Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 52835

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

BARCO N.V.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	26/05/2021
Name	Jenny Dierckx		
Title	IPR Service Manager		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	42960805
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Yanling Cottle
Filer Authorized By:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TJM
Receipt Date:	11-JUN-2021
Filing Date:	11-AUG-2020
Time Stamp:	09:24:50
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	POA_0005USC4.pdf	502469 a4976ecae3e024d63857f2042ed8b60fd4f04198	no	2

Warnings:

Information:	
Total Files Size (in bytes):	502469

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16990215
Filing Date	2020-08-11
First Named Inventor	Koen Simon Herman BEEL
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	BEEL3001C4/TJM

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TJM

	1	Summons To Attend Oral Proceedings in corresponding European Application No. 12762258.7, dated May 20, 2021.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TJM

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas J. Moore/	Date (YYYY-MM-DD)	2021-05-28
Name/Print	THOMAS J. MOORE	Registration Number	28974

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	42834516
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas J. Moore/Shelly Darrenkamp
Filer Authorized By:	Thomas J. Moore
Attorney Docket Number:	BEEL3001C4/TL
Receipt Date:	28-MAY-2021
Filing Date:	11-AUG-2020
Time Stamp:	08:10:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_ids_.pdf	1034387 d4b493a8bd83a6c8f2dc2fcb474f6bed95f6dc73	no	4

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Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
2	Non Patent Literature	Summonstoattendoralproceedings_20May2021.pdf	3806026 a4cbac9591e7978bff2b1b60596e82dd2ad2d236	no	72
Warnings:					
Information:					
			Total Files Size (in bytes):	4840413	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16990215
Filing Date	2020-08-11
First Named Inventor	Koen Simon Herman BEEL
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	BEEL3001C4/TL

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7853535	B2	2010-12-14	Colella	
	2	7908401	B2	2011-03-15	Chang	

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U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20060080707	A1	2006-04-13	Laksono	
	2	20100149206	A1	2010-06-17	Shigehisa et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	1525300	CN	A	2004-09-01	Microsoft Corp.	Abstract.	X

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

	2	1555197	CN	A	2004-12-15	Shenzhen Postgraduate Inst Tsi	Abstract.	☒
	3	101046952	CN	A	2007-10-03	Kei Nakayama	Abstract.	☒
	4	101075896	CN	A	2007-11-21	Polycom Inc.	Abstract.	☒
	5	102025774	CN	A	2011-04-20	TPV Display Technology Xiamen	Abstract.	☒
	6	102088593	CN	A	2011-06-08			☒
	7	2007148904	JP	A	2007-06-14	Toshiba Corp	Abstract.	☒
	8	201012222	TW	A	2010-03-16	Primax Electronics Ltd	Abstract.	☒

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Chinese Office Action in corresponding Chinese Application No. 201810229467.1, dated April 7, 2020.	✕
	2	Chinese Office Action in corresponding Chinese Application No. 201811092577.4, dated April 7, 2020.	☒

If you wish to add additional non-patent literature document citation information please click the Add button Add

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas Lee/	Date (YYYY-MM-DD)	2021-05-21
Name/Print	THOMAS LEE	Registration Number	66396

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	42783900
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Shelly Darrenkamp
Filer Authorized By:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TL
Receipt Date:	21-MAY-2021
Filing Date:	11-AUG-2020
Time Stamp:	11:18:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	BEEL3001C4_IDS_Transmittal_Ltr.pdf	26350 8002029771bc22d2c705450ed7260276d17c71ba	no	2

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2	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_IDS_SB08_Part1.pdf	616269 83164092ac0d021b98375c9873fd62df660154d3	no	13
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_ids_Sb08_part2.pdf	1038362 a328a901c226076e3fa110ac936407f74934b921	no	13
Warnings:					
Information:					
4	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_ids_sb08_part3.pdf	1035135 e487017b7b1daa2dfd02f2e44d5f50e8a33a7912	no	5
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Continuation Patent Application of:
U.S. App. No. 14/278,442

