TECHNICAL REPORT

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Information technology — Cross jurisdictional and societal aspects of implementation of biometric technologies — Biometrics and children

Technologies de l'information — Aspects pangouvernementaux et pansociétaux de l'implémentation des technologies biométriques — Biométrie et enfants

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Foreword

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The committee responsible for this document is ISO/IEC JTC 1, *Information technology*, SC 37, *Biometrics*.

Introduction

In the growing involvement of children in biometric systems, several issues concerning their use of biometrics appear more critical than to adults.

Most problems rely on the physical and psychological immaturity of children. The bodies of children are still in a growing phase and this may cause difficulties in the biometric capture and comparison processes. For the children themselves, the usability of a biometric system becomes a crucial factor.

On the other hand, their psychological immaturity implies that there could be situations where parent(s) or legal representative(s) have to support them to use biometric systems, especially when data protection or privacy issues are involved.

In this Technical Report, the definition of "child" is considered from the applicative point of view in Clause 5. In Clause 6, studies on biometrics for children are surveyed for certain modalities because the application of biometrics is heavily dependent on the modality. Clause 7 introduces examples of application of biometrics that are typical to children and present clear benefits. Finally, Clause 8 summarizes various elements concerning the protection of children when using biometric systems with particular reference to data protection and psychological concerns.

Examples of the benefits to be gained by using the Technical Report are the following:

— operational support in using biometrics applied to the context of children;

— enhanced acceptance by subjects of systems (children, parents and legal representatives, tutors,…) using biometric technology;

— improved public perception and understanding of these systems;

— smoother introduction and operation of these systems;

— adoption of commonly approved good privacy practice.

The primary stakeholders are identified as follows:

— parents and legal representatives;

— users of the biometric data;

— developers of technical standards;

— subjects who provide the biometric sample;

— requirements analysts;

— system architects;

— IT designers;

— public policy makers.

Any jurisdiction of the country for which the biometric system is intended to shall be considered.

Information technology — Cross jurisdictional and societal aspects of implementation of biometric technologies — Biometrics and children

1 Scope

This Technical Report builds upon the general recommendations given in ISO/IEC TR 24714-1.

It provides guidance for users (as defined in ISO/IEC 2382-37) of biometric recognition systems on specific requirements in relation to deployments when children are included as subjects in the biometric process.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 2382-37, *Information technology — Vocabulary — Part 37: Biometrics*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 2382-37 and the following apply.

3.1
child
person below the age of 18, unless the laws of a particular country set the legal age for adulthood younger[1]

3.2
friction ridges
ridges present on the skin of the fingers and toes, the palms and soles of the feet, which makes contact with an incident surface under normal touch

4 Symbols and abbreviated terms

BIODEV	Biometrics Data Experimented in Visa (European Commission funded experimentation, 2005)
BKA	Bundeskriminalamt (Federal Criminal Police Office of Germany)
dpi	dots per inch
EC	European Commission
EER	Equal Error Rate
JRC	European Commission Joint Research Center
MYCHIP	The Masonic Youth Child Identification Program (MYCHIP)

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1)   http://www.ohchr.org/en/professionalinterest/pages/crc.aspx [viewed 12 July 2015].

NCMA	National Center for Missing Adults
NCMEC	National Center for Missing and Exploited Children
NIJ	National Institute of Justice
NIST	National Institute of Standards and Technology (U.S. Department of Commerce)
NMCO	Nation's Missing Children Organization
TNO	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (Netherlands Organisation for Applied Scientific Research)
UIDAI	Unique IDentification Authority of India (UIDAI)
UNICEF	United Nations Children's Fund

5   Background and rationale

5.1   Definition of "child" in terms of age

The term "child" is generally considered to cover the period between birth and puberty and, from a legal point of view, may be substituted by the term "minor". The concept itself of "minor" is not sharply defined in most jurisdictions. The ages of criminal responsibility and consent, the age at which attendance at school ceases to be obligatory, the age at which legally binding contracts can be entered into, and so on, can all be different.

With regards to the age limit of childhood, the above mentioned convention on the Rights of the Child defines a child as a person below the age of 18, unless the laws of a particular country set the legal age for adulthood younger.

In accordance with the above mentioned convention, for the purpose of this Technical Report, a "child" is an individual up to 18 years although, from a morphological point of view, all the biometrics characteristics can be considered stable at earlier ages.

5.2   Ethical background

The 1959 United Nations Declaration of the Rights of the Child,[1] approved by the United Nations General Assembly, clearly ratifies that, by reason of their physical and mental immaturity, children need special safeguards and care, including appropriate legal protection.

With specific reference to identity management, the principle three of the above mentioned declaration prescribes that "The child shall be entitled from his birth to a name and a nationality".

