BIODEV II

Experiment concerning the capture, storage and verification of biometric data for visa applicants conducted by Austria, Belgium, France, Germany, Luxemburg, Portugal, Spain and United Kingdom under the aegis of the European Commission

Agreement n° JLS/2005/ARGO/GC/05

Children Fingerprinting

Intermediary report to the European Commission

05 September 2008

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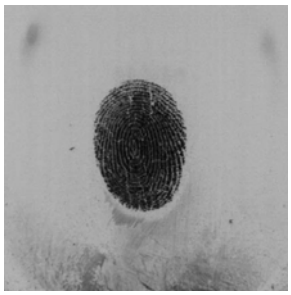
This report presents a review of the collection and control of fingerprints from juvenile visa applicants carried out under the BIODEV projects and the French national visa program as well.

Only the most significant data processed by Belgium, Germany and France are presented here.

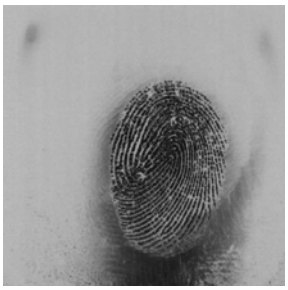
1 Juvenile fingerprinting issue

Juvenile fingerprints raise 2 main problems:

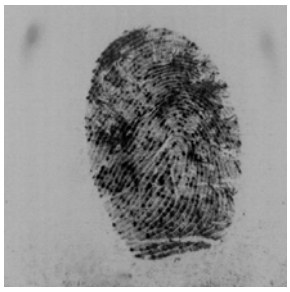
a) Size of the finger



1 year old
S = 5,1 pixels



4 years old
S = 5,9 pixels



4 years old
S = 6,8 pixels

Adult
S = 9,1 pixels

We must therefore succeed in extracting information on fingerprints whose average spacing between lines is smaller than usual fingerprints. It roughly consists in "**enlarging" small fingerprints** (zoom) in order to achieve the coding of minutiae.

b) Growth between 2 captures:

The juvenile matching requires a method taking into account the constant homothetie existing between juvenile and adult fingerprint as well as translation, rotation and distortions.

A **fingerprint growing process** allows solving this problem:

The juvenile mode comes at three levels in the complete algorithmic chain:

- at the automatic extraction of minutiae (step coding)
- the level of calculating the topological information (step coding)
- and at the matcher (step matching which uses the information calculated at the coding)

In the case of authentication, only steps 1 and 3 are concerned. In the identification stage, all the 3 steps are involved.

The juvenile fingerprint acquisition requires a high scan precision at least (500 dpi resolution min) to preserve fine and close ridges, especially for very young children.

These techniques have been implemented partially in the BIODEV experiments and in the French national visa program They will be **fully implemented in the VIS.**

