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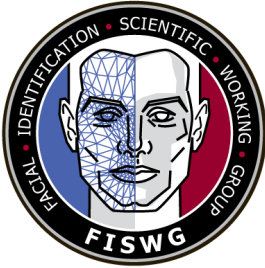
Facial Recognition Systems Operation Assurance: Preserving Image Quality in Desktop Documents

1. Introduction

1.1 When inserting facial images into desktop documents the processes in this FISWG document presents methods to preserve the image quality.

1.2   This document 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.

1.2.1 It should be noted that using desktop documents in the described manner is not a recommended process and should only be performed when necessary. It is always advisable to transfer imagery in a lossless file format.

1.2.2 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.

1.2.3 This process is expected to work with any image format inserted into Office 2016 (e.g., bmp, png) however, agencies who utilize this technique should verify if the process works as intended with their own images before deploying this as a standard operating procedure.

2. Scope

2.1 This document provides a detailed process with examples for maintaining image quality when storing facial images using Microsoft Office applications. If these processes are not followed, the quality of these images will be compromised when/if enrolled or searched in Facial Recognition Systems (FRS) or used for one-to-one comparisons.

2.2 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 FRS or for one-to-one comparisons.

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2.3 The intended audience of this document is system owners, system users, and system administrators of existing FRS and Facial Image Comparison reviewers or examiners.

3. Referenced Documents

3.1 *ASTM Standards*:

E2916 Terminology for Digital and Multimedia Evidence Examination[1]

3.2 *Other Documents*:

Microsoft Office file formats[2]

NIST Multiple Encounter Dataset (MEDS)[3]

4. Terminology

4.1 *Definitions:* See ASTM E2916 Terminology for Digital and Multimedia Evidence Examination terms.

4.2 *Acronyms*:

4.2.1 *FRS: facial recognition systems*

4.2.2 *BMP: bitmap*

4.2.3 *PNG: portable network graphics*

4.2.4 *NIST: National Institute of Standards and Technology*

5. Image Transfer Best Practice

5.1 When any imagery is transferred between agencies, it is best practice to exchange an exact (bit for bit) copy of the original image for any forensic purpose. The copy should be made with a conventional copy command using the operating system's intrinsic commands. Practices such as, making copies by opening an image in an image

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[1] For referenced ASTM standards, visit 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] Microsoft technical documentation, including file formats, is available from https://docs.microsoft.com/en-us/#office or https://microsoft.com.
[3] Available from National Institute of Standards and Technology (NIST) website https://www.nist.gov/itl/iad/image-group/special-database-32-multiple-encounter-dataset-meds or http://www.nist.gov.

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editor, utilizing a screen capture, or printing to rescan the image, corrupts the original imagery and should never be used.

5.2 Once exact copies are made so the originating agency can retain the verified original images, it is then best practice to use lossless compression software that can package, transport, and extract the imagery to the destination agency. There are many software packages that can be used to do this which include, but are not limited to the following:

5.2.1 Winzip: https://www.winzip.com/

5.2.2 7Zip: https://www.7-zip.org/

5.2.3 Gzip: https://www.gzip.org/

5.2.4 WinRAR: https://www.win-rar.com

5.3 Lossless data compression is the key feature to ensure with these software applications. Some packages may also offer encryption, but this function is not covered in this document.

6. Procedure

6.1 This document covers the following areas:

6.1.1 How to modify Microsoft Office components (e.g., Word, Excel, PowerPoint) to preserve maximum image quality when inserting facial imagery.

