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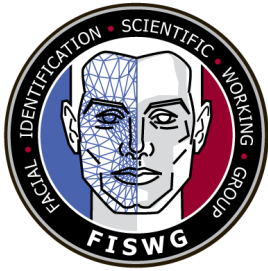
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Facial Recognition Systems Operation Assurance: Preserving Image Quality in Desktop Documents

1. Scope

1.1 The scope of this document is to provide a detailed process and examples of how image quality can be maintained if applications such as Microsoft Office are used to store facial images that may then be enrolled or searched in automated facial recognition systems (FRS) or used for one-to-one comparisons. If these processes are not properly managed, then image quality will be reduced.

1.2 This applies to Microsoft Word (.docx), Excel (.xlsx) and PowerPoint (.pptx) in Microsoft Office version 2016 ONLY. Different processes may be required for other versions of Microsoft Office.

1.3 Many Internet resources are available which detail the file formats used in Microsoft Office documents [1].

1.4 Agency system administrators should be consulted regarding image extraction usage so proper computer security issues can be addressed. If the processes in this document are used, it is recommended to not convert the Office documents to a PDF file format as this conversion appears to lower the quality of the images in the resultant PDF file.

2. Referenced Documents

2.1 *ASTM Standards:*¹

E2916 Terminology for Digital and Multimedia Evidence Examination

E2825 Standard Guide for Forensic Digital Image Processing

¹ For referenced ASTM standards, visit www.nist.gov/osac/astm-launch-code, or the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 Other Standards:

Microsoft Office file formats²

NIST Multiple Encounter Dataset (MEDS)³ <https://www.nist.gov/itl/iad/image-group/special-database-32-multiple-encounter-dataset-meds>

3. Terminology

3.1 Definitions:

3.1.1 See ASTM E2916 Terminology for digital and multimedia evidence examination terms.

3.2 Acronyms

3.2.1 *PPI*—Pixels per inch measurement of the pixel density of an electronic image, or of a device such as a computer monitor or camera. For example, a 1200 PPI image will display higher quality detail than a 300 PPI image. Use of PPI as a resolution term is generally used with digitally captured images (i.e., photography).

4. Summary of Guide

4.1 This document provides guidelines and techniques to ensure image quality is maintained when facial images are inserted into desktop documents for storage or submitting to agencies for enrolling or searching with facial recognition systems or for one to one comparisons.

4.2 The intended audience of this document is system owners, system users, and system administrators of existing automated facial recognition systems and Facial Image Comparison examiners.

5. Significance and Use

5.1 Introduction

5.1.1 Attention to ensuring and preserving image quality in facial images presented to an FRS for enrollment or searching is critical to achieve the best possible accuracy. It is always recommended to transfer facial images in their original file format without

² Microsoft technical documentation, including file formats, is available from docs.microsoft.com/en-us/#office or <https://microsoft.com>.

³ Available from National Institute of Standards and Technology (NIST) website www.nist.gov/itl/iad/image-group/special-database-32-multiple-encounter-dataset-meds or www.nist.gov.

alterations. However, there are instances where documents are used to store images, and then transfer the images from a point of origin to the FRS agency. When documents are used there are simple steps which can be done to preserve image quality.

5.1.2 This document covers the following areas:

- How to modify Microsoft Office components (e.g., Word, Excel, PowerPoint) to preserve maximum image quality when inserting facial imagery
- Examples of how image quality is reduced when Microsoft Office is not setup to maximize image quality

5.2 Data Set

5.2.1 Facial imagery from the NIST Multiple Encounter Dataset (MEDS) was used in this document [2].

NIST Special Database 32 - Multiple Encounter Dataset (MEDS) is a test corpus organized from an extract of submissions of deceased persons with prior multiple encounters. MEDS is provided to assist the FBI and partner organizations refine tools, techniques, and procedures for face recognition as it supports Next Generation Identification (NGI), forensic comparison, training, and analysis, and face image conformance and inter-agency exchange standards. The MITRE Corporation (MITRE) prepared MEDS in the FBI Data Analysis Support Laboratory (DASL) with support from the FBI Biometric Center of Excellence.

Acknowledgement

This dataset is being released (as prepared by MITRE Corporation) to support the NIST Multiple-Biometric Evaluation 2010 (MBE). In addition, this dataset is available to any user interested in biometric research. The sponsor of this joint effort and provider of the data is the Federal Bureau of Investigation (FBI).

5.2.2 Ten images from MEDS were randomly selected based on image size. For facial images used, issues such as lighting or pose were not considered.