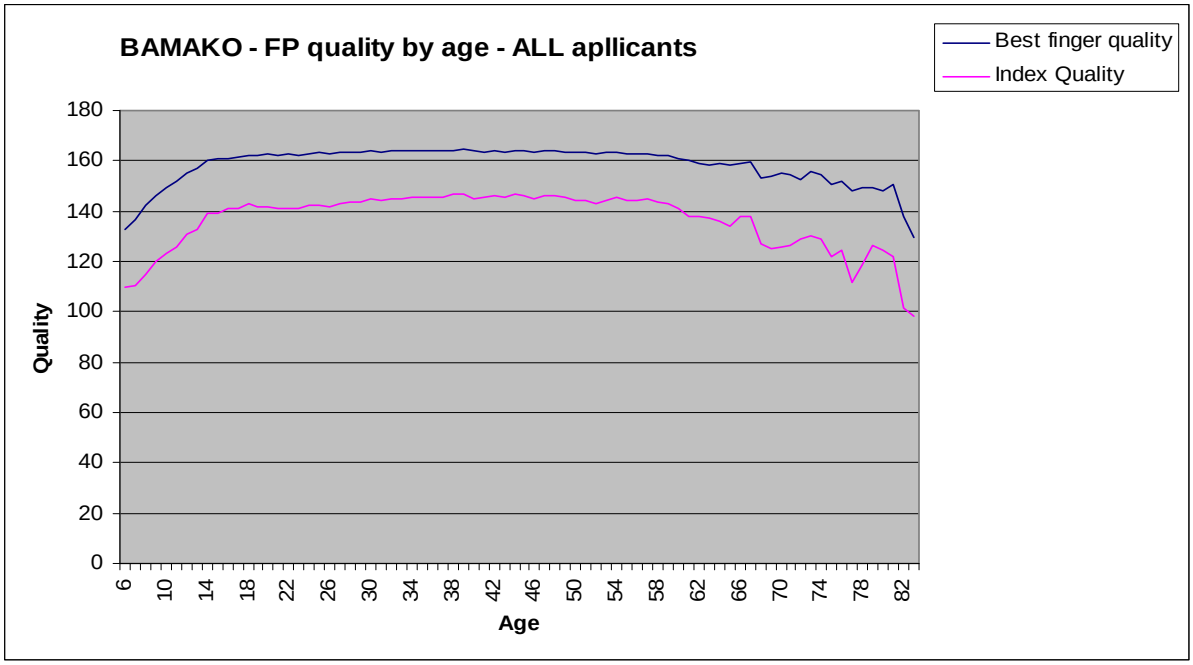
2 Fingerprint collection at the consulates

In the framework of BIODEV, all visa applicants are generally enrolled from the age of 6 at each visa application with 500dpi fingerprints scanners.

2.1 Influence of applicant age on fingerprint quality

The following curves show the average quality of the best finger (top curve) and index (bottom curve) from 45.000 fingerprint sets collected at the French consulates in Bamako (Mali).

It can be noticed that the fingerprint **quality increases from the age of 6 to 14**, stabilizes until the age of 60 and then decreases for the elderly.



The quality is represented by SAGEM proprietary scores given at the enrolment time.

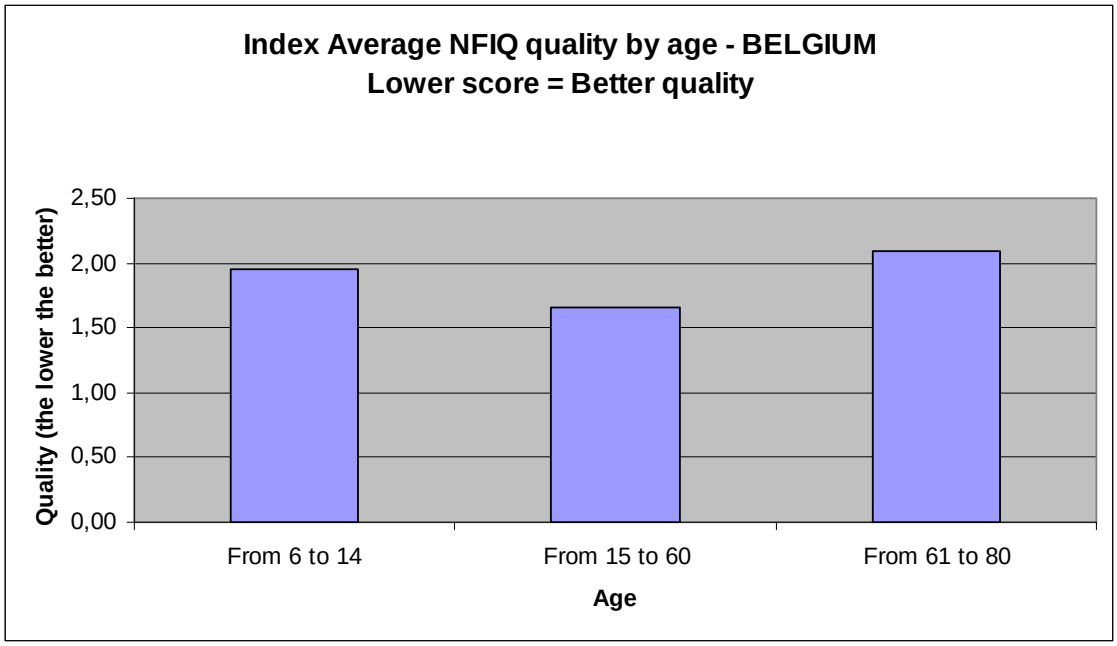
Similar curves have been obtained from the all the consulates participating to BIODEV.

