US 20060072903A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0072903 A1**

Weldum et al. (43) **Pub. Date: Apr. 6, 2006**

(54) **METHOD AND SYSTEM FOR STORING CALIBRATION DATA WITHIN IMAGE FILES**

(75) Inventors: **David Weldum**, Jamesville, NY (US); **Clark Bendall**, Syracuse, NY (US); **Michael C. Lesmerises**, Liverpool, NY (US); **Thomas Karpen**, Skaneateles, NY (US); **Jon Salvati**, Skaneateles, NY (US)

Correspondence Address:
WALL MARJAMA & BILINSKI
101 SOUTH SALINA STREET
SUITE 400
SYRACUSE, NY 13202 (US)

(73) Assignee: **Everest VIT, Inc.**, Flanders, NJ (US)

(21) Appl. No.: **11/294,285**

(22) Filed: **Dec. 5, 2005**

Related U.S. Application Data

(62) Division of application No. 10/080,144, filed on Feb. 21, 2002, now abandoned.

(60) Provisional application No. 60/270,967, filed on Feb. 22, 2001.

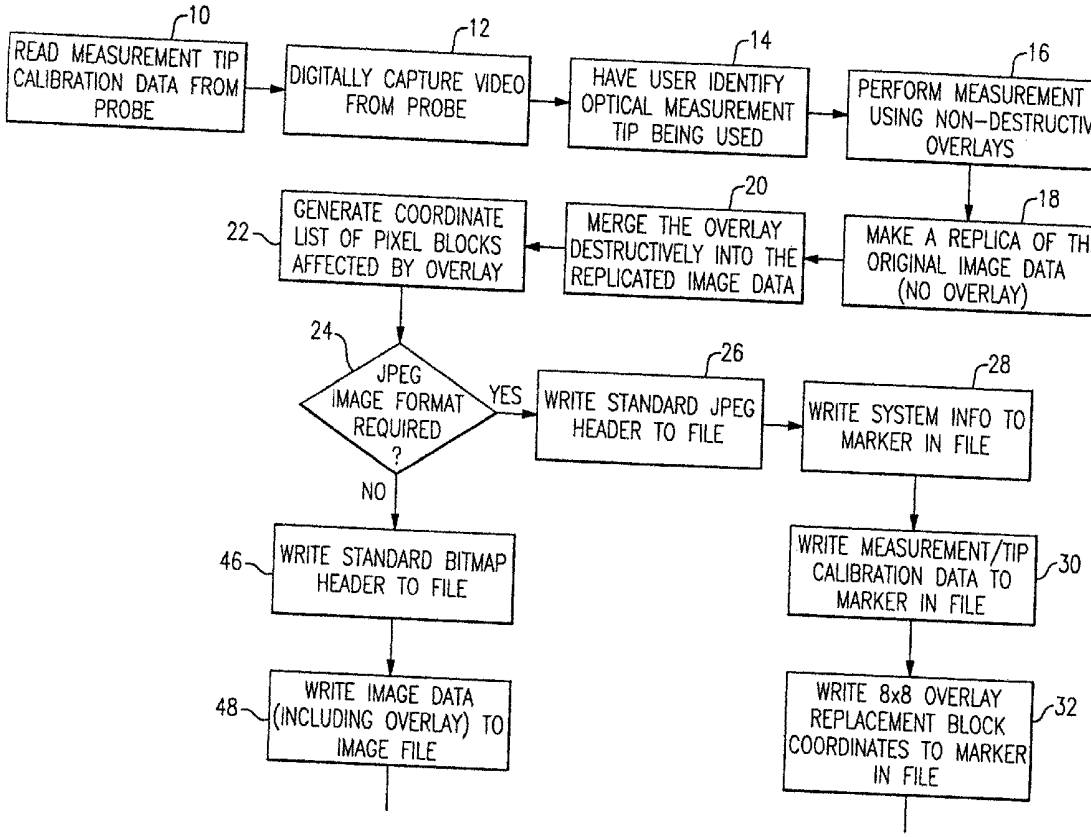
Publication Classification

(51) **Int. Cl.**
H04N 5/781 (2006.01)

(52) **U.S. Cl.** **386/95**; 386/125

(57) **ABSTRACT**

A system and method for storing, within an image transfer medium, an image and image-specific data associated with the image includes obtaining the image-specific data from a probe such as a borescope or endoscope, obtaining the corresponding image, choosing a specific image transfer medium, writing the image to the medium, and writing the image-specific data to a marker in the medium. In this manner, storing a combination of image data and one or more of system calibration data, overlay replacement data, and audio comment data in a single file of either a non-standard file format or a standard file format that does not explicitly support the inclusion of these data types is possible.



