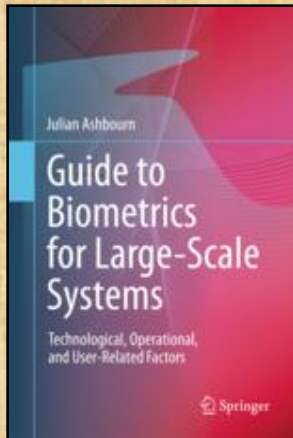


H.G. Wells

Final Conclusion

- ❖ The time has come to take a fresh look at what we might achieve with this technology
 - ❖ A re-statement of relevance
 - ❖ Best practices around systems integration
 - ❖ Clarity around privacy, ownership and data protection (on an international scale)
 - ❖ Clarity of purpose with respect to large scale public sector applications (and communication)
- ❖ A Biometric Constitution?
- ❖ See <http://biometrics.zzi.org>

Thank You



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