

# **NIST Special Database 29 Plain and Rolled Images from Paired Fingerprint Cards at 500 ppi**

Craig Watson  
Patricia Flanagan

# **NIST Special Database 29 Plain and Rolled Images from Paired Fingerprint Cards at 500 ppi**

Craig Watson  
Patricia Flanagan  
*Information Technology Laboratory  
Information Access Division*

May 2016



U.S. Department of Commerce  
*Penny Pritzker, Secretary*

National Institute of Standards and Technology  
*Willie May, Under Secretary of Commerce for Standards and Technology and Director*

## Table of Contents

1.0 Introduction.....	1
1.1 File Naming Structure.....	2
1.2 Conversion from ANSI/NIST Data Format.....	2
1.3 Image File Conversion.....	2
1.4 Text File Creation.....	3
2.0 Data Format.....	3
2.1 Card Segmentation.....	3
3.0 Directory Structure.....	3
4.0 Known Consolidations.....	6
5.0 References.....	6

# NIST Special Database 29

## Plain and Rolled Images from Paired Fingerprint Cards at 500 ppi

### 1.0 Introduction

This document describes the updated web release of the *NIST Special Database 29*, which contains 6048 fingerprint images in PNG format. The original CD-ROM released *Special Database 29* (SD29) was made available in 2001 and contained 216 fourteen-print fingerprint card pairs stored in the ANSI/NIST data format [1] compressed with WSQ [2]. The original lossless JPEG compressed [3] version of the previously CD-ROM released WSQ compressed ANSI/NIST files have been converted into Portable Network Graphics (PNG) [4] images and metadata text file pairs. Each file pair consists of a metadata file containing information about its corresponding fingerprint image file.

The original released ANSI/NIST file database contains ten rolled fingerprint images of a subject's left and right hands, right and left hand slaps, and thumbs (plain prints from the bottom of the fingerprint card) and has the extension *.an2*. Descriptive information about the images is also included in the file.

NIST *Special Database 29* fingerprint database offers the user complete paired fingerprint cards that include all ten rolled fingerprints and the plain/flat impressions at the bottom of the card. Paired fingerprint cards are two sets of fingerprints for one individual captured at different dates. By including all the fingerprint data for the card pairs, a user can compare any combination of *plain* and *rolled* images. This database has 216 paired fingerprint cards. Each card is scanned at 19.7 ppm (500 ppi) and segmented into individual fingerprint images. The segmented images are in PNG format. Reference information is included in a metadata text file *History* field to help reconstruct the fingerprint card image if desired. For example, the History line in the metadata file, *History: a025\_01 3984 2500 0 0*, contains the file original file name, the pixel size of the fingerprint card image before segmentation (width, height) and the (x,y) location for the upper/left corner of the fingerprint in the fingerprint card image. The metadata file also has the gender of the individual, the finger position (Table 1) and the fingerprint classification (Table 2).

This fingerprint data is available in two resolutions. *Special Database 29* images are 19.7 pixels per millimeter (ppmm) (500 pixels per inch (ppi)) and *Special Database 30* images are 39.4 pixels per millimeter (ppmm) (1000 pixels per inch (ppi)).

Finger position	Finger code
Unknown	0
Right thumb	1
Right index finger	2
Right middle finger	3
Right ring finger	4
Right little finger	5
Left thumb	6
Left index finger	7
Left middle finger	8
Left ring finger	9
Left little finger	10
Plain right thumb	11
Plain left thumb	12
Plain right four fingers	13
Plain left four fingers	14

**Table 1** – Finger position code

Description	Code
Plain arch	PA
Tented arch	TA
Radial loop	RL
Ulnar loop	UL
Plain whorl	PW
Central pocket loop	CP
Double loop	DL
Accidental whorl	AW
Whorl, type not designated	WN
Right slant loop	RS
Left slant loop	LS
Scar	SR
Amputation	XX
Unknown or unclassifiable	UN

**Table 2** – Pattern classification

## 1.1 File Naming Structure

The ANSI/NIST files are named with the first letter *a* or *b* to represent the first or second instance of the subject. The subjects are numbered 001 - 216. (e.g., *a001.an2*) The newly formatted image and text files include the finger position in the file name. (e.g., *a001\_01.png* and *a001\_01.txt*)

## 1.2 Conversion from ANSI/NIST Data Format

The conversion process from ANSI/NIST data format to image and text file pairs was done using a Perl script and programs from NIST Biometric Image Software (NBIS) [5] and Netpbm packages. Below are the steps taken to convert the original database images to the updated web version.