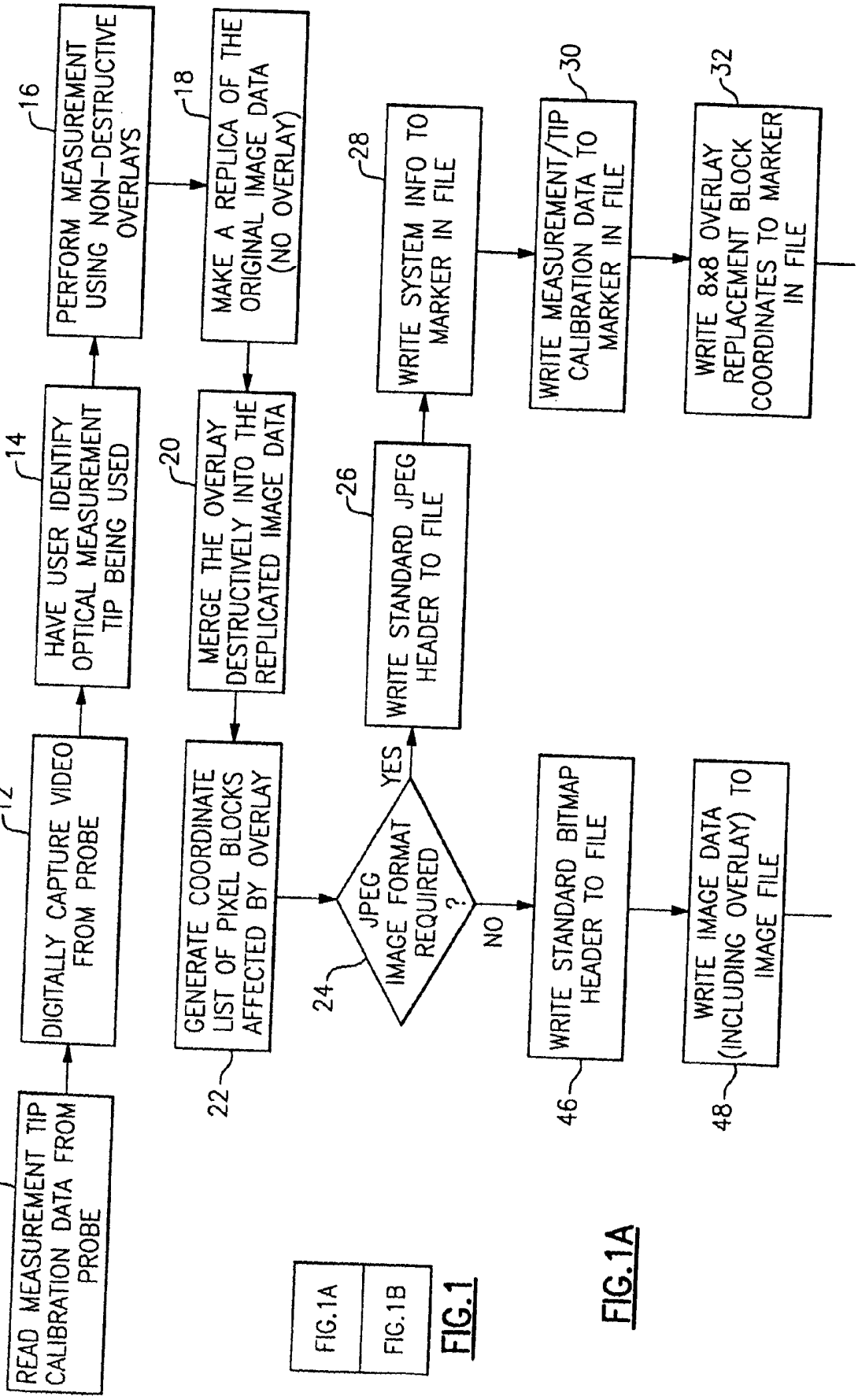


FIG.1A

FIG.1A
FIG.1B

FIG.1

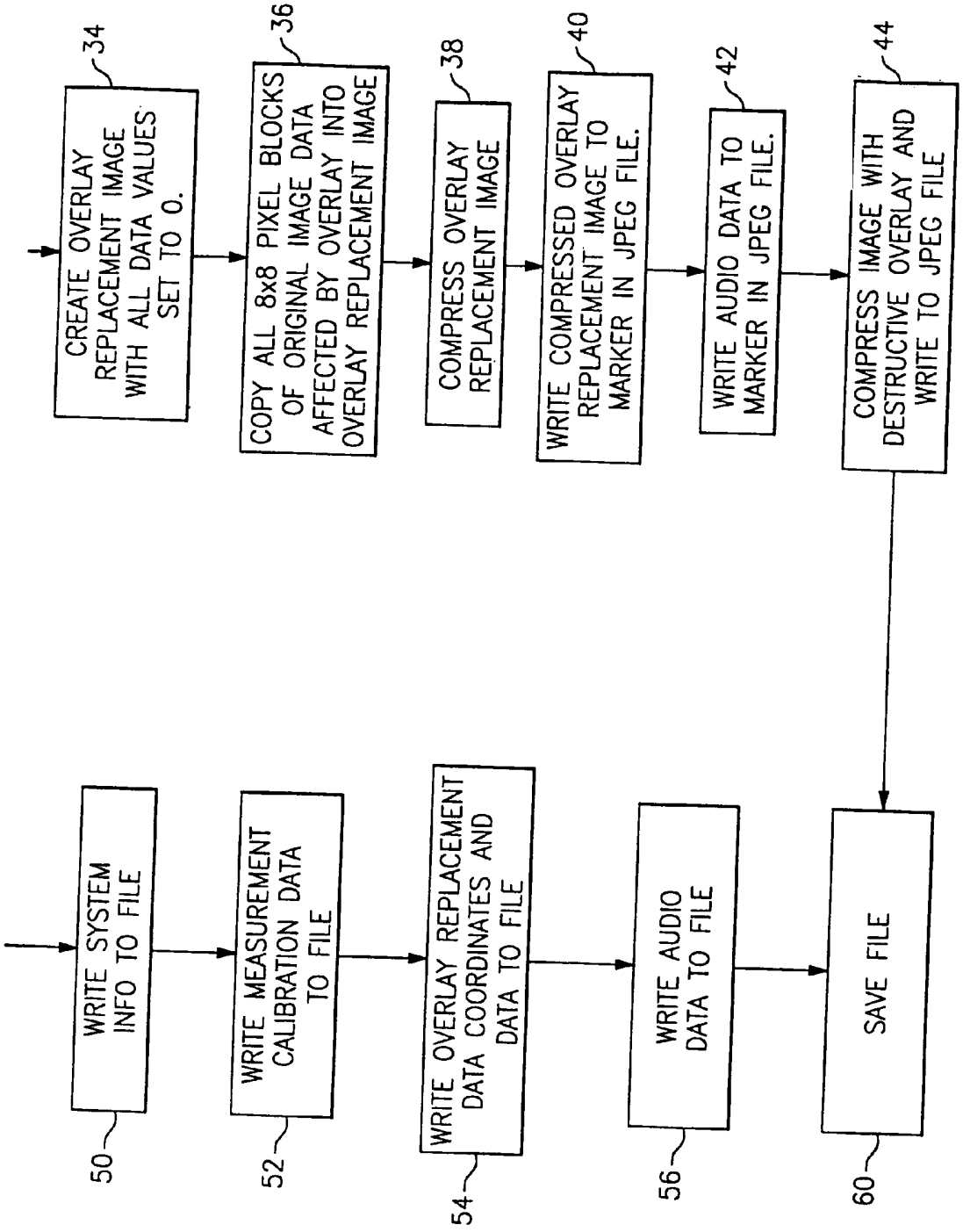

CREATE OVERLAY REPLACEMENT IMAGE WITH ALL DATA VALUES SET TO 0.
34
COPY ALL 8x8 PIXEL BLOCKS OF ORIGINAL IMAGE DATA AFFECTED BY OVERLAY INTO OVERLAY REPLACEMENT IMAGE
36
COMPRESS OVERLAY REPLACEMENT IMAGE
38
WRITE COMPRESSED OVERLAY REPLACEMENT IMAGE TO MARKER IN JPEG FILE.
40
WRITE AUDIO DATA TO MARKER IN JPEG FILE.
42
COMPRESS IMAGE WITH DESTRUCTIVE OVERLAY AND WRITE TO JPEG FILE
44
WRITE SYSTEM INFO TO FILE
50
WRITE MEASUREMENT CALIBRATION DATA TO FILE
52
WRITE OVERLAY REPLACEMENT DATA COORDINATES AND DATA TO FILE
54
WRITE AUDIO DATA TO FILE
56
SAVE FILE
60