Name	Date	Type	Size	Dimensions	Height	Width
S514-01-t10_01.jpg	4/1/2021 1:02 PM	JPG File	459 KB	3008 x 2000	2000 pixels	3008 pixels
S514-01-t10_02.jpg	4/1/2021 1:02 PM	JPG File	449 KB	3008 x 2000	2000 pixels	3008 pixels
S284-02-t10_01.jpg	4/1/2021 1:02 PM	JPG File	157 KB	768 x 960	960 pixels	768 pixels
S284-02-t10_02.jpg	4/1/2021 1:02 PM	JPG File	149 KB	768 x 960	960 pixels	768 pixels
S518-02-t10_02.jpg	4/1/2021 1:02 PM	JPG File	100 KB	768 x 960	960 pixels	768 pixels
S518-01-t10_02.jpg	4/1/2021 1:02 PM	JPG File	100 KB	768 x 960	960 pixels	768 pixels
S303-01-t10_01.jpg	4/1/2021 1:02 PM	JPG File	98 KB	768 x 960	960 pixels	768 pixels
S435-01-t10_01.jpg	4/1/2021 1:02 PM	JPG File	98 KB	768 x 960	960 pixels	768 pixels
S518-01-t10_01.jpg	4/1/2021 1:02 PM	JPG File	98 KB	768 x 960	960 pixels	768 pixels
S518-02-t10_01.jpg	4/1/2021 1:02 PM	JPG File	97 KB	768 x 960	960 pixels	768 pixels

Figure 1: MEDS Data Set Used

6. Procedure

6.1 Image Insertion Process

6.1.1 Step 1: Open Word from Microsoft Office 2016

6.1.2 Step 2: Select Home->Options->Advanced. Then locate “Image Size and Quality.” Select:

- “Do not compress images in file”
- Set “Set default target output file to:” 330 ppi

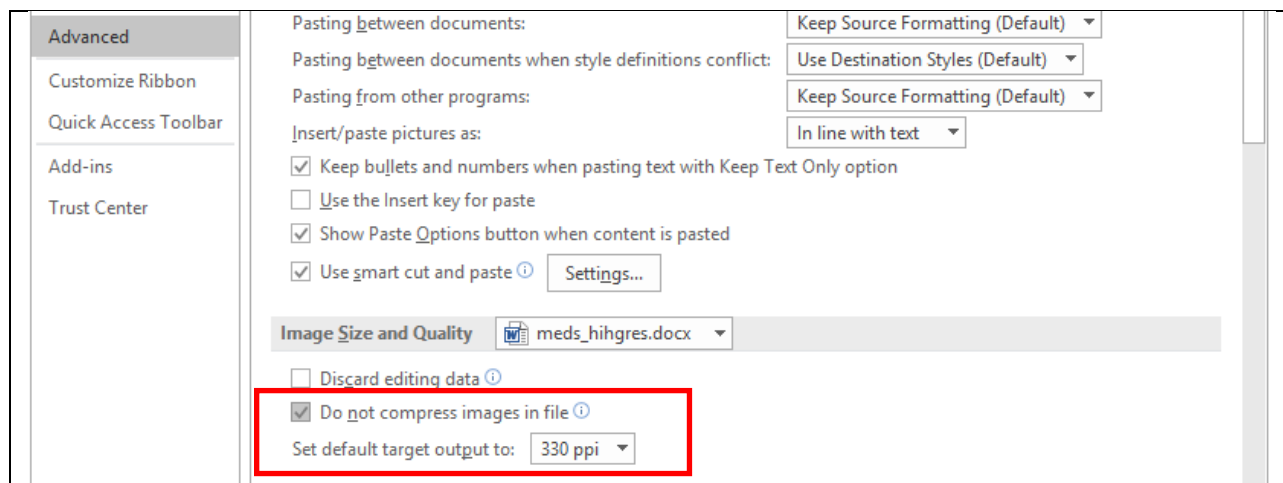


Figure 2: Image Quality Settings

Note that Excel and PowerPoint 2016 have the same options.

6.1.3 Step 3: Insert the images into the document and save the document to disk.

6.1.3.1 For Word & PowerPoint use the Copy and Paste function.

6.1.3.2 For Excel, use the Insert Picture function

6.1.4 Step 4: The user will see that final file size of the .docx will be larger since the facial images will not be compressed.

