Original Research Paper

Biometric Finger Print Identification
Is It a Reliable Tool or Not?

*Arsalaan. F. Rashid, **Mehreen Lateef, ***Balbir Kaur, ***O. P. Aggarwal, ****Sajad Hamid, *****Neeraj Gupta

Abstract

Compared to a visual comparison of signatures or photo ID's, biometric identification is more accurate and less time consuming. This has resulted in application of biometric identification in diverse field from preparation of nationwide databases to daily attendance taking of employees of governmental and non governmental institutions. The present study is based of employee database registering attendance through biometric means. An important conclusion of the study is that biometric identification is not infallible and is prone to non correctable errors. Wearing down of fingerprint pattern was found to be a major source of errors in registering biometric fingerprint attendance. In agrarian rural economies like India were hard manual labour may be the only means of subsistence for a large population, this inaccuracy can be a source of avoidable problem for poor and hardworking people. This becomes especially significant when biometric identification based "Adhaar" cards are made a prerequisite for getting wages from government sponsored schemes developed for benefit of poor unemployed strata of Indian population. Databases developed by such methods are prone to limitations which have to be thoughtfully corrected before the system is fully institutionalized.

Key Words: Biometric identification, Databases, Rural Economies, Adhaar cards

Introduction:

"Biometric identification" is a general term for technologies that permit matches between a "live" digital image of a part of the body and a previously recorded image of the same part, usually indexed to personal or financial information. [1] Biometric identifiers include digital fingerprints, retinal scans, hand geometry, facial characteristics, and vocal patterns. Biometric scanning systems typically do not record the entire imprint of a physical feature but only that portion, or "template" that should be time-invariant within some statistical limit. Since the body changes over time, the statistical algorithm must be elastic enough to match a stored image with a later live scan from the same person, without normally matching two similar individuals.

Corresponding Author:

* Senior Resident, Department of Forensic Medicine, SKIMS Medical College, Bemina Srinagar
E-mail: afrashid@gmail.com
** P.G. Student First Year,
 ***Prof
 ***Prof & HOD, Dept. of FMT, MMIMSR, Mullana
****Lecturer, Dept. of Anatomy, SKIMSMC, Bemina
****Senior Executive, Dept. of Information Technology, MMIMSR, Mullana,
DOR: 28.12.12   DOA: 22.2.13

This creates limitations on the uniqueness of the images, which are overcome by using multiple images from one person, or a biometric image plus other information.

In some applications identities can be verified within a population of millions. Compared to a visual comparison of signatures or photo ID's, biometric identification is less fallible and potentially much faster. This has prompted the use of biometrics for noncriminal governmental and commercial applications. [2]

Material and Methods:

The study was undertaken on the employees and students of a University undergoing biometric verification for purpose of attendance. A total of 3250 staff and non staff members of this University campus were taking biometric identification for daily attendances were analyzed for this study. 1250 people belonged to teaching staff (38.46%), 1400 were from non-teaching category (43.07%) and 600 belonged to intern/house physician/post graduate student group (18.46%). (Table 1)

Out of 3250 subjects 25 (0.769%) had problems registering their attendance. These 25 subjects were divided into three categories namely Elderly >60 years age; Manual labourers; Females. Careful examination of fingerprints was done using high power magnifying glass as aid.

The biometric capture device model A 10 is an optical image capture solid state charge coupled device with piezoelectric ultrasonic transducer mechanism for live scan capture. (Fig.1, 2)

Observations and Results:

It was observed that out of total 3250 employees 25 people had problems registering their attendance through biometric means (0.769%). Out of these 25 people two belonged to elderly staff category (> 60 years) (8%); 19 were manual workers belonging to various departments like plumbing, landscaping, sanitation, engineering etc.(76%); 4 were females who belonged to teaching staff and were also doing various household chores (16%). (Table 3)

In majority of cases the most probable cause for non registering of attendance by biometric machines was loss of finger print pattern by wear and tear (80%), age (8%), physical injuries to fingers (8%), poor body built with anemia (4%). (Table 4) As is evident excessive use of digits over prolonged time intervals results in wearing down of finger print pattern and is clearly seen on close examination of fingers. Age also plays a role due to loss of elasticity of skin. Physical injuries damaging deeper dermis also cause error in biometric readings. Among the 4 females studied two had worn out fingerprint ridge pattern; one had an old healed injury on finger and in one case none of the above mentioned causes could be found to cause error in biometric attendance.