The importance of the identity in the context of childhood is reinforced by the Articles 7 and 8 of the Convention on the Rights of the Child[2] (20 November 1989, entry into force 2 September 1990), cited also by UNICEF.[3] The articles highlight the obligation of the States Parties to respect the right of the child to preserve his or her identity.

The 1959 United Nations Declaration of the Rights of the Child and the Convention on the Rights of the Child, while ratifying that children shall be the object of special respect and protection, highlight the importance of identity and pave the way to the implementation of biometric recognition systems.

5.3   General considerations

Due to the widespread diffusion of biometrics and to the growing involvement of children in the identity management processes, some concerns have been raised due to the legal, social and ethical aspects encompassed.

Apart from the apprehensions, it should be highlighted that biometrics can assume a straightforward importance for the safety and security itself of children.

Biometrics is an important tool in fighting crimes, such as, human trafficking with a particular reference to children who are often the innocent victims of abuses and violence or even appreciated source of human body organs unscrupulously offered on the terror market.

Other applications of biometrics for children have a different purpose. For example, some school canteens or libraries have introduced a biometric check to verify the identity of children in accessing the services offered.

The target of these applications is the alleviation of potential frauds. In some national jurisdictions, the local Data Protection Commissions can consider this purpose non-sufficient to satisfy the principle of "proportionality".

The proportionality principle refers to a general principle of law that requires in general a fair balance and reasonable relationship between the means requested or used, including the severity and the duration of the means, and the objective sought.[4]

6 Studies on biometrics for children

6.1 General

This Clause analyses some aspects relative to the biometric technologies which have already found an application for children. The text justifies the selection of the biometric modalities in the section.

6.2 Study on age estimation of children

Estimating the age of children in photographic images may be useful in determining whether a child has the same identity as a reported missing child. It may also be of assistance in determining the relative age of exploited children from photographs and videos.

NIST has published a study "Face Recognition Vendor Test (FRVT) Performance of Automated Age Estimation Algorithms". Automated age estimation has applications specific to children, including automated age regression/progression and investigation support to law enforcement. As seen from the most accurate commercial age estimation technology, the average age estimation error for children ages 0 to 14 is approximately 2,4 years.

6.3 Fingerprints

6.3.1 Physiology

Primary dermal ridges[2)] (ridge counts) are formed during the gestational weeks 12 to 19 and the resulting fingerprint ridge configuration (fingerprint) is fixed permanently.[5]

Despite being fully formed and invariant in numbers of lines, drawings or details (minutiae), ridges do change in size throughout the growth of the child, becoming thicker and widening the gap between them.[6]

Various studies have tried to assess several aspects relative to the use of fingerprint recognition for children. In particular, two issues have been mainly investigated: the minimum age for enrolment and the feasibility of recognizing fingerprints of children after a certain number of years.

Some data about the children's age in which the acquisition of fingerprint may considered significant are reported in 6.3.2.

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2) The term "dermal ridge" intends "friction ridge", as defined in 3.2.

6.3.2 Studies concerning the use of fingerprints for children

The Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (TNO) in 2005, conducted a study into the feasibility of using biometrics. A section of it concerns children and aims to establish the identity of children, specifically whether it is possible to take fingerprints and the effects of the growth of children's faces on recognition.[7] As attains fingerprints, the study highlights the significant difficulty of acquiring the fingerprints of children below the age of four.

This BIODEV II study (funded by the European Commission, Agreement n° JLS/2005/ARGO/GC/05) [8] focused on "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". The study points out that a study on children's fingerprints raise two main problems: the size of the finger and the growth between two fingerprints' acquisitions.

The US National Institute of Justice (NIJ), between 2006 and 2009 funded a study on "Quantifying the Dermatoglyphic Growth Patterns in Children through Adolescence".[9] The study was conducted by a major US fingerprint systems company and its goal was to provide the NIJ and scientific community a means to develop a statistically valid mathematical model for predicting the shape changes of fingerprints during this period of growth.

The University of Göttingen between 2009 and 2010, carried out a study[10] funded by the German Bundeskriminalamt (BKA) about the feasibility of recognizing fingerprints of children after a certain number of years. The analysis of growth effects on fingerprints clearly showed growth to result chiefly in an isotropic rescaling.

A study investigating the verification performance of three age groups of participants (3 to 10, 11 to 18 and 19+ years) found that the 3 to 10 years age group (n = 145) performed significantly worse (in terms of EER) than the other two with regards fingerprint verification. The middle, ring and little fingers performed significantly worse for the younger children than the other two age groups, while little difference in performance was found for the thumb and index fingers.[11]

A study on the use of fingerprint recognition for children has been carried out by the EC Joint Research Center of Ispra (Italy) in 2013.[12]

This Technical Report summarizes the findings of a JRC study dedicated to the question of whether or not automated fingerprint recognition for children is feasible, that is, if the recognition rates obtained with this technology for children are similar to those reached for adults.