6.1.5 Examples:

File	File size on disk
Raw images not inserted into the document	1,728 KB
Docx: No compression	1,815 KB
Docx: 300 PPI	1,814 KB
Docx: 220 PPI	1,329 KB
Docx: 96 PPI	402 KB

Figure 3: Office Document File Size Comparison

Looking at a single image inserted and extracted as an example:

File	File size	rows	cols	channels	ppi	format	SHA1
Original file inserted	469949	2000	3008	3	(300 300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759
Docx: No compression document	469949	2000	3008	3	(300 300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759
Docx: 330 ppi resolution document	469949	2000	3008	3	(300 300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759
Docx: 200 ppi resolution document	216668	924	1390	3	(220 220)	RGB	531152964A71D4D8A3B453 F3D5CE8C2953F3CDC0
Docx: 96 ppi resolution document	16400	404	608	3	(96 96)	RGB	A9E8A46E28BEAF9E3275F DD1BC81B50511FCB5E0

Figure 4: File Comparison

6.2 Observations:

- The original image was extracted from the “No Compression” and 330 ppi documents as evidenced by the identical SHA1 checksum (yellow highlight)
- As the Word image quality resolution is reduced from “No Compression” to 96 ppi the inserted image file is reduced in size with a corresponding reduction in image quality



Figure 5: Image Comparison

6.3 Image Extraction Process

6.3.1 **Step 1:** Copy the document to a temporary directory

6.3.2 Step 2: Rename the .docx file to .zip

The screenshot shows a Windows File Explorer window with the address bar set to 'OS (C:) > Temp > Documents > Extract'. The main pane displays a table of files:

Name	Date modified	Type	Size
meds_highres_NoComp.docx	4/2/2021 10:44 AM	Microsoft Office ...	1,815 KB
meds_highres_NoComp.zip	4/2/2021 10:44 AM	WinZip File	1,815 KB

Figure 6: Before and After File Copy and Rename

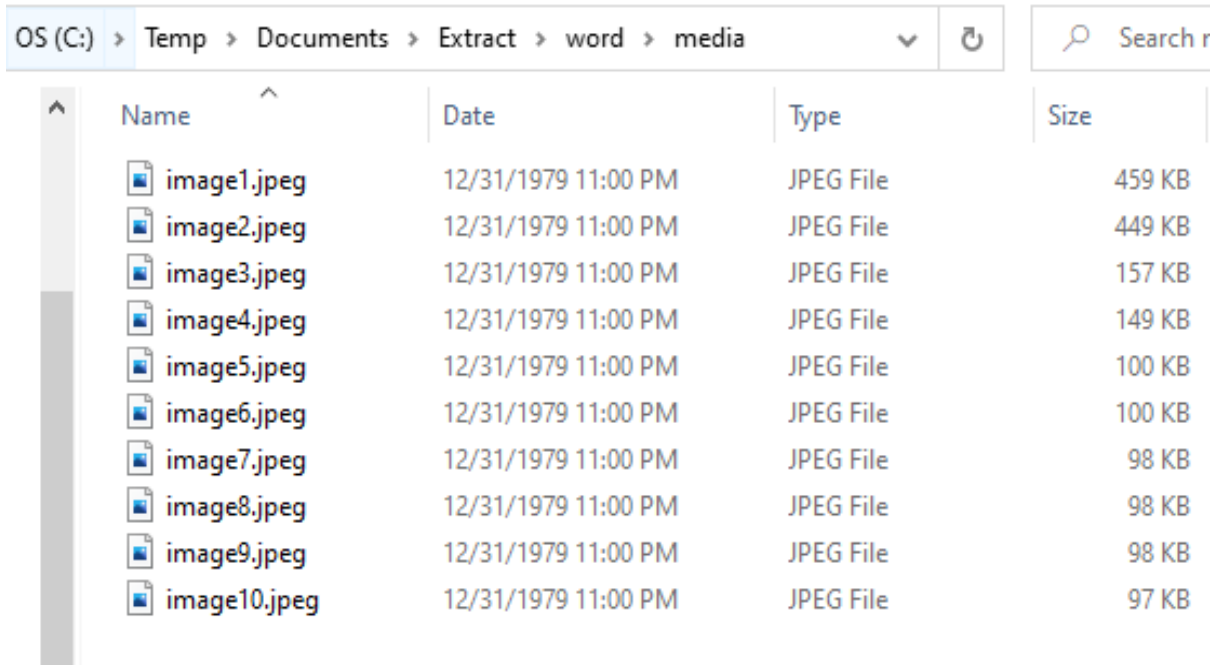
6.3.3 Step 3: Extract the zip file to disk using any 'unzipping' software on your system.