6.1.2 Examples of how image quality is reduced when Microsoft Office is not setup to maximize image quality.
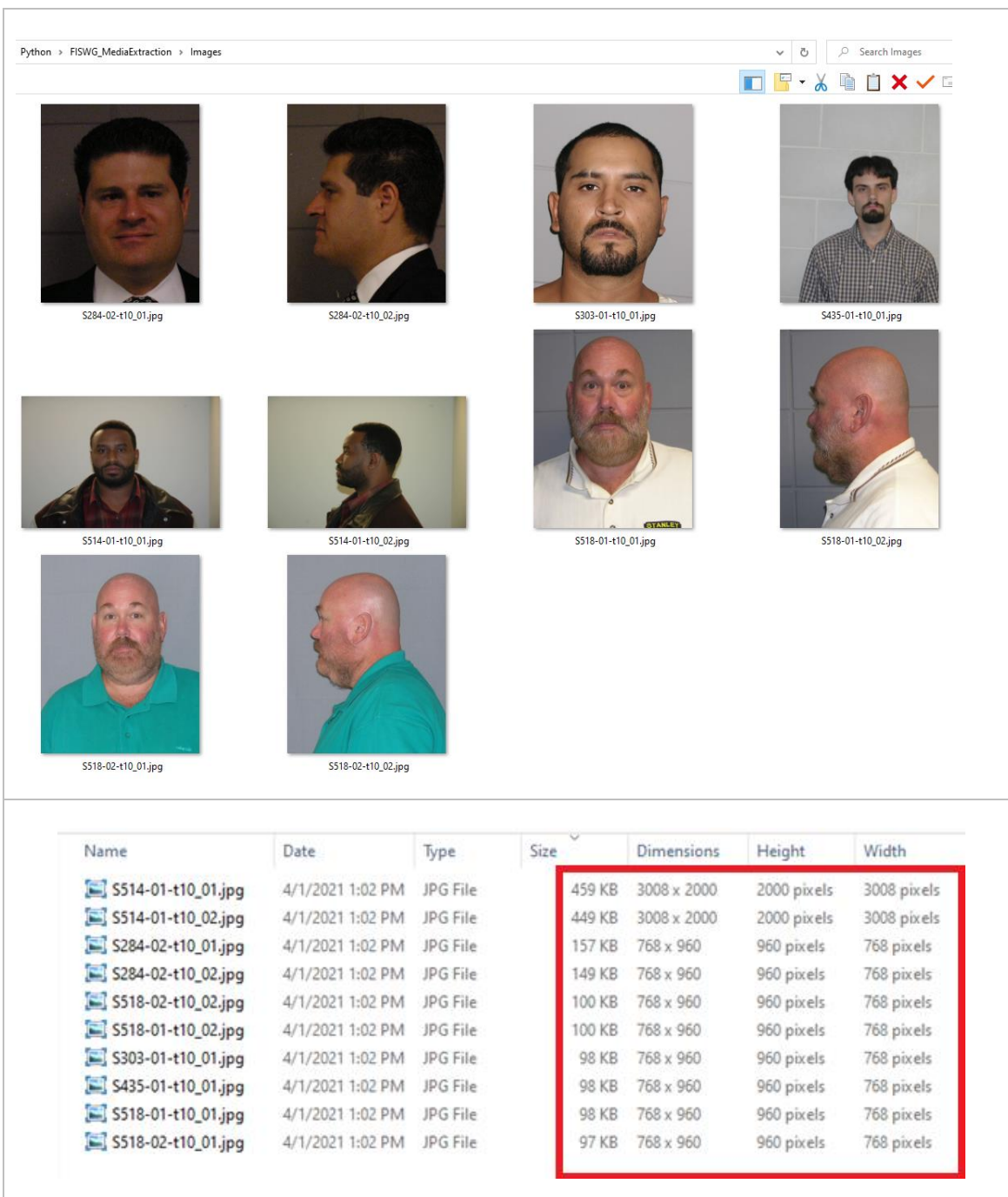
6.2 Data Set

6.2.1 Facial imagery from the NIST Special Database 32 (SD 32) Multiple Encounter Dataset (MEDS) was used in this document.

6.2.2 NIST SD 32 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 to 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.

6.2.3 Acknowledgement: NIST SD 32 MEDS 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).

6.2.4 Ten images from MEDS were randomly selected based on image size (see Figure 1). For facial images used, issues such as lighting or pose were not considered.

Figure 1: MEDS Data Used

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6.3 If copies of original imagery cannot be obtained and the only copy available is in a desktop document, the processes for inserting and extracting the images from the internal data structures of desktop documents as described in this guideline can be used. For the cases defined and tested in this document, the process retrieves a copy of the pixels of the image as they were originally inserted into the desktop document.

6.4 Depending on how the images were originally inserted into the document, these pixels may, or may not, be an accurate representation of the original images. The processes described below explain how to maximize the likelihood that the pixels in the desktop document are an accurate copy of the original images – at the expense of making the desktop document larger than it would be with the typical default settings of the desktop programs.

6.5 Caveats and exceptions in this process include, but are not limited to the following:

6.5.1 Defaults settings and internal processes of desktop applications can change at any time, without notification or warning by the application vendors (e.g., open source or Microsoft Office). This could break the processes in this document.