Except the French system, the other enrolment solutions use the NIST fingerprint image quality standard (NFIQ) in which the quality score varies from 1 to 5 (the lower score the better quality).

Generally, **a fingerprints set of the category 1-3 is considered as having a sufficient quality to be used in an automated system (**like an automatic gate control).

Example from BELGIUM:

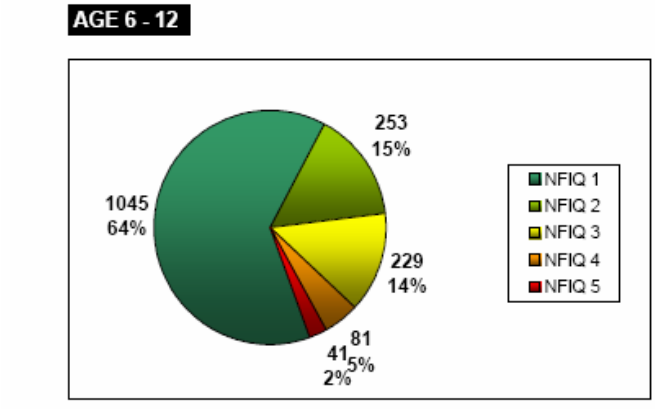
Average quality for each age group of 14 000 fingerprints sets captured in the Belgian consulate in Bujumbura, Kigali, Kinshasa and Lubumbashi.

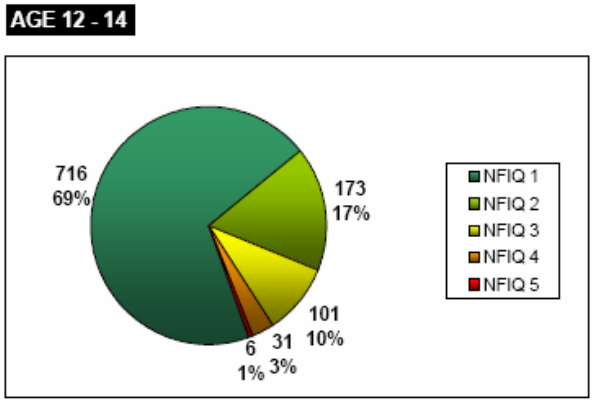


Example from GERMANY: Damascus and Ulan Bator consular posts

Of the total number of 1649 collected FP from children in the **age between 6 and 12, 93% can be considered with sufficient quality.**

Of the total number of 1027 collected FP from children in the **age between 12 and 14 96% can be considered with sufficient quality.**