## 1.3 Image File Conversion

1. The NBIS *An2ktool* was used to extract Type-1, Type-2, and Type-14 record information and images from an ANSI/NIST file. Each image file was renamed to reflect the name of the original ANSI/NIST file and the finger position of the image (e.g., *a001\_01.xxx*).
2. The NBIS *Djpegl* program was used to convert the JPEGL file into a) a raw image and b) a NISTCOM (NCM) [1] text file which contains the image height and width information.
3. The Netpbm *Rawtopgm* program, along with the height and the width of the image was used to convert the raw image into a PGM (Netpgm grayscale image) file.

4. The Netpbm *Pnmtopng* program was used to convert the PGM to a PNG (e.g., a001\_01.png) file.

## 1.4 Text File Creation

1. No information was extracted from the Type-1 record for the text file.
2. Gender was extracted from field 2.024 of the Type-2 record.
3. The Type-14 records hold the images for the subject, the finger position and the history values pertaining to the image. The finger position was taken from field 14.031. The history values were taken from field 14.020. (e.g., *History: f0001\_01.pct W a0591.pct*)
4. The completed text file (e.g., a001\_01.txt) contains the gender, finger position, fingerprint classification and history of its corresponding image (e.g., a001\_01.png).

The resulting image and corresponding text files were put into a directory named after the original file name (a001) within a hierarchy of directories similar to that of the source files.

## 2.0 Data Format

### 2.1 Card Segmentation

This data came from an archive of fingerprint cards that contained several varieties of fingerprint card styles. The fingerprint boxes on the cards varied in position and style as shown when comparing Figure 1 and Figure 2. Segmentation was done by detecting the fingerprint layout independently for each fingerprint card. Since each fingerprint card layout was different, the sizes of the segmented images also varied. Figure 3 shows the rolled images for the left and right thumbs and the left four plain impressions as segmented from the fingerprint card in Figure 2. The 14 segmented images contain all the pixel data from the original fingerprint card, so a user could reconstruct the card and resegment the data. An adaptive segmentation would be most useful for the plain impressions at the bottom of the card because the fingerprint impressions occasionally crossed over the boxed area used for simple template segmentation as shown in Figure 4 (file b027.an2).

## 3.0 Directory Structure

The top level of the directory structure has one directory *sd29*. In the *sd29* directory is 433 directories starting with *a001* and ending in *b216*. There are 216 directories starting with a and 216 directories starting with b. The file pairs (a and b for the first character in the filename) are sequentially numbered. Figure 5 shows the structure of the database.