FIG.1B

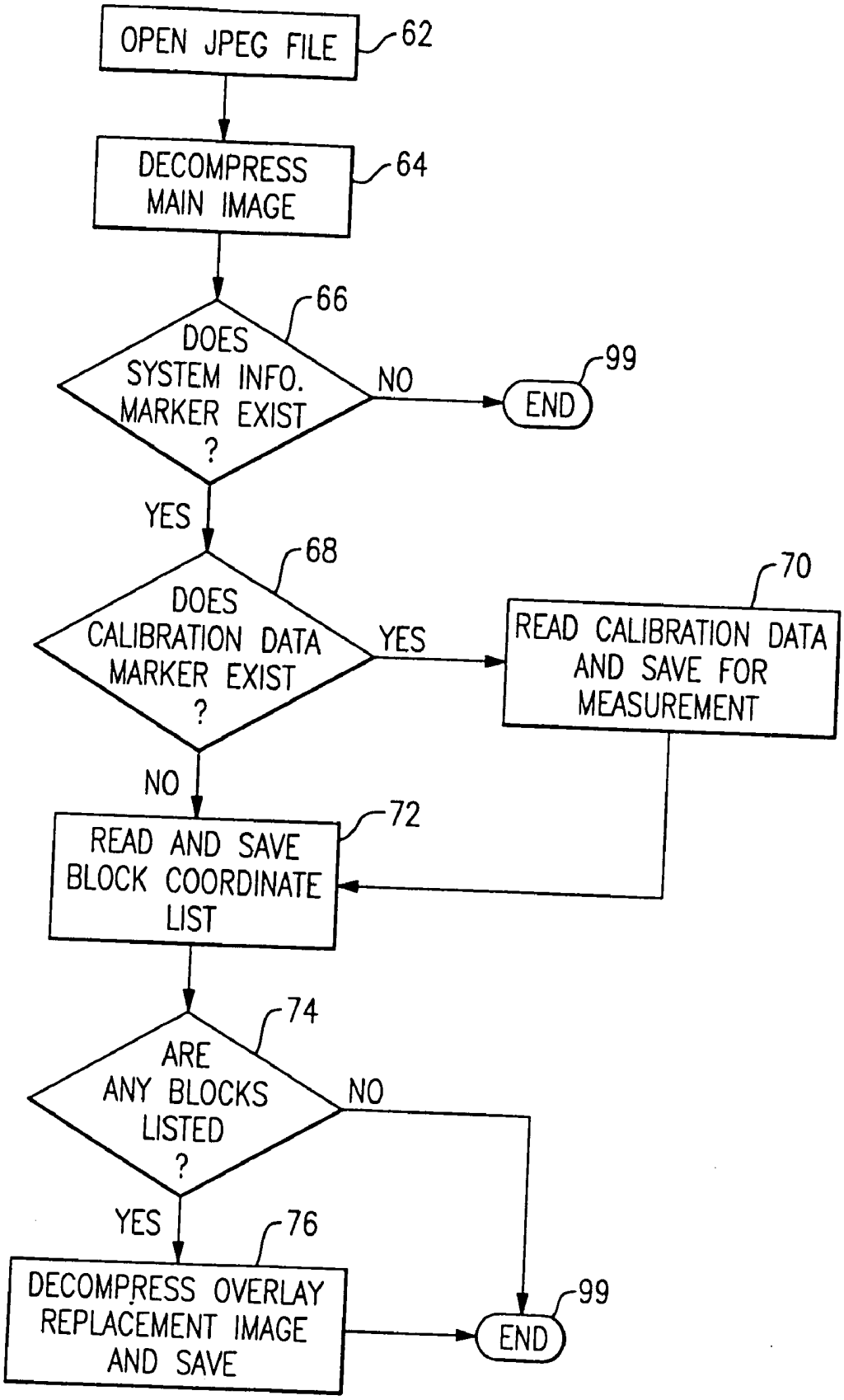

OPEN JPEG FILE
62
DECOMPRESS MAIN IMAGE
64
DOES SYSTEM INFO. MARKER EXIST ?
66
NO
END
99
YES
DOES CALIBRATION DATA MARKER EXIST ?
68
YES
READ CALIBRATION DATA AND SAVE FOR MEASUREMENT
70
NO
READ AND SAVE BLOCK COORDINATE LIST
72
ARE ANY BLOCKS LISTED ?
74
NO
YES
DECOMPRESS OVERLAY REPLACEMENT IMAGE AND SAVE
76
END
99

FIG.2

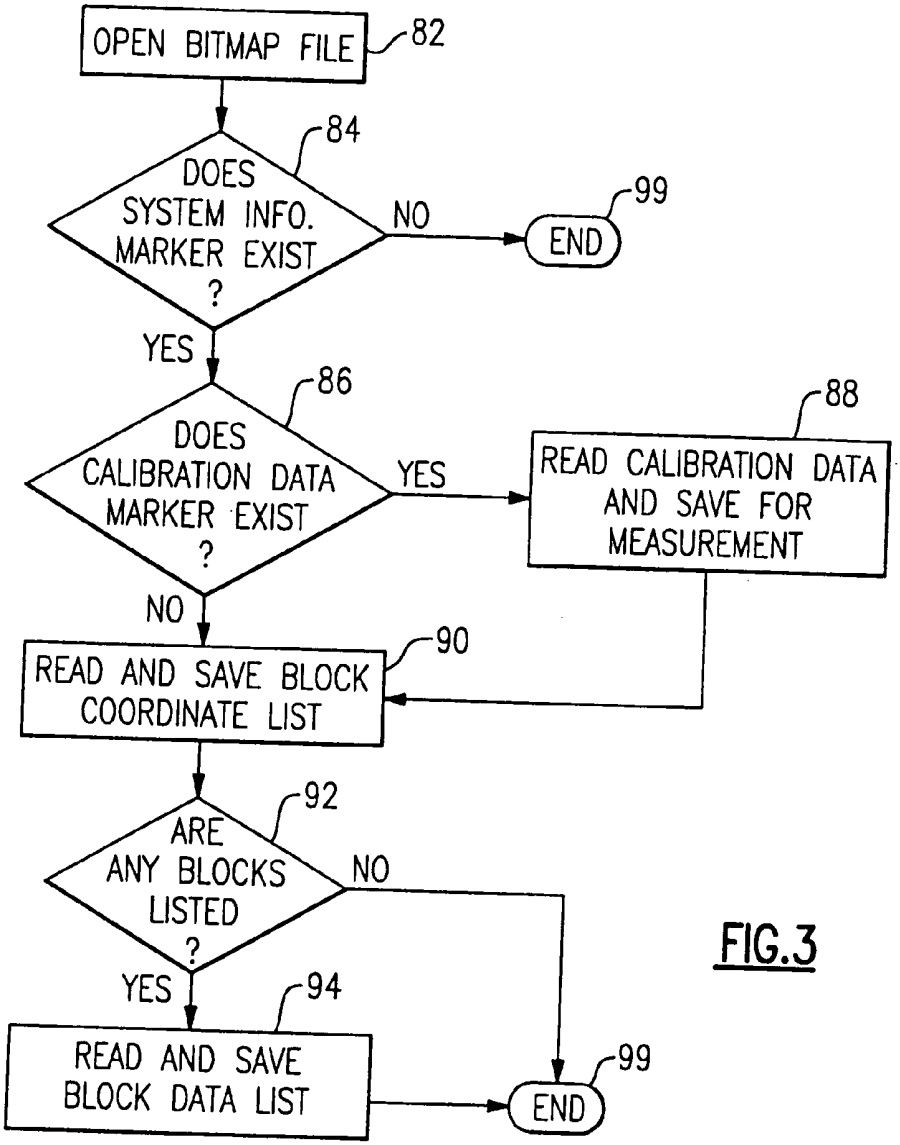

OPEN BITMAP FILE
82
DOES SYSTEM INFO. MARKER EXIST ?
84
NO
99
END
YES
DOES CALIBRATION DATA MARKER EXIST ?
86
YES
88
READ CALIBRATION DATA AND SAVE FOR MEASUREMENT
NO
READ AND SAVE BLOCK COORDINATE LIST
90
ARE ANY BLOCKS LISTED ?
92
NO
YES
READ AND SAVE BLOCK DATA LIST
94
99
END