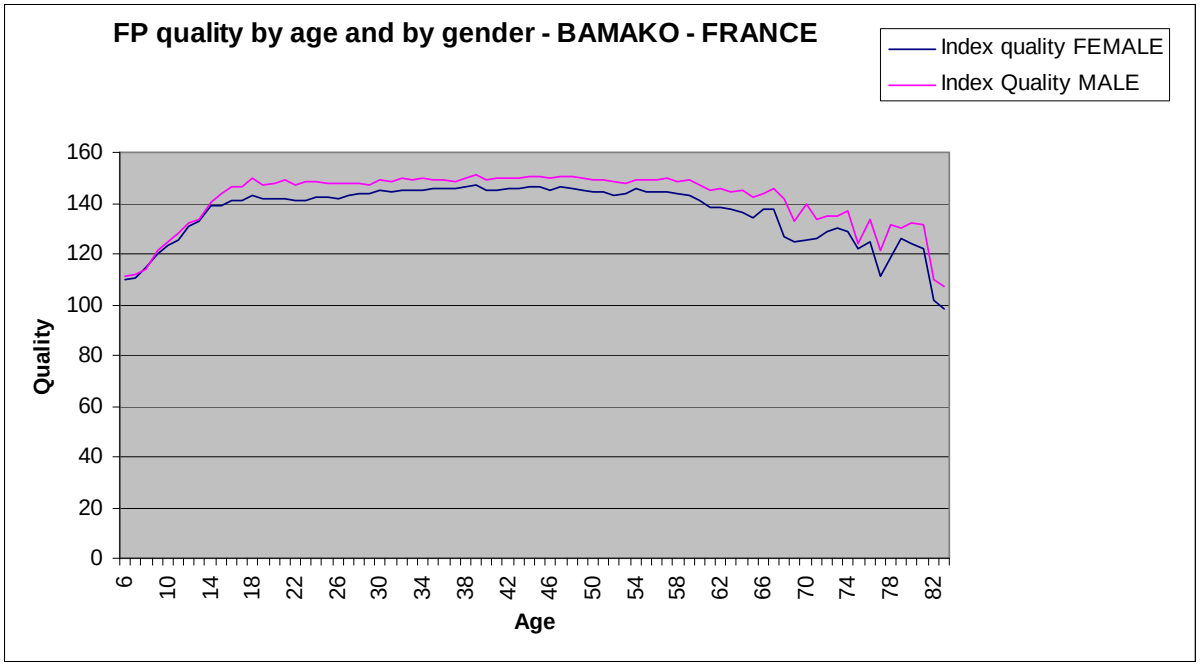




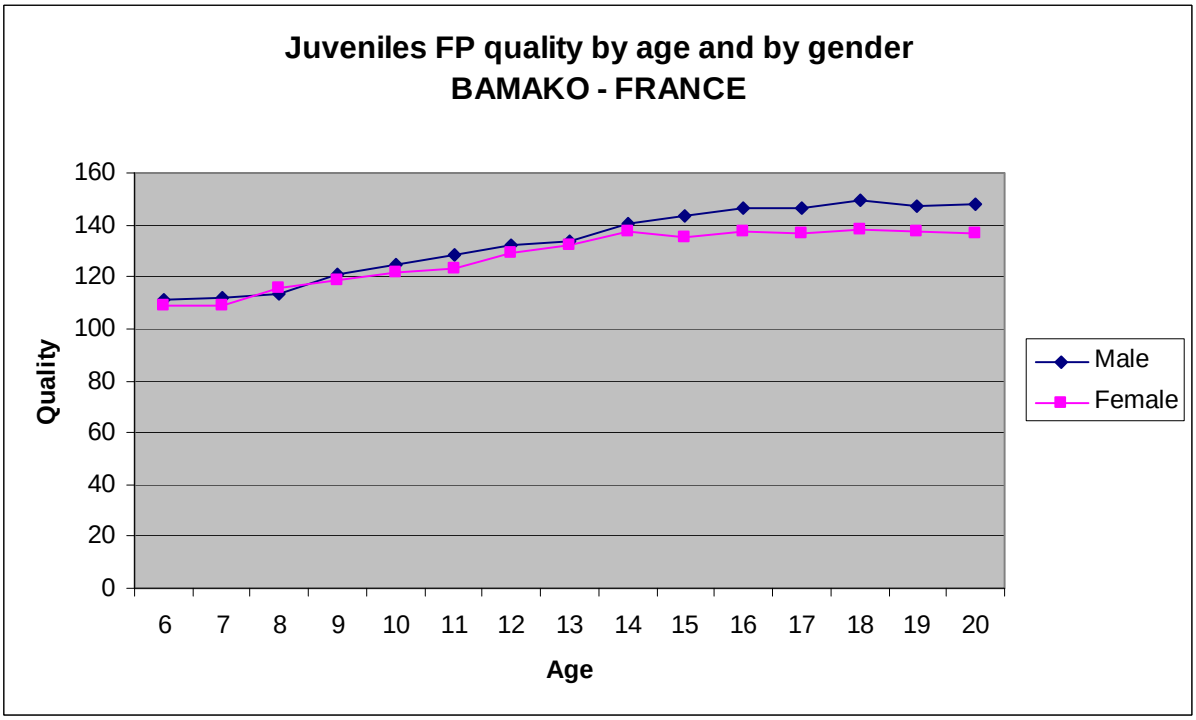
The charts below are based solely on the quality of the 2 **index fingers** because they are those stored in the **biometric passport's** chip as well as those generally used for **verification** (1st line control at the border).