Main conclusions of the report are that fingerprint recognition is possible even for very young children though at a lower recognition rate than for older children, growth has limited influence on fingerprint recognition but image quality (in terms of low contrast and distortion effects) is the ultimate problem for child fingerprints, and image quality is strongly influenced by size.

In every case, the report suggests that alternative acquisition devices or software for children fingerprints should be needed in the future. For example, in Reference [13], it is reported that the use of a 1 000 dpi fingerprint acquisition system for children younger than three years old is suggested.

6.4 Face

6.4.1 Physiology

In general terms, the face grows downward and forward from the cranial base and around the eyes.[14]

The anthropometric data available indicate that the growth of children's faces is a complex process that differs between boys and girls. The age at which puberty-related growth changes occurs, for instance, ranges from 10 to 16 years for girls and 12 to 19 years for boys.[15]

Growth takes place in spurts, and the proportions do not remain constant, making it very difficult to express the effect of growth in a facial recognition algorithm.[7]

Several studies were conducted in the United States from the 1920s through the 1970s concerning facial growth over time in children. These studies are marked for features on the skull x-rays. Some of the studies also include face image photography.

The studies are available through the American Association of Orthodontists Foundation (AAOF) Craniofacial Growth Legacy Collection.[3]

6.4.2 Study concerning the use of face recognition for children

A series of studies are actually ongoing as concerns the use of face recognition for children.

A document provided by TNO (2005) points out that, based on the information available from the technology provider of the face recognition system[16] used in the TNO trial, facial recognition is not reliable under the age of 5; it is not until the age of 13 that ageing ceases to have any marked effects, as facial form is then stable.

In Reference [17], reported a craniofacial growth model that characterizes growth related shape variations observed in human faces during formative years.

6.5 Iris

6.5.1 Physiology

The iris is an internal effector organ of the eye, located behind the cornea and the aqueous humour but in front of the lens.[18] Images of the iris, adequate for personal identification with very high confidence, can be acquired from various distances.

6.5.2 Study concerning the use of iris recognition for children

Various international programs aim to recognize children through iris recognition.

In India, the UIDAI programme publishes demographics on the age distribution of persons enrolled (iris and fingerprints) for national ID, in 2014 over 600 million, includes the children age groups.

According to UIDAI "...the limitation on iris capture of a child only due to the requirement for a child to follow the instructions of keeping his/her eyes open before the iris camera. On an average, the age at which the child can understand and follow such instructions will be around four years…".[4]

6.6 Hand geometry

6.6.1 Physiology

Hand geometry scanners have been used by children above the age of seven or eight.[19] For use with children, hand geometry scanners should update their templates as they mature.[19]

Since the template will have been modified, by the time the children reach their mid-teens, even though their hands have changed considerably, they can continue to use hand geometry scanners without difficulty.

The user's fingers should be of sufficient length to reach the platen finger pins. Some children are smaller in stature, and may have to be older before they can reliably use hand geometry scanners. Likewise, some children are larger in stature and their fingers will reach the platen pins at a younger age.

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3)   http://www.aaoflegacycollection.org/aaof_home.html [viewed 12 July 2015].

4)   http://uidai.gov.in/UID_PDF/Working_Papers/UID_and_iris paper final.pdf [viewed 12 July 2015].

6.6.2 Studies concerning the use of hand geometry for children

A study investigating the hand geometry verification performance of three age groups of participants (3 to 10, 11 to 18 and 19+) found that the two younger age groups (n = 145 and 156 respectively) outperformed those aged 19+. A possible explanation for this was the impact of wrinkles and/or finger length on finger and segment length detection.[10]

7 Applications

7.1 Identification and protection of newborns

Identification of newborns is one of the main tasks of the medical team following birth.[6]

Up to now there is not a single biometric system developed for identification of newborn babies, so that, most maternities still rely on bracelets and/or stamps for this purpose.

Most common technologies used to identify infants are based on the recognition of the following:

— DNA;

— footprints;

— heel scan;

— fingerprints;

— palm prints.

Several hospital and organizations recognize the important role for infant-mother and child identification implements biometric programmes.

7.2 Fight against children trafficking

The 2002 Brussels Declaration on preventing and combating trafficking in human beings,[20] pays special attention to children. The special vulnerability and needs of child trafficked victims is recognized and enshrined in international and national law.

The inclusion of biometrics in issued travel documents is contributing to better identification of trafficked children.

7.3 Missing children search

In the United States, there are several resources available to assist in the identification of missing children.