FIG.3

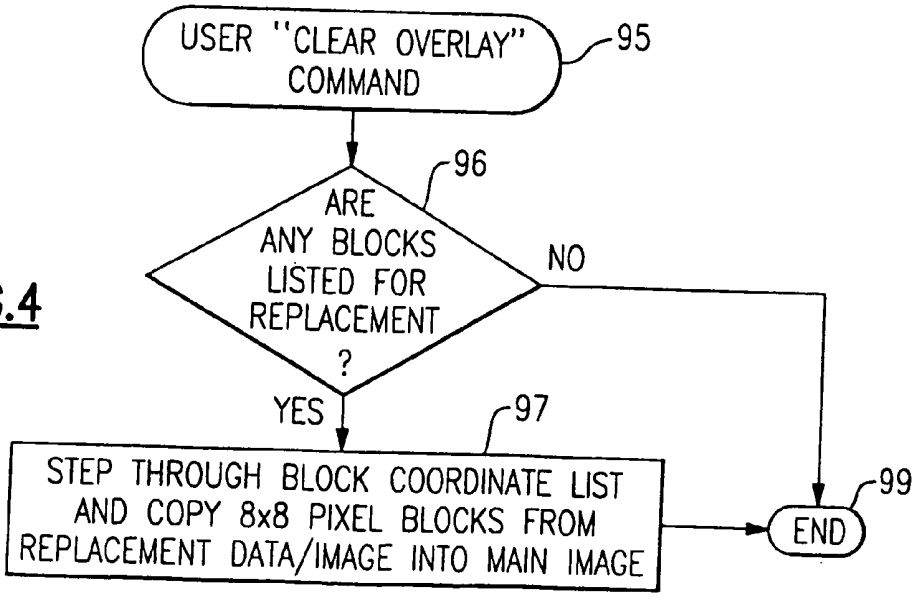

USER "CLEAR OVERLAY" COMMAND
95
ARE ANY BLOCKS LISTED FOR REPLACEMENT ?
96
NO
YES
97
STEP THROUGH BLOCK COORDINATE LIST AND COPY 8x8 PIXEL BLOCKS FROM REPLACEMENT DATA/IMAGE INTO MAIN IMAGE
99
END

FIG.4

METHOD AND SYSTEM FOR STORING CALIBRATION DATA WITHIN IMAGE FILES

FIELD OF THE INVENTION

[0001] This invention relates generally to the field of storing calibration data for a probe, and more particularly to a method for storing calibration data within image transfer media.

BACKGROUND OF THE INVENTION

[0002] In certain endoscopes/borescopes, hereinafter referred to as probes, there are data associated with the images, such as the calibration parameters for the measurement tip and probe that were used to capture the image, along with audio comments regarding the captured image, that must be kept with the images. In a competitive system, image data, audio data, and calibration data are each stored in separate files. This approach allows the audio and/or calibration data easily to become separated from the image making features such as off-line measurement and audio playback unusable. Embedding the data right in the image solves this problem.

[0003] Graphical overlay data added to images can obscure parts of the image. It is generally desirable for this overlay data to be viewable using standard software packages, but it is also desirable in some applications to be able to recover the image data that has been replaced by the overlay. This invention allows both goals to be met.

SUMMARY OF THE INVENTION

[0004] Briefly stated, a system and method for storing, within an image transfer medium, an image and image-specific data associated with the image includes obtaining the image-specific data from a probe such as a borescope or endoscope, obtaining the corresponding image, choosing a specific image transfer medium, writing the image to the medium, and writing the image-specific data to a marker in the medium. In this manner, storing a combination of image data and one or more of system calibration data, overlay replacement data, and audio comment data in a single file of either a non-standard file format or a standard file format that does not explicitly support the inclusion of these data types is possible.

[0005] According to an embodiment of the invention, a method for storing calibration data within image transfer media, includes the step of embedding data specific to a measurement system into the image transfer media so that the data is retrievable by a custom application directly from the image transfer media, thereby allowing re-measurement without using a second transfer media for measurement system information.

[0006] According to an embodiment of the invention, a method for storing overlay replacement data within image transfer media includes the step of embedding data into the image transfer media so that a destructive overlay added to the image is visible using a standard image viewer, and image data that was replaced by the destructive overlay is reconstituted from the embedded data.

[0007] According to an embodiment of the invention, a method for storing audio data along with an image within a standard image transfer media which does not provide explicit support for storing audio data includes the step of writing the audio data to a marker in the image transfer media such that the image is visible using a standard image viewer, while the audio data is retrievable by a custom application.

[0008] According to an embodiment of the invention, a method for storing image data and corresponding image-specific data includes the step of storing a combination of image data and one or more of system calibration data, overlay replacement data, and audio comment data in a single file of either a non-standard file format or a standard file format that does not explicitly support the inclusion of these data types.

[0009] According to an embodiment of the invention, a method for storing, within an image transfer medium, an image and image-specific data associated with the image includes the steps of obtaining the image-specific data; obtaining the image; choosing a specific image transfer medium; writing the image to the medium; and writing the image-specific data to a marker in the medium.

[0010] According to an embodiment of the invention, a system for storing calibration data within image transfer media includes means for embedding data specific to a measurement system into the image transfer media so that the data is retrievable by a custom application directly from the image transfer media, thereby allowing re-measurement without using a second transfer media for measurement system information.

[0011] According to an embodiment of the invention, a system for storing overlay replacement data within image transfer media includes means for embedding data into the image transfer media so that a destructive overlay added to the image is visible using a standard image viewer, and image data that was replaced by the destructive overlay is reconstituted from the embedded data.