2.2 Influence of gender

The following chart shows the expected **gap between Male and Female**, mainly due to finger size:

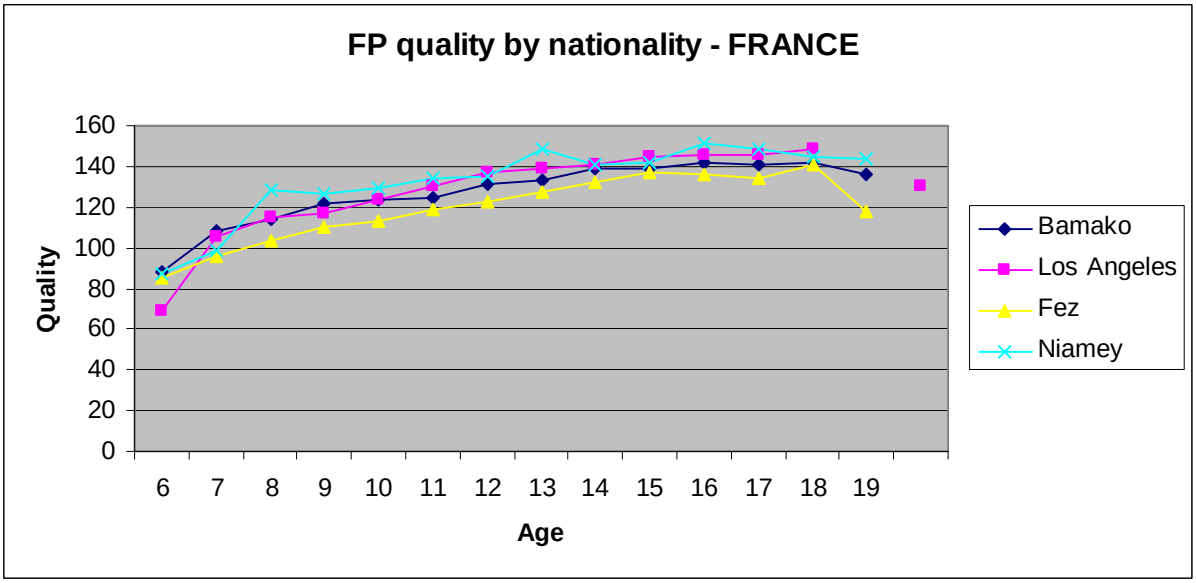


It can be noticed that the **influence of gender** is **not very significant for children:**



2.3 Influence of nationality / consular post

The following chart shows significant discrepancy among consulates whatever the age of the applicant



These variations are due in part to **ethnic differences** but they can also be explained by the **different environments** from one consulate to another. (desk disposition, operator training, etc)

2.4 Consular staff's perception

Consular officers have **no particular difficulty to capture fingerprints from children in the age from 6 to 12**. (see attached the results of the survey carried out among 60 French consulates)

However they report difficulties with the elderly (important number of attempts)

2.5 Evolution of juvenile fingerprints

Under BIODEV, fingerprints capture is performed at each new application request, so the fingerprints recorded at a previous request are replaced by new data at each new application.