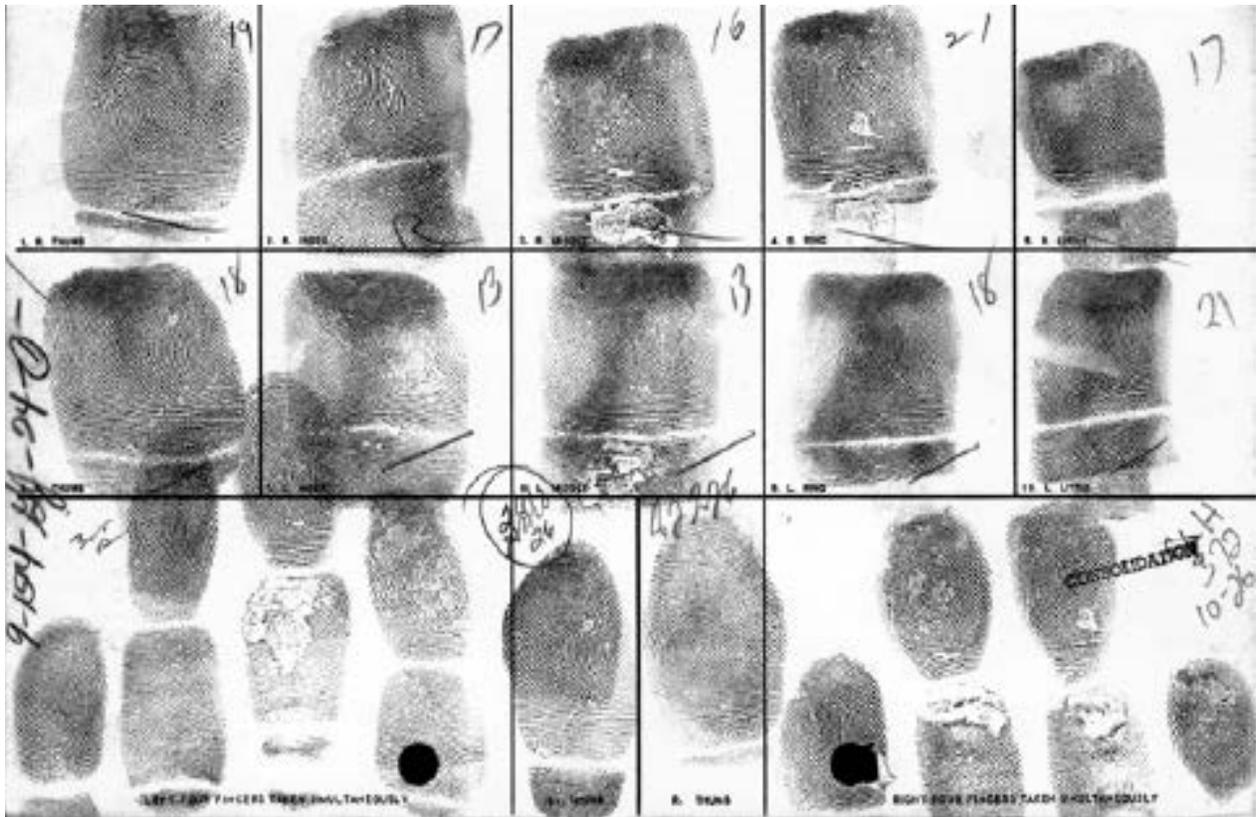
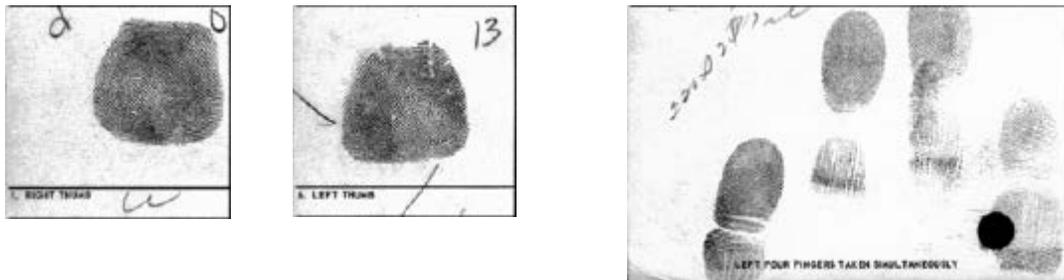


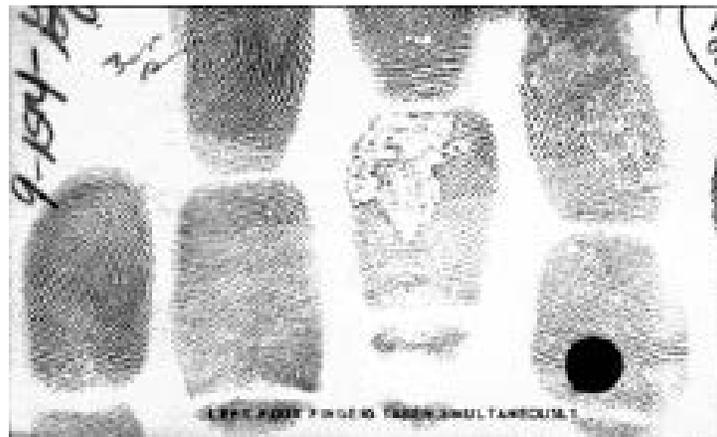
Figure 1 - Image of fingerprint card a042.an2 from the database