[0012] According to an embodiment of the invention, a system for storing audio data along with an image within a standard image transfer media which does not provide explicit support for storing audio data includes means for writing the audio data to a marker in the image transfer media such that the image is visible using a standard image viewer, while the audio data is retrievable by a custom application.

[0013] According to an embodiment of the invention, a system for storing image data and corresponding image-specific data includes storing a combination of image data and one or more of system calibration data, overlay replacement data, and audio comment data in a single file of either a non-standard file format or a standard file format that does not explicitly support the inclusion of these data types

[0014] According to an embodiment of the invention, a system for storing, within an image transfer medium, an image and image-specific data associated with the image includes means for obtaining the image-specific data; means for obtaining the image; means for choosing a specific image transfer medium; means for writing the image to the medium; and means for writing the image-specific data to a marker in the medium.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] **FIG. 1** shows the encoding process of the present invention;

[0016] **FIG. 2** shows the steps to recover data from a JPEG image file according to an embodiment of the invention;

[0017] **FIG. 3** shows the steps to recover data from a bitmap image file according to an embodiment of the invention; and

[0018] **FIG. 4** shows the process the system uses to clear an overlay.

DETAILED DESCRIPTION

[0019] The method of the invention could be used in any system where there is a graphic overlay added to images that must be removable, or where there are non-graphical data related to an image that are required for later use with the image. In one application, the method is used to save shadow measurement tip calibration data and overlay removal data in bitmap and JPEG images captured using a videoprobe remote visual inspection system or an accompanying personal computer application. This allows images to have "destructive" overlays that are visible in the image using standard image viewing software, but which are removable by a custom application to present a clean image to the viewer. Storing tip calibration data in the image also allows measurements to be repeated on the image using either the system software or a custom PC-based software package. Similarly, audio data could be included in the image file and later recovered.

[0020] Referring to **FIG. 1**, the encoding process of the invention is shown using calibration data for a borescope or endoscope (hereinafter referred to as a "probe") and a JPEG file as an example. In step **10**, measurement tip calibration data is read. In step **12**, the video image from the probe is captured. In step **14**, the user identifies the specific optical measurement tip being used. The desired measurement, such as, for example, measuring the length of a defect observed with the probe, is performed using non-destructive overlays in step **16**. A replica of the original image data with no overlay is made in step **18**. Then, in step **20**, the overlay is merged destructively into the replicated image data. In step **22**, a coordinate list of pixel blocks affected by the overlay is generated.

[0021] In step **24** the question is asked whether or not JPEG image format is required, or whether bitmap format would work. If JPEG format is required, the standard JPEG header is written to the file in step **26**. The JPEG file format allows for user-defined markers to be placed in the file. Each marker can specify up to 64 kilobytes of user data to follow. The markers and data are ignored by general image viewers, but can be read by application specific viewers. An embodiment of the invention places shadow measurement tip calibration parameters in one of these fields, and overlay replacement data in two or more others. Specifically, one marker stores a list of the coordinates of the 8×8 pixel-blocks in the image that contain overlay data. Another marker stores a compressed version of those 8×8 pixel-blocks without the overlay. If more than 64 kilobytes are required, additional markers are used. When the image is retrieved, these markers and data can be extracted, and the stored 8×8 pixel-blocks can be decompressed. They can then replace the corresponding pixel-blocks in the decompressed original image, effectively removing the overlay from the image. Additional markers could also be used to store audio data.

[0022] The system information is written to the marker in the file in step **28**, after which the measurement/tip calibration data are written to the marker in the file in step **30**. 8×8 overlay replacement block coordinates are written to the marker in the file in step **32**. Then an overlay replacement image with all the data values set to zero is created in step **34**. All 8×8 pixel blocks of original image data affected by the overlay are copied into the overlay replacement image in step **36**. The overlay image is compressed in step **38**, and then written to the marker in the JPEG file in step **40**. In step **42**, audio data is optionally written to the marker in the file if present. In step **44**, the image with the destructive overlay is compressed and written to the JPEG file, after which the file is saved in step **60**.

[0023] If JPEG format is not required, the standard bitmap header is written to the file in step **46**. With bitmap images, the shadow measurement tip calibration parameters, the 8×8 pixel-block coordinate list, and the non-compressed 8×8 pixel-blocks are stored at the end of the file, after the image data. Audio data could also be added to the end of the file. General image viewers ignore this additional data, but application specific viewers can look for it and extract it. When the image is retrieved, the stored 8×8 pixel-blocks can replace the corresponding pixel-blocks in the original image, effectively removing the overlay from the image.

[0024] In step **48**, the image data, including the overlay, is written to the image file. The system information is written to the file in step **50**. Then, the measurement calibration data are written to the file in step **52**, after which the overlay replacement data coordinates and the data are written to the file in step **54**. Audio data is optionally written to the file in step **56**, after which the file is saved in step **60**.

[0025] Referring to **FIG. 2**, the steps to recover data from a JPEG image file are shown. The JPEG file is opened in step **62**, after which the main image is decompressed in step **64**. In step **66**, the existence of the system information marker is checked. If the marker does not exist, the process ends in step **99**. If the marker exists, the existence of the calibration data marker is checked in step **68**. If the calibration data marker exists, the calibration data is read and saved for measurement in step **70**. The block coordinate list is then read and saved in step **72**. In step **74**, the system checks to see if any blocks are listed, and if not, the process stops in step **99**. Otherwise, the overlay replacement image is decompressed and saved.