As a result, it was not possible to verify the effectiveness of the "juvenile" algorithms solving the difficulties posed by the growth of fingers.

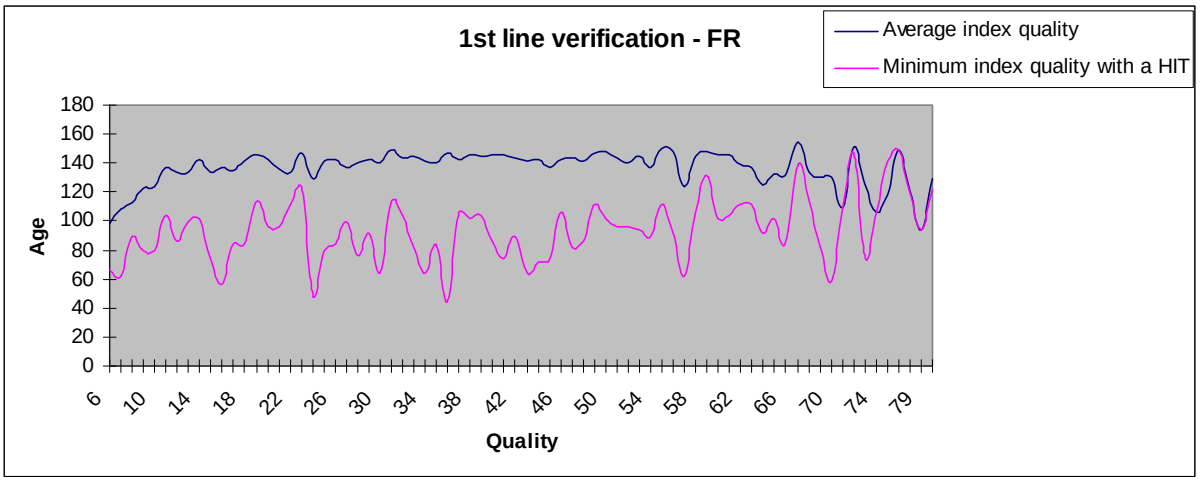
However, **no case of false acceptance** has been reported by the border guards

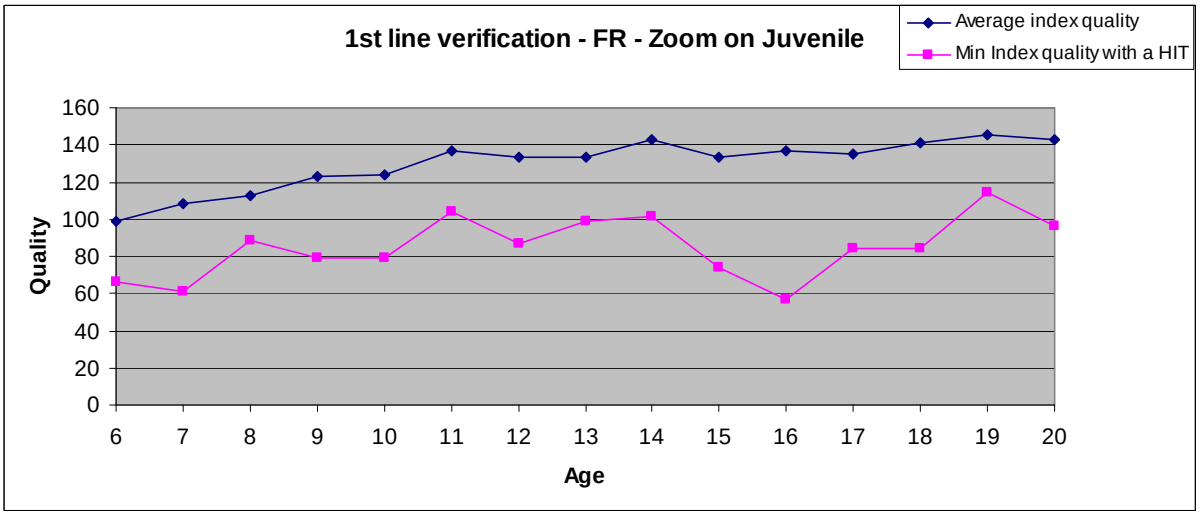
3 Border control

3.1 1st line border control (1:1 check)

