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

1   **1. Introduction**

2   1.1 When inserting facial images into desktop documents the processes in this

3   FISWG document present:

4   1.1.1 How to adjust Microsoft Office Word 2016 (.docx) to maximize image quality

5   when inserting facial images. These adjustments also apply to Excel and PowerPoint

6   (.xlsx and .pptx).

7   1.1.2 If Word 2016 is properly adjusted before inserting images, the images extracted

8   are the same images as inserted into Word, thus preserving image quality as proven by

9   the identical SHA1 checksums.

10   1.1.3 This process should work with any image format inserted into Office 2016

11   (e.g., bmp, png, etc.) but agencies who utilize this technique should verify the process

12   works as intended with their own images before deploying this as a standard operating

13   procedure.

14   **2. Scope**

15   2.1 This document provides a detailed process with examples for maintaining image

16   quality when storing facial images using Microsoft Office applications. If these

17   processes are not followed, the quality of these images will be compromised when/if

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18   enrolled or searched in Facial Recognition Systems (FRS) or used for one-to-one

19   comparisons.

20   2.2 This document applies to Microsoft Word (.docx), Excel (.xlsx) and PowerPoint

21   (.pptx) in Microsoft Office version 2016 ONLY. Different processes may be required for

22   other versions of Microsoft Office.

23   2.3 This document provides guidelines and techniques to ensure image quality is

24   maintained when facial images are inserted into desktop documents for storage or

25   submitting to agencies for enrolling or searching with facial recognition systems or for

26   one-to-one comparisons.

27   2.4 The intended audience of this document is system owners, system users, and

28   system administrators of existing facial recognition systems and Facial Image

29   Comparison examiners.

30   **3. Referenced Documents**

31   3.1 *ASTM Standards*:

32   E2916 Terminology for Digital and Multimedia Evidence Examination[1]

33   3.2 *Other Documents*:

34   Microsoft Office file formats[2]

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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.

35   NIST Multiple Encounter Dataset (MEDS)[3]

4. Terminology

37   4.1 *Definitions:* See ASTM E2916 Terminology for Digital and Multimedia

38   Evidence Examination terms.

39   4.2 *Acronyms*:

40   4.2.1 *FR*: face recognition

41   4.2.2 *FRS*: facial recognition systems

42   4.2.3 *IPD*: Interpupillary distance

43   4.2.4 *BMP*: bitmap

44   4.2.5 *PNG*: portable network graphics

45   4.2.6 *NIST*: National Institute of Standards and Technology

46   4.2.7 *FRVT*: Facial Recognition Vendor Tests

5. Image Transfer Best Practice

48   5.1 When any imagery is transferred between agencies, it is always best practice to

49   exchange an exact (bit for bit) copy of the original image for any forensic purpose. The

50   copy should be made with a conventional copy command using the operating system's

51   intrinsic commands. A copy should never be made by opening the image in an image

52   editor to save a new copy of the image, or a screen capture or printing to rescan

53   images. These practices risk corruption or degradation of the original imagery.

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[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.

54   5.2 Once exact copies are made so the originating agency can keep the verified

55   original images, it is then always best practice to use lossless compression software that

56   can package, transport, and extract the imagery to the destination agency. There are

57   many software packages that can be used to do this which include but are not limited to

58   the following:

59   • Winzip: https://www.winzip.com/

60   • 7Zip: https://www.7-zip.org/

61   • Gzip: https://www.gzip.org/

62   • WinRAR: https://www.win-rar.com

63   5.3 Lossless data compression is the key feature to ensure with these software

64   applications. Some packages may also offer encryption, but this function is not covered

65   in this document.

66   **6. Procedure**

67   6.1 This document covers the following areas:

68   6.1.1 How to modify Microsoft Office components (e.g., Word, Excel, PowerPoint) to

69   preserve maximum image quality when inserting facial imagery.

70   6.1.2 Examples of how image quality is reduced when Microsoft Office is not setup to

71   maximize image quality.