6.5.2 The insert and extraction process defined in this document have not been tested on all variants of image formats, image resolutions, and other associated image parameters. It may break without notification or warning for cases that have not been tested.

6.6 These desktop applications may convert an image from its original format into another image format within the office document, even if the pixel values are preserved.

6.7 Image Insertion Process – Word.

6.7.1 Open Word from Microsoft Office 2016.

6.7.2 Select Home→Options→Advanced.

6.7.3 Locate "Image Size and Quality."

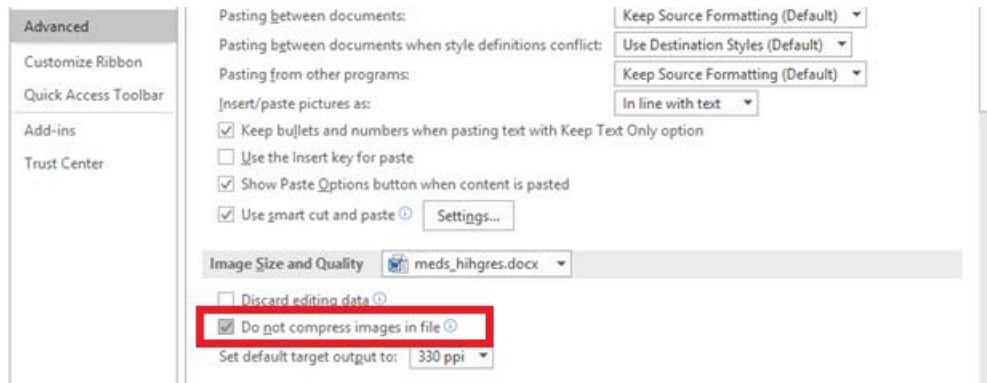6.7.4 Select "Do not compress images in file" (see Figure 2).

Figure 2: Image Size and Quality settings – Word

6.7.5 Insert the images into the document using the Copy and Paste function and save the document to disk.

6.7.6 The user will see that final file size of the .docx will be larger since the facial images will not be compressed.

6.7.7 Table 1 provides a comparison of Word document files sizes for different levels of image compression.

Table 1: Document file size comparison – Word

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

6.7.8 Table 2 provides an example of a single image inserted and extracted.

Table 2: Image insertion and extraction example – Word

File	File size	Rows	Columns	Channels	Resolution	Format	SHA1
Original file inserted	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759
Docx: No compression document	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759
Docx: 300 ppi resolution document	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759

6.8 Image Insertion Process – Excel

6.8.1 Open Excel from Microsoft Office 2016.

6.8.2 Select Home→Options→Advanced.

6.8.3 Locate "Image Size and Quality."

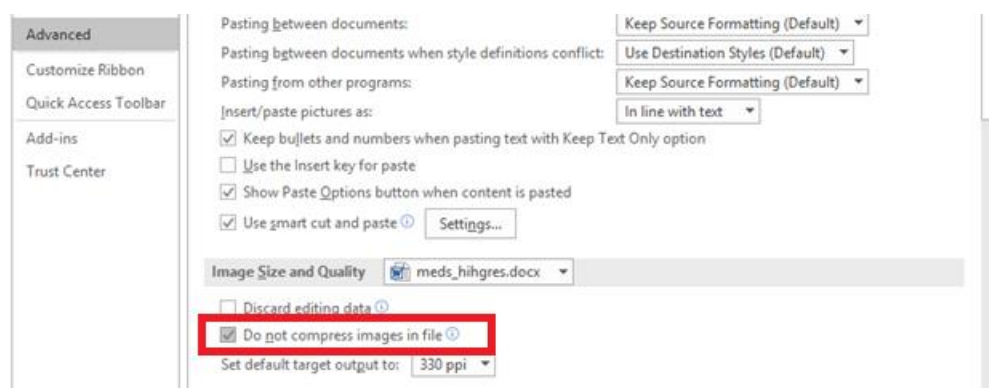6.8.4 Select "Do not compress images in file" (see Figure 3).