The following chart shows the performance of the controls carried out at Roissy Charles de Gaulle airport from a sample of 2,000 passengers arriving from 46 different destinations during the months of June and July 2008. The booths at the airport are equipped with single finger sensors.

The top curve represents the average quality index score got at the enrolment time in the consulate. The bottom curve gives the minimum quality over which the 1:1 check was successful.





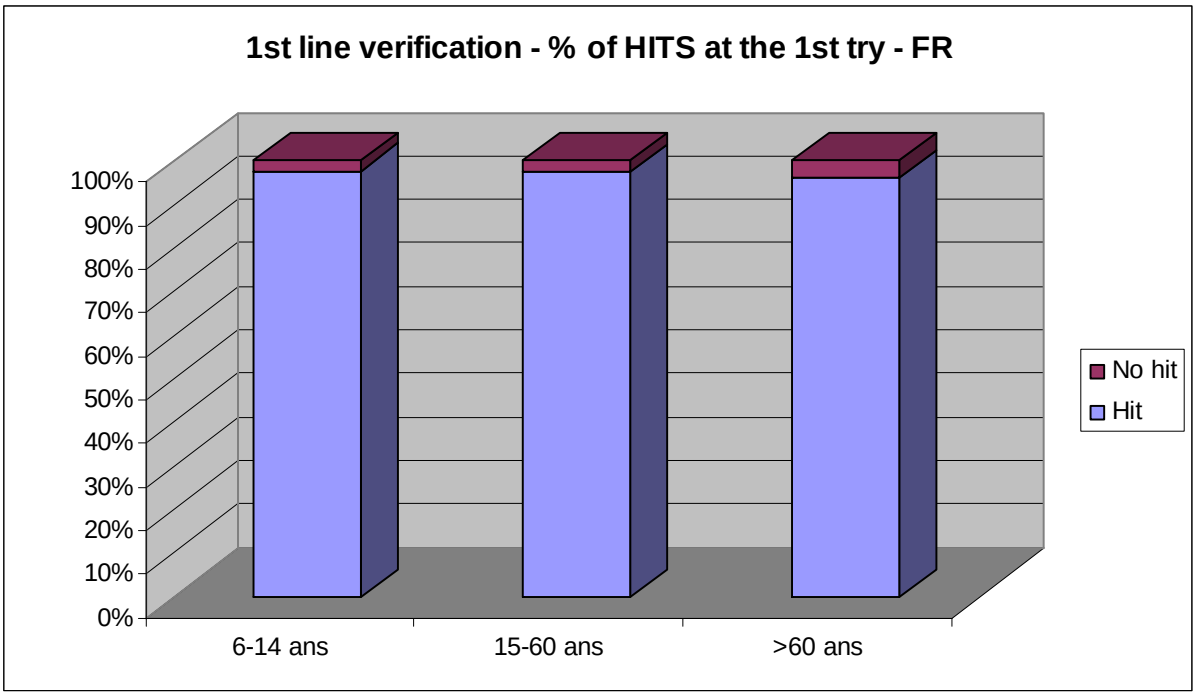
Comments:

1. The **quality obtained from the age of 6 is largely sufficient** to ensure a high success rate in 1:1 checking (the blue curve is clearly above the red one)

2. On a practical level, there is **no significant difference between the control of fingerprints from children and adults**.

3.There are potentially **more difficulties with the elderly** (the 2 curves meet up above the age of 70).