72   6.2 Data Set

73   6.2.1 Facial imagery from the NIST Special Database 32 (SD 32) Multiple Encounter

74   Dataset (MEDS) was used in this document.

75   6.2.2 NIST SD 32 MEDS is a test corpus organized from an extract of submissions of

76   deceased persons with prior multiple encounters. MEDS is provided to assist the FBI

77   and partner organizations refine tools, techniques, and procedures for face recognition

78   as it supports Next Generation Identification (NGI), forensic comparison, training, and

79   analysis, and face image conformance and inter-agency exchange standards. The

80   MITRE Corporation (MITRE) prepared MEDS in the FBI Data Analysis Support

81   Laboratory (DASL) with support from the FBI Biometric Center of Excellence.

82   6.2.3 Acknowledgement: NIST SD 32 MEDS is being released (as prepared by

83   MITRE Corporation) to support the NIST Multiple-Biometric Evaluation 2010 (MBE). In

84   addition, this dataset is available to any user interested in biometric research. The

85   sponsor of this joint effort and provider of the data is the Federal Bureau of Investigation

86   (FBI).

87   6.2.4 Ten images from MEDS were randomly selected based on image size; see

88   Figure 1. For facial images used, issues such as lighting or pose were not considered.

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Figure 1: MEDS Data Used

89

90   6.3 If copies of original imagery cannot be obtained and the only copy available is in a

91   desktop document, then the processes for inserting and extracting the images from the

92   internal data structures of desktop documents as described in this guideline can be

93   used. For the cases defined and tested in this document, the process retrieves a copy of

94   the pixels of the image as they were originally inserted into the desktop document.

95   6.4 Depending on how the images were originally inserted into the document, these

96   pixels may, or may not, be an accurate representation of the original images. The

97   processes described below explain how to maximize the likelihood that the pixels in the

98   desktop document are an accurate copy of the original images – at the expense of

99   making the desktop document larger that it would be with the typical default settings of

100   the desktop programs.

101   6.5 Caveats and exceptions in this process include but are not limited to the following:

102   6.5.1 Defaults settings and internal processes of desktop applications can change at

103   any time, without notification or warning by the application vendors (e.g., open source or

104   Microsoft Office). This could break the processes in this document.

105   6.5.2 The insert and extraction process defined in this document have not been

106   tested on all variants of image formats, image resolutions, and other associated image

107   parameters. It may break without notification or warning for cases that have not been

108   tested.

109   6.6 These desktop applications may convert an image from its original format into

110   another image format within the office document, even if the pixel values are preserved.

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111   6.7 Image Insertion Process – Word

112   6.7.1 Open Word from Microsoft Office 2016.

113   6.7.2 Select Home→Options→Advanced.

114   6.7.3 Locate "Image Size and Quality."

115   6.7.4 Select "Do not compress images in file" (see Figure 2).
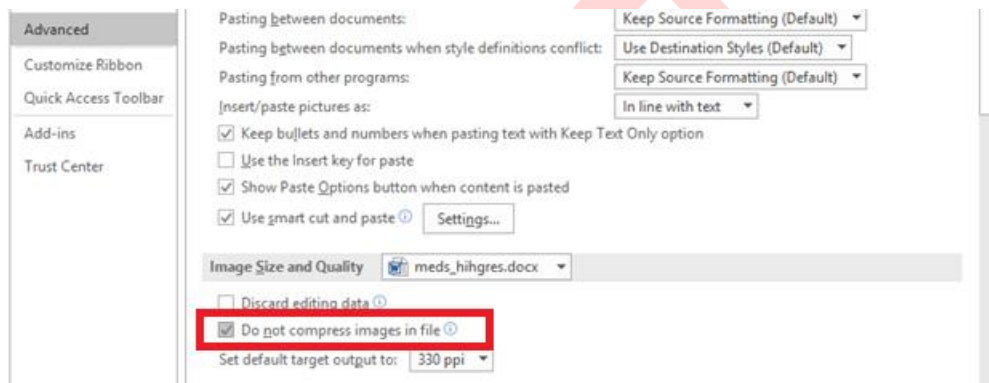
116

117   **Figure 2: Image Size and Quality settings – Word**

118   6.7.5 Insert the images into the document using the Copy and Paste function and

119   save the document to disk.