[0026] Referring to **FIG. 3**, the steps to recover data from a bitmap file are shown. The bitmap file is opened in step **82**, after which the existence of the system information marker is checked in step **84**. If the system information marker is not present, the process ends at step **99**. If the system information marker is present, the system looks for the calibration data marker in step **86**. If the calibration data marker exists, the calibration data is read instep **88** and saved for measurement. then the block coordinate list is read and saved in step **90**. In step **92**, the system checks to see if any blocks are listed. If no blocks are listed, the process ends at step **99**. Otherwise, the block data list is read and saved in step **94**.

[0027] Referring to **FIG. 4**, the process the system uses to clear an overlay is shown. In step **95**, the system checks to see if a user has issued a "clear overlay" command. If so, the system checks in step **96** to see if any blocks are listed for replacement. If not, the process ends at step **99**. If any blocks are listed for replacement, in step **97** the block coordinate list is used to copy 8×8 pixel blocks from the replacement data/image into the main image.

[0028] There is a wide variety of image transfer media which can be used for the embedded measurement and overlay removal data. For example, the standard image transfer media can be digital still images such as JPEG, bitmap, TIFF, PCX etc.; digital motion video such as MPEG, AVI, etc.; and analog video using an approach similar to closed captioning. With the method of the present invention, the bitmap file structure preferably includes:

[0029] (a) Bitmap Header,

[0030] (b) Bitmap image data (with overlay),

[0031] (c) System info section,

[0032] (d) Measurement/tip calibration data section,

[0033] (e) Overlay replacement coordinates/data, and

[0034] (f) Audio comment data section.

[0035] The JPEG file structure preferably includes:

[0036] (a) JPEG Header,

[0037] (b) System info marker (JFIF Extension),

[0038] (c) Measurement/tip calibration data marker (JFIF Extension),

[0039] (d) Overlay replacement coordinates marker (JFIF Extension),

[0040] (e) Compressed overlay replacement image marker (JFIF Extension),

[0041] (f) Audio comment marker (JFIF Extension), and

[0042] (g) Image data (with overlay).

[0043] The system info section/marker preferably includes:

[0044] (a) Header to identify source and type of data,

[0045] (b) Number of bytes in section,

[0046] (c) Image dimensions,

[0047] (d) Original image source, whether an endoscope system or not,

[0048] (e) System software versions,

[0049] (f) Standard optical distortion (for use in reference-based measurements),

[0050] (g) System serial number,

[0051] (h) Zoom level,

[0052] (i) Image horizontally flipped from original or not,

[0053] (j) Video standard of system (NTSC or PAL), and

[0054] (k) Exposure control mode.

[0055] The measurement/tip calibration data section/marker preferably includes:

[0056] (a) Header to identify source and type of data,

[0057] (b) Number of bytes in section,

[0058] (c) Positions of cursors from measurement screen,

[0059] (d) Type of measurement-performed,

[0060] (e) Measurement result,

[0061] (f) Format of tip calibration data,

[0062] (g) Tip type (forward view or side view),

[0063] (h) Tip color code,

[0064] (i) Tip serial number,

[0065] (j) Tip optical distortion,

[0066] (k) Shadow geometry parameters, and

[0067] (l) Checksum of tip calibration data.

[0068] The JPEG overlay replacement coordinates marker preferably includes:

[0069] (a) Header to identify source and type of data,

[0070] (b) Number of bytes in section, and

[0071] (c) X/Y coordinates of 8×8 pixel blocks affected by overlay.

[0072] The JPEG overlay replacement data marker preferably includes:

[0073] (a) Header to identify source and type of data,

[0074] (b) Number of bytes in section, and

[0075] (c) Compressed overlay replacement image where all 8×8 pixel blocks affected by overlay were filled with the original image data prior to compression. All blocks not affected by the overlay are set to values of 0 to allow maximum compression on those areas. JPEG compresses images in 8×8 pixel blocks. Information in one block does not affect the compression in any other block, so when the two compressed images are later uncompressed, the 8×8 blocks from the overlay replacement image used to "erase" the overlay are identical to what they would have been in the original image had there been no overlay.

[0076] The bitmap overlay data replacement section preferably includes:

[0077] (a) Header to identify source and type of data,

[0078] (b) Number of 8×8 pixel overlay replacement block packets in section, and

[0079] (c) Series of block packets each consisting of horizontal and vertical block coordinates followed by 192 bytes of data (8×8 pixels per block, 1 red byte, 1 green byte, 1 blue byte per pixel).

[0080] The audio comment data marker/section preferably includes:

[0081] (a) Header to identify source and type of data,

[0082] (b) Number of bytes in section, and

[0083] (c) Audio data.

[0084] While the present invention has been described with reference to a particular preferred embodiment and the accompanying drawings, it will be understood by those skilled in the art that the invention is not limited to the preferred embodiment and that various modifications and the like could be made thereto without departing from the scope of the invention as defined in the following claims.

1. (canceled)
2. (canceled)
3. (canceled)
4. (canceled)
5. (canceled)
6. (canceled)
7. (canceled)
8. (canceled)
9. (canceled)
10. (canceled)
11. (canceled)
12. (canceled)
13. (canceled)
14. (canceled)
15. (canceled)
16. (canceled)
17. (canceled)
18. (canceled)
19. (canceled)
20. (canceled)
21. (canceled)
22. (canceled)
23. (canceled)
24. (canceled)
25. (canceled)
26. (canceled)
27. (canceled)
28. (canceled)

29. A method of inspecting an engine, said method comprising the steps of:

providing an endoscopic probe;

providing an optical measurement tip for use with said endoscopic probe;

capturing image data representative of a portion of said engine using said endoscopic probe and said optical measurement tip;

performing a dimensional measurement using said captured image data and measurement tip calibration data specific to said optical measurement tip;

embedding data sets representative of said captured image data and said measurement tip calibration data into a single data package; and

storing said single data package.