This chart shows the failure rate at the first capture for each age group. Again there is no significant difference between children (2.3%) and adults (2.4%). The failure rate for the elderly is a little higher (4%).



3.2 2nd line identification (1:N check)

There was not enough information available concerning the control of children at the 2nd line.

4 Conclusions

Even if consular staff training and enrolment software have to be improved in order to obtain better fingerprints quality, BIODEV experiments have proved the **feasibility and reliability of children fingerprinting from the age of 6.**

Indeed, although the quality of fingerprints improves between the ages of 6 and 14 years, **no significant differences have been found between children and adults at a practical level**, either during fingerprints capture or border control.

5 Annex : Survey among the French consulates regarding children fingerprinting

	Error rate	Quality	Difficulties	Nb of visas issued since 01/01/08	Visas granted to children in the age bewteen 5-15
ABIDJAN				3 824	73
ABUJA				327	12
ACCRA	0	bonne	aucune	489	9
AGADIR	0	bonne	aucune	2 627	140
ALEP	0	bonne	aucune	720	30
AMMAN	0	bonne	aucune	1 266	48
ANKARA	0	bonne	aucune	2 984	136
ANNABA				8 645	429
BAMAKO	variable	variable	aucune	3 105	111
BANGUI	0	bonne	aucune	517	6
BEYROUTH	0	bonne	aucune	6 065	230
BOMBAY	0	très bonne	aucune	11 260	676
BRAZZAVILLE	0	bonne	aucune	1 499	22
BUJUMBURA				373	13
CASABLANCA	0	satisfaisante	aucune	15 401	1260
CHISINAU	0	bonne	enf < 8ans	939	56
COLOMBO	0	bonne	aucune	621	19
CONAKRY				2 420	60
COTONOU	0	bonne	aucune	1 744	21
DAKAR	5%	bonne	aucune	5 232	112
DAMAS	0	bonne	aucune	1 255	33
DIEGO-SUAREZ	0	bonne	aucune	129	4
DOUALA	0	bonne	aucune	1 526	29
DOUBAI	50% (7-9ans)	bonne	aucune	2 941	215
FES	0	bonne	entre 6 et 8ans	4 416	342
HARARE	0	bonne	aucune	254	16
ISLAMABAD				898	30
KAMPALA				454	39
KHARTOUM	0	bonne	aucune	491	31
KINSHASA	0	bonne	aucune	892	42
LAGOS	0	bonne	aucune	4 990	296
LE CAIRE	0	bonne	aucune	6 002	357
LIBREVILLE				2 340	77
LOME				1 413	30
LUANDA	0	bonne	aucune	807	20
MAJUNGA				144	5
MANAMA	0	bonne	aucune	1 268	103
MARRAKECH				3 488	325
MINSK	nb prises	mauvaise	nb prises	4 155	274
MORONI				659	16
NAIROBI				847	14
NEW-YORK	0	bonne	aucune	2 449	20
NIAMEY	0	bonne	aucune	1 168	50

NOUAKCHOTT	0	bonne	aucune	1 186	49
ORAN	0	bonne	aucune	6 475	298
OUAGADOUGOU	0	satisfaisante	aucune	2 291	45
POINT.NOIRE	0	bonne	aucune	733	19
PORT-AU-PRINCE.				1 187	44
RABAT	0	bonne	aucune	7 626	644
SANAA	0	bonne	aucune	481	17
SAN FRANCISCO	0	bonne	aucune	1 090	7
ST-LOUIS	0	bonne	aucune	99	1
TAMATAVE	0	bonne	aucune	441	4
TANANARIVE	0	bonne	aucune	3 599	114
TANGER	0	bonne	aucune	4 460	404
TBILISSI	0	bonne	aucune	1 848	56
TEHERAN	0	bonne	aucune	4 377	225
TEL AVIV	0	bonne	aucune	125	2
TRIPOLI				2 292	123
YAOUNDE	0	bonne	aucune	1 702	30