Figure 3: Image Size and Quality settings – Excel

6.8.5 Insert the images into the document using the Copy and Paste function and save the document to disk.

6.8.6 The user will see that final file size of the .xlsx will be larger since the facial images will not be compressed.

6.8.7 Table 3 provides a comparison of Excel document files sizes.

Table 3: Document file size comparison – Excel

File	File size on disk
Raw images not inserted into the document	1,728 KB
Xlsx: No compression	1,776 KB
Xlsx: 300 ppi	1,776 KB

6.8.8 Table 4 provides an example of a single image inserted and extracted.

Table 4: Image insertion and extraction example – Excel

File	File size	Rows	Columns	Channels	Resolution	Format	SHA1
Original file inserted	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D3EC75CDA1BBB1740B759
Docx: No compression document	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D3EC75CDA1BBB1740B759
Docx: 300 ppi resolution document	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D3EC75CDA1BBB1740B759

6.9 Image Insertion Process – PowerPoint

6.9.1 Open PowerPoint from Microsoft Office 2016.

6.9.2 Select Home→Options→Advanced.

6.9.3 Locate "Image Size and Quality."

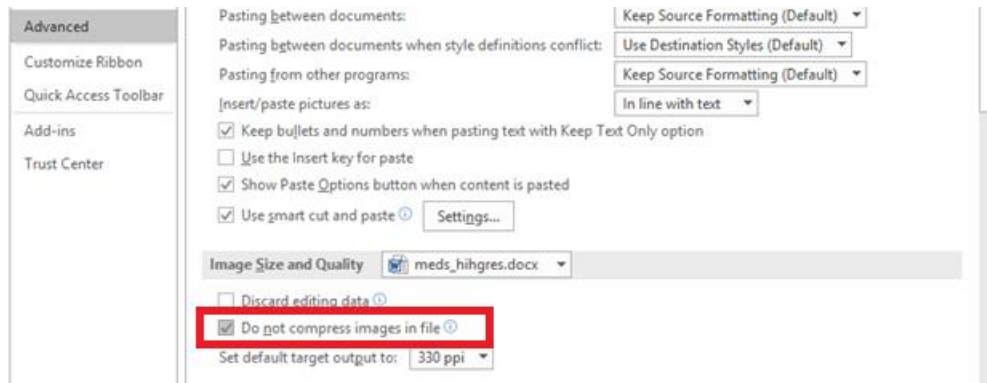6.9.4 Select "Do not compress images in file" (see Figure 4).

Figure 4: Image Size and Quality settings – PowerPoint

6.9.5 Insert the images into the document using the Copy and Paste function and save the document to disk.

6.9.6 The user will see that final file size of the .pptx will be larger since the facial images will not be compressed.

6.9.7 Table 5 provides a comparison of PowerPoint document files sizes.

Table 5: Document file size comparison – PowerPoint

File	File size on disk
Raw images not inserted into the document	1,728 KB
Xlsx: No compression	1,845 KB
Xlsx: 300 ppi	1,845 KB

6.9.8 Table 6 provides an example of a single image inserted and extracted.

Table 6: Image insertion and extraction example – PowerPoint

File	File size	Rows	Columns	Channels	Resolution	Format	SHA1
Original file inserted	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759
Pptx: No compression document	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759
Pptx: 300 ppi resolution document	469949	2000	3008	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D 3EC75CDA1BBB1740B759

6.10 Observations

6.10.1 The original image was extracted from the "No Compression" and 300 ppi documents as evidenced by the identical SHA1 checksum (yellow highlight); see Table 2, Table 4, and Table 6.

6.10.2 As the 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; see Figure 5.

Figure 5: Image quality reduction corresponding to image compression

6.11 Image Extraction Process

6.11.1 Copy the document to a temporary directory.
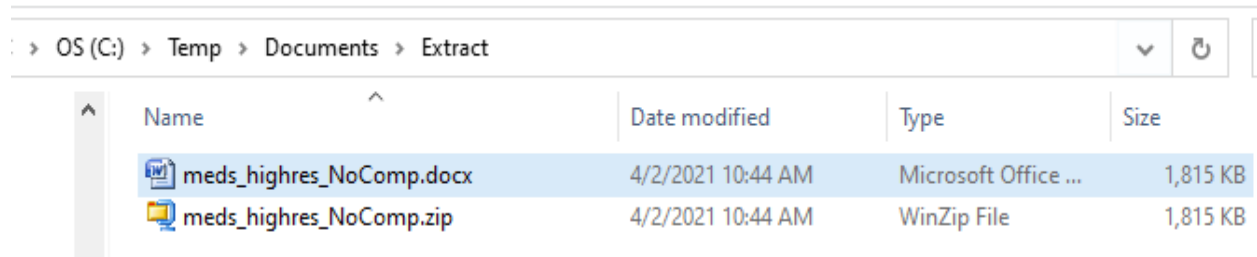
6.11.2 Rename the file to .zip; see Figure 6.