30. A method as recited in claim 29, wherein the embedding step includes the step of embedding a data set representative of said dimensional measurement into said single data package.

31. A method as recited in claim 29, wherein said single data package is selected from the group consisting essentially of digital still image, digital video, and analog video formats.

32. A method as recited in claim 31, wherein said digital still image format includes at least one of JPEG, TIFF, bitmap, and PCX formats.

33. A method as recited in claim 31, wherein said digital video format includes at least one of MPEG and AVI formats.

34. A method as recited in claim 31, wherein said analog video format uses closed captioning.

35. A method as recited in claim 29, including the step of embedding markers for each of the dimensional measurement and measurement tip calibration data within the single data package in relation to said image data.

36. A method as recited in claim 29, including the steps of capturing audio data as part of said inspection and embedding the captured audio data into said single data package.

37. A method of measuring the defect of an object, said method comprising the steps of:

providing an endoscope;

providing an optical measurement tip for use with said endoscope;

capturing image data representative of a portion of said defect using said endoscope probe and said optical measurement tip;

performing a dimensional measurement of said defect using said captured image data and measurement tip calibration data specific to said optical measurement tip;

embedding data sets representative of said captured image data and said measurement tip calibration data into a single data package; and

storing said single data package.

38. A method as recited in claim 37, including the step of embedding a data set representative of the dimensional measurement into the single data package.

39. A method as recited in claim 37, wherein said data package is selected from the group consisting essentially of digital still image, digital video, and analog video formats.

40. A method as recited in claim 39, wherein said digital still image format includes at least one of JPEG, TIFF, bitmap, and PCX formats.

41. A method as recited in claim 39, wherein said digital video format includes at least one of MPEG and AVI formats.

42. A method as recited in claim 39, wherein said analog video format uses closed captioning.

43. A method as recited in claim 37, including the steps of capturing audio data associated with said measurement and embedding the captured audio data in the single data package.

44. A method as recited in claim 37, wherein said embedding step includes the step of providing markers for each of the measurement image data and calibration tip data within the single data package in relation to said image data.

45. A method as recited in claim 37, wherein the measurement tip calibration data specific to said optical tip includes at least one of the tip type, the tip color code, the tip serial number, the tip optical distortion, shadow geometry parameters, and a checksum of tip calibration data.

46. A method of inspecting an engine, said method comprising the steps of:

providing an endoscopic probe;

providing an optical measurement tip for use with said endoscopic probe;

capturing image data representative of a portion of said engine using said endoscopic probe and said optical measurement tip;

performing a dimensional measurement using said captured image data and measurement tip calibration data specific to said optical measurement tip;

embedding data sets representative of said captured image data, said measurement tip calibration data and said dimensional measurement into a single data package; and

storing said single data package.

47. A method of measuring the defect of an object, said method comprising the steps of:

providing an endoscope;

providing an optical measurement tip for use with said endoscope;

capturing image data representative of a portion of said defect using said endoscope probe and said optical measurement tip;

performing a dimensional measurement of said defect using said captured image data and measurement tip calibration data specific to said optical measurement tip;

embedding data sets representative of said captured image data, said measurement tip calibration data and said dimensional measurement into a single data package; and

storing said single data package.

48. A system for inspecting and measuring an object comprising:

an endoscope having an endoscopic probe including an optical measurement tip;

means for capturing image data representative of a portion of said object using endoscopic probe and said optical measurement tip;

means for performing a dimensional measurement using said captured image data and measurement tip calibration data specific to said optical measurement tip;

means for embedding data sets representative of said captured image data, said measurement tip calibration data and said dimensional measurement into a single data package; and

means for storing said single data package.

* * * * *

专利名称(译)	用于在图像文件内存储校准数据的方法和系统		
公开(公告)号	US20060072903A1	公开(公告)日	2006-04-06
申请号	US11/294285	申请日	2005-12-05
[标]申请(专利权)人(译)	EVEREST VIT		
申请(专利权)人(译)	EVEREST VIT，INC.		
当前申请(专利权)人(译)	EVEREST VIT，INC.		
[标]发明人	WELDUM DAVID BENDALL CLARK LESMERISES MICHAEL C KARPEN THOMAS SALVATI JON		
发明人	WELDUM, DAVID BENDALL, CLARK LESMERISES, MICHAEL C. KARPEN, THOMAS SALVATI, JON		
IPC分类号	H04N5/781 A61B1/04 G01D18/00 H04N1/32		
CPC分类号	A61B1/04 H04N1/32128 H04N2201/0079 H04N2201/3204 H04N2201/3252 H04N2201/3264 H04N2201/3277		
优先权	60/270967 2001-02-22 US		
外部链接	Espacenet USPTO		

摘要(译)

用于在图像传输介质内存储与图像相关联的图像和图像特定数据的系统和方法包括从诸如管道镜或内窥镜的探针获得图像特定数据，获得相应图像，选择特定图像传输介质，将图像写入介质，以及将图像特定数据写入介质中的标记。以这种方式，将图像数据和系统校准数据中的一个或多个，覆盖替换数据和音频注释数据的组合存储在非标准文件格式或未明确支持该标准文件格式的标准文件格式的单个文件中。包含这些数据类型是可能的。