Application No.:	**16/990,215**	**Confirm. No.:**	**5914**
Filing Date:	**August 11, 2020**	**Art Unit:**	**3600**
First Inventor:	**Koen Simon Herman BEEL**	**Customer No.:**	**23364**
Attorney No.:	**BEEL3001C4/TL**	**Examiner:**	**TBD**
For:	**ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS**		

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Sir:

INTRODUCTORY COMMENTS

Pursuant to Rule 37 C.F.R. §§ 1.51(b), 1.56, 1.97 and 1.98, this Information Disclosure Statement is submitted in the above-identified patent application. A listing of documents to be published on the face of any patent granted from this application is submitted herewith on the attached form PTO/SB/08A. Any other documents or information submitted for consideration by the Examiner are listed on the attached forms. Copies of the references are not provided as they are of record in the parent Application Nos. 14/278,442 and 13/270,659 (*see* MPEP 609.02).

This Information Disclosure Statement is submitted before the mailing of a first Office action on the merits. No fees are required.

The Examiner is requested to acknowledge consideration of the information provided in this paper in accordance with prescribed procedures.

BACON & THOMAS, PLLC
625 Slaters Lane, Fourth Floor
Alexandria, Virginia 22314-1176
Phone: (703) 683-0500

Respectfully submitted,

/Thomas Lee/

Date: May 21, 2021

THOMAS LEE
Attorney for Applicant
Registration No. 66,396

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16990215
Filing Date	2020-08-11
First Named Inventor	Koen Simon Herman BEEL
Art Unit	3600
Examiner Name	TBD
Attorney Docket Number	BEEL3001C4/TL

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6601087		2003-07-29	Zhu et al.	
	2	7584313		2009-09-01	Hay et al.	
	3	7762470		2010-07-27	Finn et al.	
	4	8069465		2011-11-29	Bartholomay et al.	
	5	8327410		2012-12-04	Andersen et al.	
	6	8521926		2013-08-27	Hsueh et al.	
	7	8601470		2013-12-03	Yue et al.	
	8	8717599		2014-05-06	Ochiai et al.	

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	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

	9	8896656		2014-11-25	Epstein et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20030120849		2003-06-26	Roslak et al.	
	2	20060233191		2006-10-19	Pirzada et al.	
	3	20070162661		2007-07-12	Fu et al.	
	4	20080088634		2008-04-17	Thompson et al.	
	5	20080182518		2008-07-31	Lo	
	6	20090023475		2009-01-22	Chang et al.	
	7	20090029647		2009-01-29	Wei et al.	
	8	20090251621		2009-10-08	Ichieda	

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	9	20100022274		2010-01-28	Roberts et al.	
	10	20100077021		2010-03-25	Hsueh et al.	
	11	20100091987		2010-04-15	Takahashi et al.	
	12	20100115145		2010-05-06	Banerjee et al.	
	13	20100154014		2010-06-17	Andersen et al.	
	14	20100297964		2010-11-25	Austin et al.	
	15	20100309896		2010-12-09	Sugiyama et al.	
	16	20110010470		2011-01-13	Hulbert et al.	
	17	20110010607		2011-01-13	Raveendran	
	18	20110038005		2011-02-17	Ochiai et al.	
	19	20110210983		2011-09-01	Theimer et al.	

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	20	20110179182	A1	2011-07-21	VADLA RAVNAS	
	21	20050015719	A1	2005-01-20	MARCHON et al.	
	22	20090092198	A1	2011-04-21	Miyata	
	23	20050122392	A1	2005-06-09	Johansen et al.	
	24	20090300520	A1	2009-12-03	Ashutosh et al.	
	25	20120054372		2012-03-01	Chen et al.	
	26	20090189981		2009-07-30	Siann et al.	
	27	20110188391		2011-08-04	Sella et al.	
	28	20100064063		2010-03-11	Deforche et al.	
	29	20110092198		2011-04-21	Miyata	
	30	20060010116		2006-01-12	Yaguchi et al.	