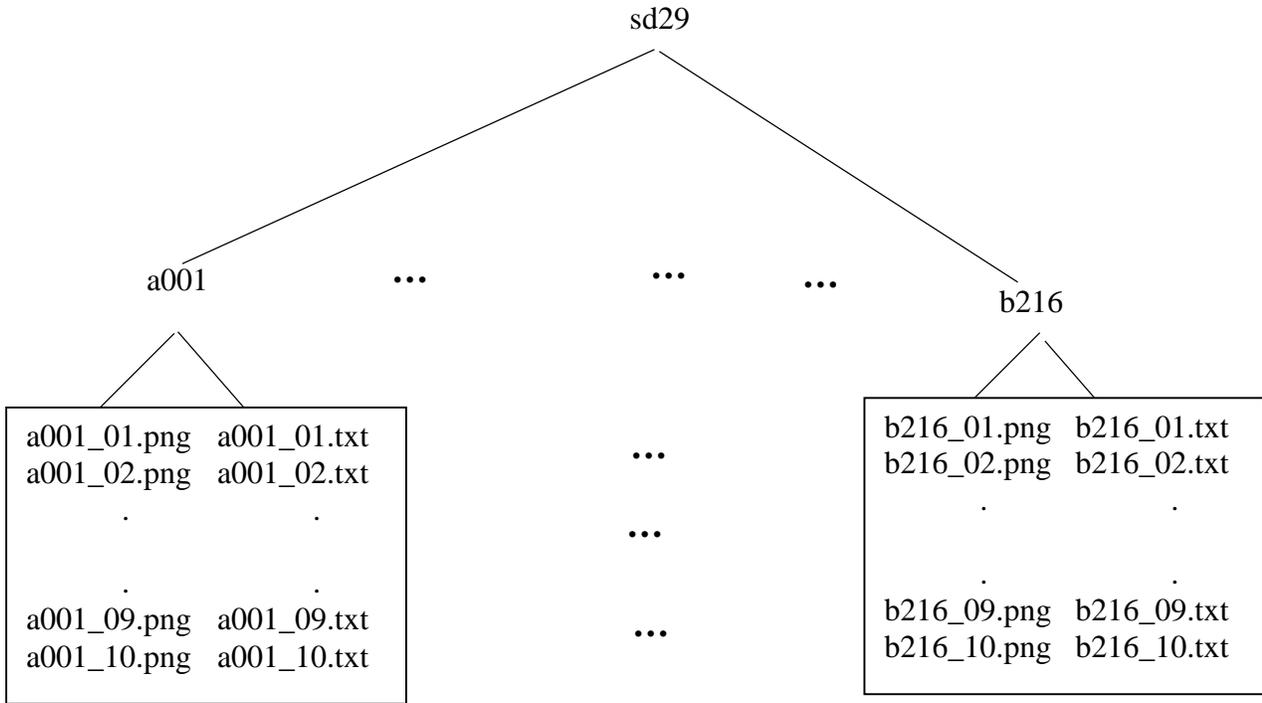
Figure 2 - Fingerprint card a021.an2 shows a different card format to segment



**Figure 3** - Segmented images for right thumb, left thumb, and the four left plain impressions.



**Figure 4** - Image where segmentation cuts through the inked fingerprint



**Figure 5 - Database Directory Structure**

#### **4.0 Known Consolidations**

These are the known consolidations within the database:

The fingerprints in these directories are from the same person but from a different fingerprint card instance:

- a207 and a211
- b207 and b211
- a154 and a166
- b154 and b166

#### **5.0 References**

[1] K. Mangold Ed., "Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information," American National Standard, ANSI/NIST-ITL 1-2011:2015.

- [2] "WSQ Gray-scale Fingerprint Image Compression Specification, IAFIS-IC-0110v2,," Federal Bureau of Investigation,, February 1993.
- [3] "Information technology -- Lossless and near-lossless compression of continuous tone still images: Baseline," International Organization for Standardization/International Electrotechnical Commission, ISO/IEC 14495-1:1999.
- [4] "Information technology -- Computer graphics and image processing -- Portable Network Graphics (PNG): Functional specification," International Organization for Standardization/International Electrotechnical Commission, ISO/IEC 15948:2004.
- [5] C. Watson et al., "User's Guide to NIST Biometric Image Software," National Institute of Standards and Technology ITL/IAD/Image Group, October 2004.