120   6.7.6 The user will see that final file size of the .docx will be larger since the facial

121   images will not be compressed.

122   6.7.7 Table 1 provides a comparison of Word document files sizes for different levels

123   of image compression.

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

124 **Table 1: Document file size comparison – Word**

125 6.7.8 Table 2 provides an example of a single image inserted and extracted.

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

126 **Table 2: Image insertion and extraction example – Word**

127 6.8 Image Insertion Process – Excel

128 6.8.1 Open Excel from Microsoft Office 2016.

129 6.8.2 Select Home→Options→Advanced.

130 6.8.3 Locate "Image Size and Quality."

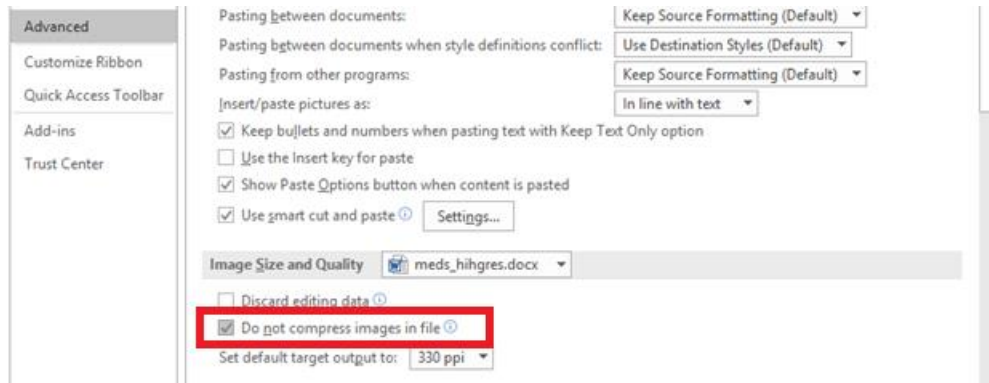131 6.8.4 Select "Do not compress images in file" (see Figure 3).

132

Figure 3: Image Size and Quality settings – Excel

133

134   6.8.5 Insert the images into the document using the Copy and Paste function and

135   save the document to disk.

136   6.8.6 The user will see that final file size of the .xlsx will be larger since the facial

137   images will not be compressed.

138   6.8.7 Table 3 provides a comparison of Excel document files sizes.

File	File size on disk
Raw images not inserted into the document	
Xlsx: No compression	
Xlsx: 300 ppi	

139   **Table 3: Document file size comparison – Excel**

140   6.8.8 Table 4 provides an example of a single image inserted and extracted.

141

File	File size	Rows	Columns	Channels	Resolution	Format	SHA1
Original file inserted	469949	2000	300 8	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D3EC75CDA1BBB1740B759
Docx: No compression document	469949	2000	300 8	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D3EC75CDA1BBB1740B759
Docx: 300 ppi resolution document	469949	2000	300 8	3	(300x300)	RGB	6CDAEDACA97FFF66FF6D3EC75CDA1BBB1740B759

142 **Table 4: Image insertion and extraction example – Excel**

143   6.9 Image Insertion Process – PowerPoint

144   6.9.1 Open PowerPoint from Microsoft Office 2016.

145   6.9.2 Select Home→Options→Advanced.

146   6.9.3 Locate "Image Size and Quality."