This case was of a young, 30years female who was poorly built with hemoglobin score of 8.9 gm% only. As per history this lady was unable to register her attendance especially on cold morning days in winters. The most probable cause may be due to non registering of capillary circulatory parameters of hands essential for "live scan" biometric identification.

Discussion:

There is difference in fingerprint image quality across age groups, although most pronounced deterioration is found in > 60 age group. Error rate in biometric identification significantly increases with increase in age group. Aging results in loss of collagen; compared to younger skin, aging skin is loose and dry. (Fig.4) Decreased skin firmness directly affects the quality of fingerprints acquired by sensors. Body shows numerous age related changes overtime, therefore a statistical algorithm must be developed that should have enough pliability to match a stored image with a later live scan from the same person, without normally matching two similar individuals. [3, 4]This results in creating limitations on exclusivity of images, which may be overcome by using multiple images from one person, or biometric image plus other information.

Compared to a visual comparison of signatures or photo ID's, biometric identification is less fallible and potentially much faster. This has prompted the use of biometrics for noncriminal governmental and commercial applications. Manual work has never been good for the hands, but now it seems it could get a person in trouble with authorities.

Labourers and builders could find their fingerprints are not recognized by new high-tech equipment, an internal report for the government has reportedly warned. They are not alone; typists, pianists, violinists and guitarists also face inaccurate readings. The problem is that fingerprints can be severely worn down, particularly among people who work with abrasive materials. (Fig. 3)

"The ridges that make up fingerprints are like a ploughed field," says fingerprint expert Raymond Broadstock. "Work such as labouring and typing wears down those ridges and affects the smoothness of the skin. It can make fingerprints very hard to read. Certain vitamin deficiencies can also do the same."

The damage is not permanent as the skin rejuvenates within days. But for those who work in such professions there is little chance for their fingers to get a long enough rest for the ridges to rebuild. "Prisoners have been known to rub their hands against the rough walls of prison cells to try and wear away the ridges," says Mr. Broadstock. Government's trials are said to have suggested that worn away fingerprints along with problems with face and iris scans could identify one in 1,000 people as someone else. [5] Criminals have a long history of tampering with their finger prints.

Famous criminals like John Dillinger have used corrosives like acids to obliterate fingerprints. Other methods involving use of specific materials to cause finger print erosion have been in practice since long time. [6, 7] Coventry and Johnson were of opinion that individuals problem with biometric system e.g.; wearing down of ridge pattern in fingerprints accounts for errors that are difficult to solve. [8]

The UIDAI's Biometric Standards Committee headed by Director General NIC (National Informatics Centre), published a report in December 2009 and advised that a biometric system based only on fingerprint might present challenges in India due to a large number of people engaged in manual labour and urged the

UIDAI to consider the use of Iris in addition to fingerprints in order to improve inclusiveness and accuracy of the system. [9]

The Unique Identification Authority of India (UIDAI) conducted a Proof-of-Concept (PoC) study of biometric enrolment from March 2010 to June 2010 in the predominantly rural areas of Andhra Pradesh, Karnataka, and Bihar. One of the objectives of the study was to measure the biometric quality that could be achieved in rural Indian conditions. The study that involved 135,000 biometric enrolments found out that Older people took longer (20% longer enrollment time) to enroll than younger people, and enrollees whose employment involved manual work took longer to enroll than the rest of the PoC population. [10]

In January 2012 UIDAI published a report on the biometric technology of the UID project for the purposes of UID enrollment. It goes into the proof of concept studies conducted in India, analysis of the study results, design decisions on biometric modes necessary in the Indian context, implementation of client and server side systems for enrollment and finally concludes with the accuracy and performance achieved by the UID biometric system using 8.4crore real enrolments.

This report also concludes with the finding that those involved in physical labour having more wear on their fingerprints took more capture time than other groups e.g.; agricultural labourers took about one third longer to register their compared with public/private sector employees and other white collar workers. [11]

One of the conclusions that the Parliament's Standing Committee on Finance (SCoF), which examined the National Identification Authority of India Bill, 2010 came to was that the full or near full coverage of marginalized sections for issuing Aadhaar numbers could not be achieved as the estimated failure of biometrics is expected to be as high as 15% due to a large chunk of population being dependent on manual labour. [12, 13]

Conclusion:

Biometric technology as means of reliable identification has certain lacunae's. This is especially significant in countries like India were a large part of population lives in a rural environment with agriculture and hard physical labour as means of subsistence. This kind of environment leads to certain physical limitations that can result in uncorrectable errors in biometric identification systems. In Indian system therefore excessive reliability on such systems needs to be re-evaluated and possible corrections should be made in technology to address these problems.