Figure 6: Before and after copying and renaming a file

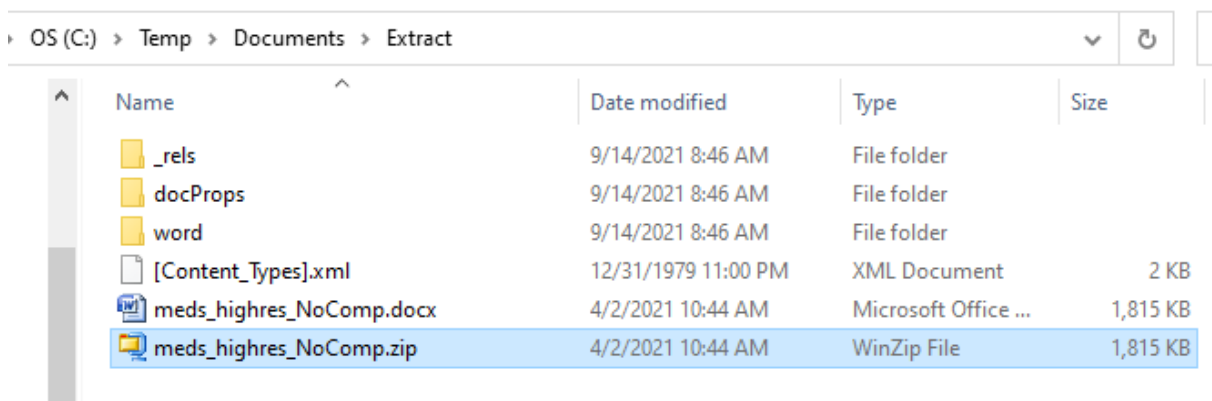6.11.3 Extract the zip file to disk using any 'unzipping' software on your system (see Figure 7).

Figure 7: Directory after unzipping a file

6.11.4 Go to the "word\media" directory to see the images (see Figure 8 and Figure 9).

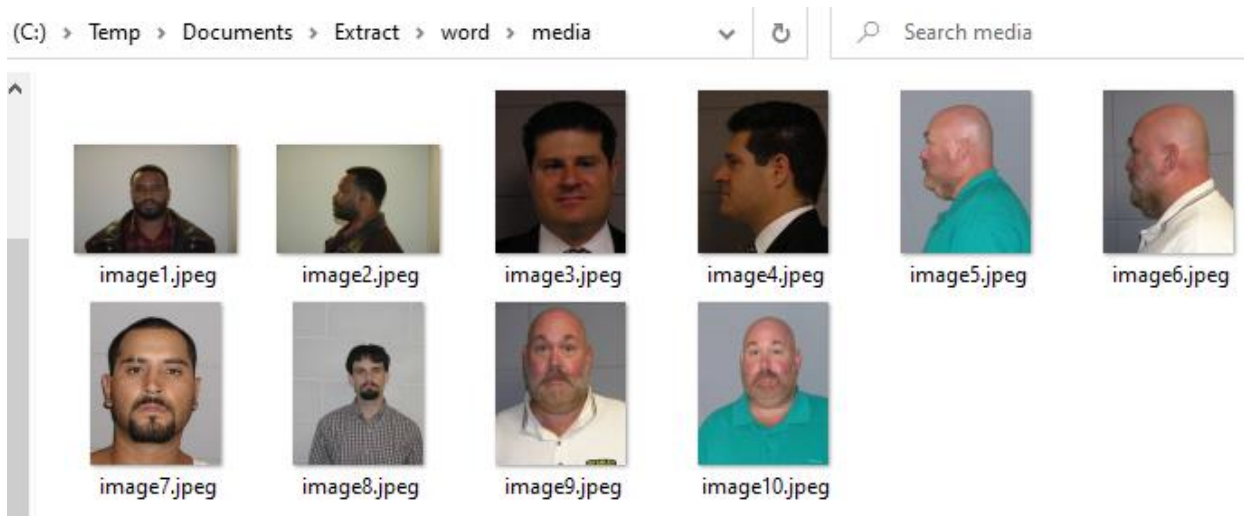**Figure 8: Image details after unzipping a file**

Figure 9: Images extracted after unzipping

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