147   6.9.4 Select "Do not compress images in file" (see Figure 4).
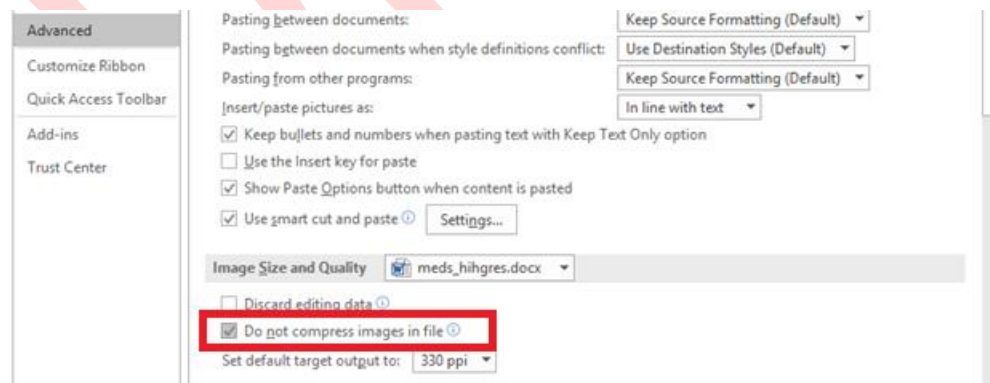
148

149 **Figure 4: Image Size and Quality settings – PowerPoint**

150   6.9.5 Insert the images into the document using the Copy and Paste function and

151   save the document to disk.

152   6.9.6 The user will see that final file size of the .pptx will be larger since the facial

153   images will not be compressed.

154   6.9.7 Table 5 provides a comparison of PowerPoint document files sizes.

File	File size on disk
Raw images not inserted into the document	
Xlsx: No compression	
Xlsx: 300 ppi	

155   **Table 5: Document file size comparison – PowerPoint**

156   6.9.8 Table 6 provides an example of a single image inserted and extracted.

157

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

158 **Table 6: Image insertion and extraction example – PowerPoint**

159   6.10 Observations

160   6.10.1 The original image was extracted from the "No Compression" and 300 ppi

161 documents as evidenced by the identical SHA1 checksum (yellow highlight); see Table

162 2, Table 4, and Table 6.

163   6.10.2 As the image quality resolution is reduced from "No Compression" to 96 ppi

164 the inserted image file is reduced in size with a corresponding reduction in image

165 quality; see Figure 5.

166   **Figure 5: Image quality reduction corresponding to image compression**

167   6.11 Image Extraction Process

168   6.11.1 Copy the document to a temporary directory.

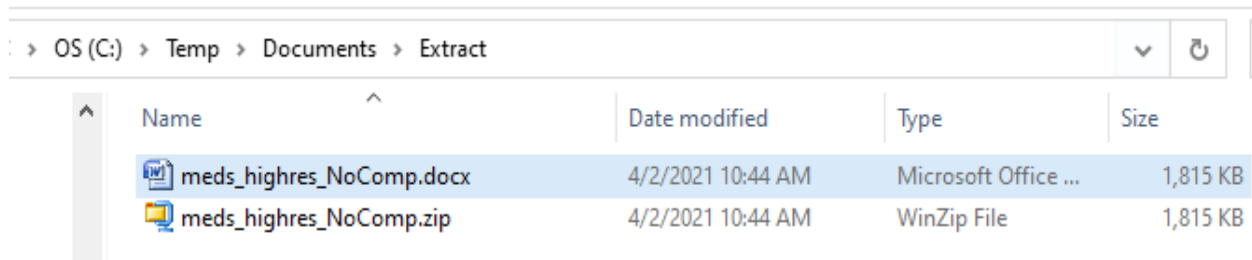169   6.11.2 Rename the file to .zip; see Figure 6.