References:

1. Biometrics in Human Services User Group (BHSUG). Volume 4, Issue 5 [Online]. Available from: URL: www.dss.state.ct.us/digital/news21/bhsug21.htm,11/01/2001.
2. **Wayman JL.** Biometric Identification and the Financial Services Industry. Congressional testimony of May20, 1998; in National Biometric Center: Collected Works (1997-200), p. 263; [Online].Available from: URL: www.engr.sjsu.edu/biometrics/nbtccw.pdf.
3. **Elliott S J, Sickler N C.** An evaluation of fingerprint image quality across an elderly population vis-a-vis an 18-25-year-old Population. Paper presented at the International Carnahan Conference on Security Technology; 2005 October 12-14; Las Palmas, Gran Canaria.
4. **Modi S K, Elliott S J.** Impact of image quality on performance: Comparison of young and elderly fingerprints. Paper presented at the 6th International Conference on Recent Advances in Soft Computing (RASC); 2006 July 10-12; Canterbury, UK.
5. http://news.bbc.co.uk/go/pr/fr//2/hi/uk_news/magazine/4349232.stm Published: 2005/10/17 12:09:52 GMT
6. **Lyle DP.** Disappearing Fingerprints. Posted in Fingerprints/Patterned Evidence [Online]. 2009 June 7. Available from: URL http:// http://writersforensicsblog.wordpress.com/category/fingerprints patterened-evidence
7. **David A.** To avoid ID, more are mutilating fingerprints. Boston globe 2010 July 21; Available from URL: http://www.boston.com/news/local/massachusetts/articles/2010/07/21/to_avoid_id_more_are_mutilating_fingerprints
8. **Coventry L, Johnson GI, Angeli AD.** Usability and Biometrics at the ATM. Proceedings of the ACM Human Factors in Computer Systems- CHI'03. ACM Press; 2003
9. The Unique Identification Authority of India. Biometric Design Standards for UID Applications Online, 2009 December Available from:URL:http://uidai.gov.in/UID_PDF/Committees/Biometrics_Standards_Committee_report.pdf
10. The Unique Identification Authority of India. UID Enrolment Proof-of-Concept Report Online; 2010 December. Available from: URL:http://uidai.gov.in/images/FrontPageUpdates/uid_enrolment_poc_report.pdf
11. The Unique Identification Authority of India .Role of Biometric Technology in Adhaar Enrollment [Online].2012 January 21. AvailablefromURL:http://uidai.gov.in/images/FrontPageUpdates/role_of_biometric_technology_in_aadhar_jan21_2012.pdf
12. Ministry of Planning. Standing Committee on Finance (2011-12), 42nd Report [Online]. 2011 December; Available from: URL: http://164.100.47.134/lsscommittee/Finance/42%20Report.pdf
13. http://www.thehindu.com/opinion/lead/article2717949.ece?homepage=true

Fig. 1: Biometric Attendance in Hospital

Fig. 2: Biometric Fingerprint Capture Device

Fig. 3: Worn Out Fingerprint due to Manual Labour

Fig. 4A: Damaged finger prints due to age related or injury related events unsuitable for biometric identification

Fig. 4B

Table 2: Grouped Sample Size

S.N.	Category	Number	(%)
1.	Teaching staff	1250	38.46
2.	Non teaching staff	1400	43.07
3.	Master roll students interns/ house physicians/postgraduates	600	18.46
	Total	3250	100

Table 3: Categories having problems with Biometric Attendance

S.N.	Category	Number	(%)
1.	Elderly Staff>60 Years	2	8
2.	Manual Labourers	19	76
3.	Females	4	16
	Total	25	100

Table 4: Main Reasons for non-registering of Attendance by Biometric devices

S.N.	Category	Number	(%)
1.	Wear and tear	20	80
2.	Age	2	8
3.	Physical injuries to fingers	2	8
4.	Poor body built with anemia	1	4
	Total	25	100

Table 1
Total Sample Size of Study

Teaching Staff	Non Teaching Staff	Master roll Students Undergraduate/Postgraduate	Total
1250	1400	600	3250