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	31	20070168481		2007-07-19	Lambert et al.			
	32	20020054044		2002-05-09	Lu et al.			

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	1	2006-185359	JP		2006-07-13	Eastman Kodak Co.	English Abstract	
	2	2009-080663	JP		2009-04-16	Brother Ind Ltd.	English Abstract	
	3	2010-263326	JP		2010-11-18	Sumitomo Electric Ind.	English Abstract	
	4	2010/008866	WO		2010-01-21	Schaaf		
	5	2008-090561	JP		2008-04-17	BROTHER IND LTD	cited in EP Search Report, English abstract & mach translation	
	6	1329055	EP		2003-07-23	SONY CORP	cited in EP Search Report, corresponds to WO 01/089156	
	7	1476242	CN		2004-02-18	SEIKO EPSON CORP	English abstract of corresponding EP 1385336, cited in CN OA	

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	Attorney Docket Number	BEEL3001C4/TL

	8	2010/105335	WO		2010-09-23	SMART TECHNOLOGIES ULC	cited in CN OA	
	9	102045864	CN		2011-05-04	NEC CASIO MOBILE COMM LTD	English abstract (Corresponds U.S. 2011/0092198), cited in CN OA	
	10	101631223	CN		2011-04-20	SHANGHAI HUAPING INFORMATION TECHNOLOGY CO LTD	Cited in CN OA dated 10-10-16, English abstract	
	11	101454762	CN		2013-06-12	SMART TECHNOLOGIES ULC	Cited in CN OA dated 10-10-16, English abstract	
	12	1550996	CN		2004-12-01	SEIKO EPSON CORP	Cited in CN OA dated 10-14-16, English abstract	
	13	101965609	CN		2011-02-02	SMART TECHNOLOGIES ULC	Cited in CN OA dated 10-14-16, English abstract	
	14	1385336	EP		2004-01-28	SEIKO EPSON CORP		
	15	2013037979	WO		2013-03-21	Barco N.V.		
	16	2008165007	JP		2008-07-17	Brother Ind Ltd		☒
	17	2000242257	JP		2000-09-08	Canon KK		☒
	18	102045864	CN		2011-05-04	NEC Casio Mobile Comm Ltd.	English abstract	☐

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	Attorney Docket Number	BEEL3001C4/TL

	19	2010/135894	WO		2010-12-02	ZTE Corporation	English Abstract	☒

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	'Universal Serial Bus 3.0 Specification", Revision 1.0 Nov. 12, 2008.	
	2	'Wireless Universal Serial Bus Specification 1.1", Revision 1.1 September 9, 2010.	
	3	AUSTIN et al., "Determinants and Patterns of Control over Technology in a Computerized Meeting Room," CSCW 90 Proceedings, pp. 39-51 (Oct. 1990).	
	4	ROTH, "Building Group Decision Support Rooms Using 'Off-the-Shelf' Computing Resources: Prospects and Issues," Database, pp. 21-31 (May 1993).	
	5	GRAY, et al., "The User Interface in Group Decision Support Systems," Group Support Systems: New Perspectives, Ch. 10, Macmillan Publishing Company, New York (1993).	
	6	Products, components, systems, and methods in public use and/or sale related to the Epson Quick Wireless Connection USB key and Quick Wireless Connection , developed by Epson (accessed July 7, 2017)	
	7	Products, components, systems, and methods in public use and/or sale related to the IOGEAR GUW2015VKIT Wireless USB to VGA Adapter Kit, developed by IOGEAR (accessed July 17, 2017).	
	8	Products, components, systems, and methods in public use and/or sale related to the ActionTec MyWirelessTV HDMI Transmitter, developed by ActionTec and Cavium (accessed Feb. 3, 2020).	