7.3.1 National Missing and Unidentified Persons System (NamUs)

National Missing and Unidentified Persons System (NamUs) contains information that can be entered by anyone, after verification by the U.S. Department of Justice. It includes links to state clearinghouses, medical examiner and coroner offices, law enforcement agencies, victim assistance groups and pertinent legislation. In addition, there is an Unidentified Persons database with information entered by medical examiners and coroners.

Therefore, NamUs contains records for adults and children.

7.3.2 National Center for Missing and Exploited Children (NCMEC)

The National Center for Missing and Exploited Children is another program in the United States. It has a missing children hotline and trains law enforcement officials, prosecutors and health care professions, resulting in the recovery of more than 208 000 missing children, as of April 2015.

7.3.3   Children's Identification and Location Database (CHILD)

The Children's Identification and Location Database (CHILD) Project[5] is a secure nationwide network and registry that utilizes iris recognition biometric technology and that was created in conjunction with the Nation's Missing Children Organization (NMCO) and National Center for Missing Adults (NCMA).

The CHILD project enables law enforcement and social service agencies throughout the country to locate and positively identify missing children with iris biometric recognition technology.

The CHILD project has created and maintains a national registry to give social service agencies, law enforcement, and other authorized users of the system, access to data.

7.3.4   Masonic Youth Child Identification Program (MYCHIP)

The Masonic Youth Child Identification Program (MYCHIP)[6] can provide a robust help to law enforcement authorities in finding and identifying a lost or missing child. More in particular, the free program provides a series of tools to the parents allowing them to acquire fingerprints of the children, a tooth print bite, and a cotton swab to gather DNA material from the child's cheek.

None of the information is copied and all the identifying materials are given to the child's family that, in case of emergency, may provide such materials to law enforcement authorities.

7.3.5   National Child Identification Program (NCIDP)

The National Child Identification Program,[7] offers to the families, at a small fee, an identification kit for children. It comprises an inkless fingerprinting card, a DNA collection envelope, and a cut-out wallet card.

The biometric data are stored in the parent's home, in order to be used by the law enforcement authorities in case of missing children.

7.4   Schools

In several schools of various countries, biometrics systems are applied for different purposes.

7.4.1   Registration

Several schools have, over the last few years, begun to use automated fingerprint identification systems for registration.

7.4.2   Library book borrowing

In several schools, the system of book borrowing is based on fingerprints for verifying the students.

7.4.3   Cashless catering

Use of biometrics to allow pupils to get their school meals without using any cash has been experimented in various countries.

7.4.4   Count of children access to catering

In some countries, the adoption of biometric systems allows a better count of the children access to the catering, in order to have the parent to more reliably pay the catering accordingly to the true expenses.

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5)   http://www.thechildproject.org [viewed 12 July 2015].

6)   http://www.mychip.org [viewed 12 July 2015].

7)   http://www.childidprogram.com/ [viewed 12 July 2015].

7.5 Children medical treatment history

In some countries, biometrics is used to access the medical treatment history for children.[21] [22]

8 Protection of children in using biometrics

8.1 Data protection and privacy

All main privacy principles in the context of biometrics are reported in ISO/IEC TR 24714-1. Also considering Reference [23] the following issues have particular relevance for children.

8.1.1 Information to be provided to parents and legal representatives — consent

Where the parents and legal representatives are allowed, they may refuse to give their consent. An alternative solution should be given and parents and legal representatives should be informed of the consequence of the refusal of not allowing the acquisition of the biometric data.

8.1.2 Information to be provided to children

If they are able to understand, children should be informed about the acquisition and use of their biometric data. They should be provided a simple explanation of why their biometric characteristics are being acquired.

8.1.3 Enrolment — procedures and environment

The enrolment procedures adopted and the environment itself in which the biometric data are collected should be respectful of the dignity of children. Possibly, the users should require the support of a paediatric psychologist who may have a generic knowledge of the biometrics process and should be involved at the beginning of the biometric project to be implemented.

8.1.4 Enrolment — right of an updated enrolment

Parents and legal representatives should have the right to ask to the entities collecting the biometric data of children to perform an updated enrolment of their children provided that they explain the reason for such request.

8.1.5 Enrolment — right to watch

Parents and legal representatives should be encouraged to be present when the biometric data are collected from their child.

8.1.6 Opt-out

Children should be provided with another means of accessing the same services if the parents and legal representatives wish them to be excused from the biometric data collection process.

8.1.7 Biometric data security

Biometric data of the children should be managed adopting high standards of security to safeguard them. The computer system containing the biometric data should be non-interoperable and located in a protected area to prevent unauthorized accesses or thefts. Parents and legal representatives should be informed how biometric data of children is kept safe.