170

Figure 6: Before and after copying and renaming a file

171

172   6.11.3 Extract the zip file to disk using any 'unzipping' software on your system; see
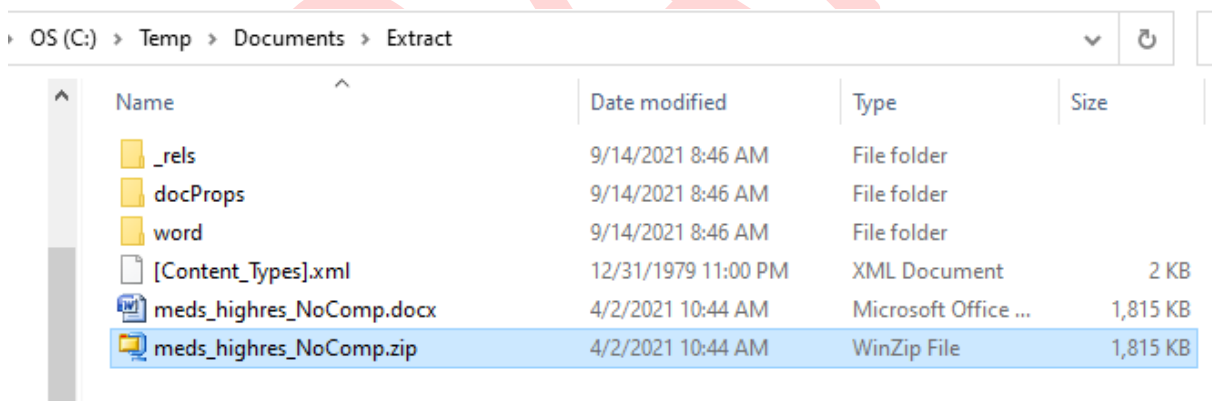
173 Figure 7.

174

175   **Figure 7: Directory after unzipping a file**

176   6.11.4 Go to the "word\media" directory to see the images; see Figure 8 and Figure

177 9.

178

Figure 8: Image details after unzipping a file
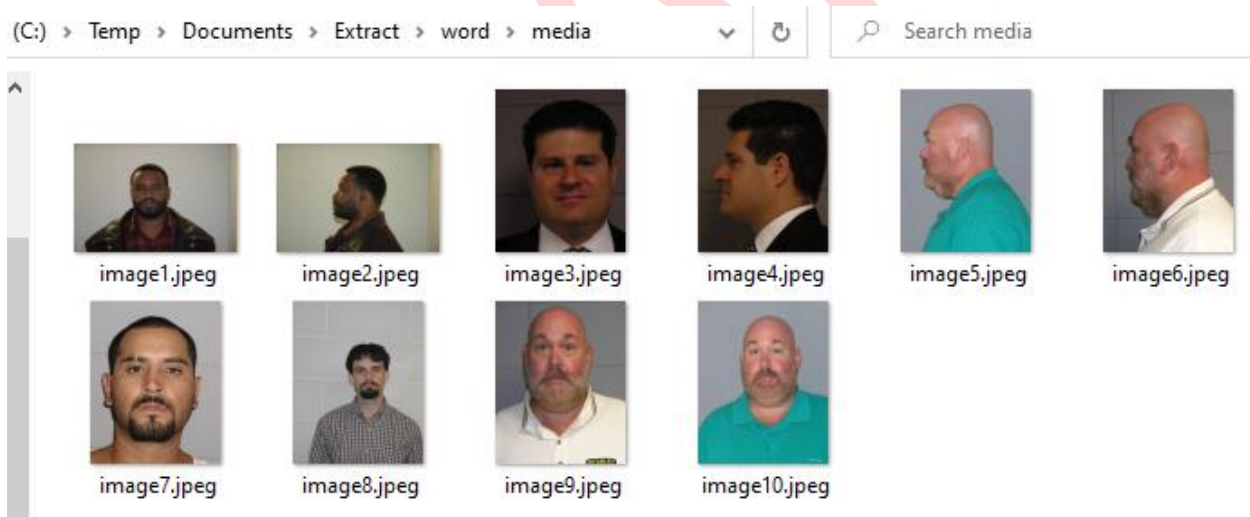

180

Figure 9: Images extracted after unzipping

182

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

184