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	9	European Search Report dated August 1, 2017, for EP 16207123.	
	10	European Extended Search Report dated November 3, 2016, for EP 16170760.9.	
	11	Chinese Office Action dated October 14, 2016, for CN 201280055744.2.	
	12	Chinese Office Action dated October 10, 2016, for CN 201280055667.0.	
	13	Final Office Action in corresponding U.S. app. 14/395,364 dated November 2, 2016.	
	14	Office Action in related U.S. app. 14/725,401 dated December 31, 2019.	
	15	Summons to attend oral proceedings in corresponding EP 12762258.7 dated December 12, 2019.	
	16	Chinese Office Action in corresponding Chinese Application No. 201280074077.2, dated September 30, 2019.	
	17	U.S. Office Action in corresponding U.S. Application No. 14/278,442, dated September 18, 2019.	
	18	Notice on Reexamination in corresponding Chinese Application No. 201280001542.X, dated June 11, 2019.	☒
	19	European Office Action in corresponding European Application No. 12759440.6-1204, dated May 28, 2019.	☐

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	Art Unit	3600
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	Attorney Docket Number	BEEL3001C4/TL

	20	U.S. Office Action in corresponding U.S. Application No. 15/449,048, dated April 8, 2019.	☐
	21	European Office Action in corresponding European Application No. 12775162.6-1204, dated May 21, 2019.	☐
	22	Chinese Office Action in corresponding Chinese Application No. 201280074077.2, dated March 5, 2019.	☐
	23	European Office Action in corresponding European Application No. 16170760.9-1216, dated April 2, 2019.	☐
	24	Non-Final Office Action in corresponding U.S. Reexamination No. 90/014,088, dated September 25, 2018.	☐
	25	Final Office Action in corresponding U.S. Reexamination No. 90/014,087, dated January 22, 2019.	☐
	26	Chinese Office Action in related Chinese Application No. 201280001542.X, dated January 2, 2019.	☒
	27	https://www.infocus.com/resources/documents/User-Guides/Liteshow-3-UserGuide.pdf, accessed October 3, 2018.	☐
	28	http://esupport.epson-europe.com/ViewArticle.aspx?lng=sv-SE&kbid=328038&data=bOU002FRlftu7YFtMOBp2mpSKntPq1A26Wyw&cl=1, accessed July 8, 2017.	☐
	29	SIPO Office Action in corresponding app. CN 201280074077.2 dated August 23, 2018.	☒
	30	Office Action in corresponding app. 15/449,048 dated October 12, 2018.	☐

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	Attorney Docket Number	BEEL3001C4/TL

	31	SIPO Office Action in corresponding app. CN 201280001542.X dated July 30, 2018.	☒
	32	EPO Office Action in corresponding app. EP 12759440.6-1204 dated August 9, 2018.	☐
	33	EPO Office Action in corresponding app. EP 12775162.6-1204 dated August 9, 2018.	☐
	34	Office Action in corresponding app. 14/725,401 dated September 10, 2018.	☐
	35	Office Action in corresponding app. 90/014,087 dated September 4, 2018.	☐
	36	Office Action in corresponding app. 16/034,846 dated October 7, 2019.	☐
	37	Office Action in corresponding app. 14/344,830 dated September 28, 2017.	☐
	38	Office Action in corresponding app. 14/344,830 dated October 6, 2016.	☐
	39		☐
	40		☐
	41	LINQ SOFTWARE USER'S GUIDE, Smart Technologies Inc., Copyright 2004-2005, Version 1.0, pages 1-19.	☐

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	42	Chinese Notice on Reexamination in corresponding Chinese Application No. 201280074077.2, dated March 31, 2020.	☒
	43	European Office Action in corresponding European Application No. 12775162.6, dated April 14, 2020.	☐
	44	Brazil Office Action in corresponding Brazil Application No. BR112014026147-4, dated April 8, 2020.	☒
	45	Brazil Office Action in corresponding Brazil Application No. BR122015022158-7, dated April 8, 2020.	☒
	46	U.S. Office Action in corresponding Application No. 16/034,846, dated June 25, 2020.	☐

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	Attorney Docket Number	BEEL3001C4/TL

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas Lee/	Date (YYYY-MM-DD)	2021-05-21
Name/Print	THOMAS LEE	Registration Number	66396