The screenshot shows the same Windows File Explorer window after unzipping. The main pane displays a table of files and folders:

Name	Date modified	Type	Size
_rels	9/14/2021 8:46 AM	File folder	
docProps	9/14/2021 8:46 AM	File folder	
word	9/14/2021 8:46 AM	File folder	
[Content_Types].xml	12/31/1979 11:00 PM	XML Document	2 KB
meds_highres_NoComp.docx	4/2/2021 10:44 AM	Microsoft Office ...	1,815 KB
meds_highres_NoComp.zip	4/2/2021 10:44 AM	WinZip File	1,815 KB

Figure 7: Directory after Unzipping

6.3.4 Step 4: Go to the directory “word\media” to see the images



Name	Date	Type	Size
image1.jpeg	12/31/1979 11:00 PM	JPEG File	459 KB
image2.jpeg	12/31/1979 11:00 PM	JPEG File	449 KB
image3.jpeg	12/31/1979 11:00 PM	JPEG File	157 KB
image4.jpeg	12/31/1979 11:00 PM	JPEG File	149 KB
image5.jpeg	12/31/1979 11:00 PM	JPEG File	100 KB
image6.jpeg	12/31/1979 11:00 PM	JPEG File	100 KB
image7.jpeg	12/31/1979 11:00 PM	JPEG File	98 KB
image8.jpeg	12/31/1979 11:00 PM	JPEG File	98 KB
image9.jpeg	12/31/1979 11:00 PM	JPEG File	98 KB
image10.jpeg	12/31/1979 11:00 PM	JPEG File	97 KB

Figure 8: Image details after Unzipping

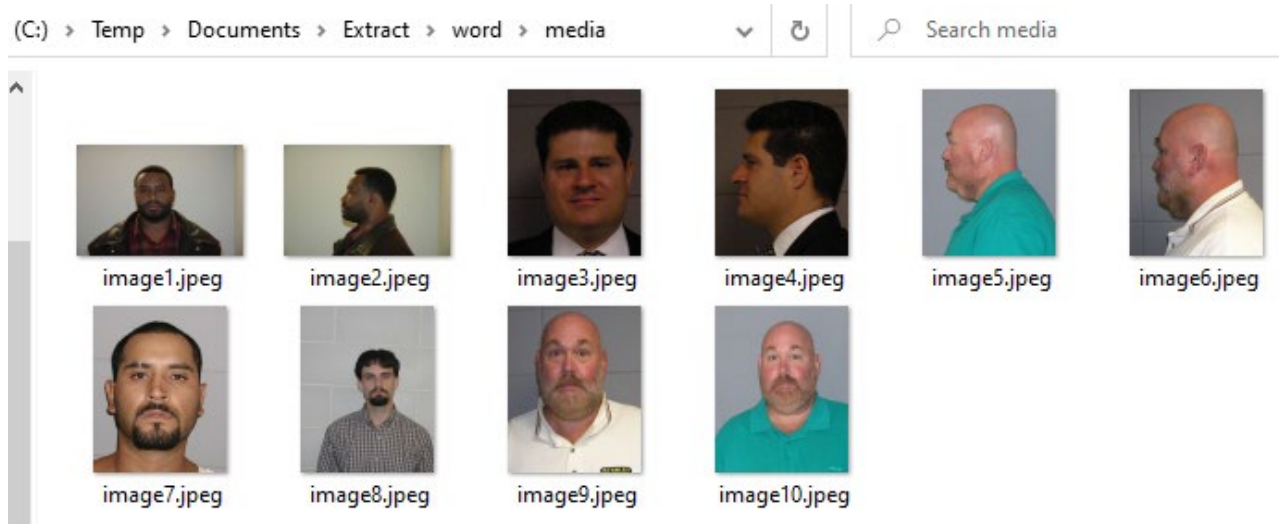


Figure 9: Images extracted after Unzipping

6.4 Outcomes

6.4.1 When inserting facial images into desktop documents the processes in this FISWG document present:

- How to adjust Microsoft Office Word 2016 (.docx) to maximize image quality when inserting facial images. These adjustments also apply to Excel and PowerPoint (.xlsx and .pptx).
- If Word 2016 is properly adjusted before inserting images, the images extracted are the same images as inserted into Word, thus preserving image quality as proven by the identical SHA1 checksums.
- This process should work with any image format inserted into Office 2016 (e.g., bmp, png, etc.) but agencies who utilize this technique should verify the process works as intended with their own images before deploying this as a standard operating procedure.

FISWG documents can be found at: www.fiswg.org