

# Biometric identifiers- manual, computer aided & automatic

Historical perspective relative to  
needs

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# Introduction

- This will be a gallop through the history and pre-history of biometric identification.
- Jim Wayman has written a detailed account.
- I started a biometric project in 1972. This was at NPL. My mentor was the late Donald Davies FRS.
- My survey includes forensic fingerprint ID and very early work on “signing” official documents with a fingerprint as proof of commitment (non-repudiation)

# Fingerprints (1)

- Social needs drove the market in ancient China. Earliest record for inked fingerprints on official documents dates from 3<sup>rd</sup> century BC.
- In West there was no interest in the skin's ridge patterns until the mid-1680's.
- Then purely academic studies began with Nehemiah Grew in UK and Marcello Malpighi in Italy.

# Fingerprints (2)

- Social needs manifested themselves with the arrival of the Industrial Revolution.
- The growth of industrial cities and major ports was facilitated by railways, canals and ship.
- Crime “followed the money”
- Fingerprinting persistent criminals was proposed.

# Fingerprint (3)

- In 1858 Sir William Herschel first used fingerprints on contracts in India. He later required two finger prints. Noting the uniqueness of the impressions inspired him and others to expand their use to prove or disprove identity.
- By 1880 Faulds devised a classification system for manual matching

# Fingerprint (4)

- Faulds asked Darwin for advice on the classification.
- Darwin referred him to his cousin, Francis Galton.
- Galton pursued the topic . In 1892 he published his book “Fingerprints”. This established the individuality and permanence of fingerprints.
- In 1900 Edward Henry convinced the UK Home Office to adopt his system for the identification of criminals. A particular benefit came from the capture of latent prints at scene of crime.

# Fingerprints (5)

- In July 1903 the Metropolitan Police created the fingerprint branch.
- The Identification Division of The FBI was established in 1924. This became the largest system in the world with 100 million card records by 1946.
- By the 1970's automation became essential. Today's AFIS systems resulted. These allow manual checks where there is doubt.

# Automatic fingerprint matching in real time (1)

- From the 1970's many research groups in Europe, North America and Japan have devised equipment for such applications as physical access control and retail banking. The need is deceptively simple compared with AFIS. Just a 1-1 match!
- A card holder claims his identity and is authenticated by touching a sensor with a specific finger. Software decides if his ID claim is genuine.

# Automated fingerprint matching in real time (2)

- Problems with early optical and “touch” chip sensors were numerous. “spoofing” became a concern.
- High cost and excessive False rejects prevented wide-spread adoption until the last few years.
- The Banks went for “Chip & PIN”
- Now at last touch chip devices are used on some lap-tops and mobile phones.

# Alternative biometrics for real time authentication(1)

- Much R&D has been expended on these.
- Candidate Physical characteristics included
- Hand shape, finger length, vascular patterns, speaker verification, handwritten signature, gait, face recognition, retinal scanning and iris recognition.
- Handshape has been widely used. It suits manual workers whose fingerprints may be damaged.
- Face is now doing well in certain applications.

# Speaker verification

- This has proved very much more difficult than it seemed in the 1990's.
- The economics are very favourable. Any telephone microphone is good enough for input.
- The market for M-commerce and e-commerce is potentially enormous.
- Verification can be done in a mobile phone or centrally.
- Recent reports suggest good progress.

# Signature verification

- I worked on this 1972-83 and 1990-3.
- With University of Kent we ran the world's first public trial at Hedge End in 1992.
- It had a higher False Accept Rate than PIN's but was popular with the Public.
- Efforts to reduce the FAR continue.
- The economics for use with touch screen Mobiles and PDA's are very favourable.

# Vascular (vein patterns)

- I worked on this 1983-93.
- The Inventor was Mr Joe Rice of Kodak (UK).
- We were ahead of our time.
- Inspired development work in S Korea and Japan has resulted in viable products
- Fujitsu's "PalmSecure" and Hitachi's Finger vein technologies are widely used in Japan.

# Iris Recognition

- Professor John Daugman of Cambridge has done outstanding research work on this.
- Given a good enrolment accuracy is very high
- Commercial progress was hampered until recently by patent problems.
- Hopefully these have been resolved.
- Distance iris image capture systems have been developed at the Sarnoff Labs.

# Face recognition

- This is the ideal contactless biometric
- Early promise was not fulfilled. However great progress has been made including by Aurora and Omniperception in the UK.
- Attempts to spoof the machines by replaying videos etc can be detected.
- Residual errors can be culled manually.

# Other candidate biometrics

- Ear sound emissions, Skin Texture, Typing Rhythm, Gait and Brain wave patterns.
- For the Brain patterns see [www.humabio-eu.org](http://www.humabio-eu.org)

# Multi-modal biometrics

- Usually this means combining two distinct modalities. Say Voice and fingerprint.
- Some people say I was the first to propose this approach to reduce False Match and False Non-Match. I was not.
- However I was a very early advocate of this approach.

# DNA Fingerprinting

- This was invented by Professor Sir Alec Jeffreys at the University of Leicester in September 1984. It was deployed in police work within a few months of the first reports.
- Although initially purely a forensic technique for identification it may soon be used for near real time applications.
- It differs from all the others mentioned in being digital rather than analogue in nature.
- Identical twins are, apparently, indistinguishable.

# Where do we go from here?

- Biometric technologies are still evolving.
- So forecasting is hazardous.
- What seems impractical today may be economic tomorrow.

Thanks for this opportunity to  
speak to you

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