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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First Named Inventor	Koen Simon Herman BEEL
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	1	6966035	B1	2005-11-15	Suess et al.	Cited in Specification
	2	8316138	B2	2012-11-20	Chang	
	3	8346753	B2	2013-01-01	HAYES	

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	1	20100087139	A1	2010-04-08	Glass	Cited in Specification and German Search Report
	2	20060095376	A1	2006-05-04	Mitchell et al.	Cited in Specification
	3	20090198839	A1	2009-08-06	Banerjee et al.	Cited in Specification

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	4	20110115689	A1	2011-05-19	Sugiyama et al.	Cited in Specification
	5	20020196378	A1	2002-12-26	Slobodin et al.	Cited in Specification
	6	20130067121	A1	2013-05-14	Beel et al.	Related U.S. App. 13/270,659
	7	20130050254	A1	2013-02-28	Tran et al.	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	3600
	Examiner Name	TBD
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	15	20090046139	A1	2009-02-19	Cutler et al.	
	16	20110023096	A1	2011-01-27	XIAO et al.	
	17	20070033289	A1	2007-02-08	NUYTTENS et al.	
	18	20140082227	A1	2014-03-20	BEEL et al.	
	19	20040125777	A1	2004-07-01	Doyle et al.	
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	22	20130054348	A1	2013-02-28	Holsman et al.	
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	26	20110078716	A1	2011-03-31	MACWAN	
	27	20100332663	A1	2010-12-30	CHANG	
	28	20090235170	A1	2009-09-17	GOLDEN et al.	
	29	20040128354	A1	2004-07-01	HORIKIRI et al.	corresponds to CN 1499841
	30	20100066806	A1	2010-03-18	LYU	
	31	20070109410	A1	2007-05-17	SIEW	
	32	20110150433	A1	2011-06-23	ALEXANDROV et al.	
	33	20110180380	A1	2011-07-28	Lee	
	34	20020174254	A1	2002-11-21	KITA et al.	corresponds to CN 1689275

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	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

	1	00/52887	WO	A1	2000-09-08	MICROSOFT CORPORATION		
	2	1246395	EP	A1	2002-10-02	MOTOROLA, INC.		
	3	1187480	EP	A1	2002-03-13	TELESUITE CORP.		
	4	2001/089156	WO	A2	2001-11-22	SONY CORP		
	5	2008/271265	JP	A	2008-11-06	MATSUSHITA ELECTRIC IND CO LTD	English abstract and translation	X
	6	2107463	EP	A2	2009-10-07	OPTION		☐
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	8	1499841	CN	A	2004-05-26	FUJI XEIOX CO LTD	cited in CN OA, corresponds to US 20040128354	☒
	9	101106681	CN	A	2008-01-16	VTRON CORP	cited in CN OA, English machine translation	☒
	10	1788494	CN	A	2006-06-14	TELESUIT CORP	cited in CN OA, English abstract	☒
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	12	101106469	CN	A	2008-01-16	AWIND INC	cited in CN OA, English abstract	☒
	13	101442500	CN	A	2009-05-27	XIAOTAO YIN	cited in CN OA, English abstract	☒
	14	101828392	CN	A	2010-09-08	CREATIVE TECH LTD	cited in CN OA, English abstract	☒
	15	102023852	CN	A	2011-04-20	JULONG EDUCATIONAL TECHNOLOGY CO LTD	cited in CN OA, English abstract	☒
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	17	2007/137415	WO	A1	2007-12-06	SMART TECH INC	cited in EP Office Communication	☐

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	1	International Search Report (ISR) dated March 6, 2013, for PCT/EP2012/068166.	
	2	International Search Report (ISR) dated March 19, 2013, for PCT/EP2012/068167.	
	3	International Search Report (ISR) dated March 4, 2013, for PCT/EP2012/068168.	

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	4	International Search Report (ISR) dated January 28, 2013, for PCT/EP2012/068169.	
	5	British Search Report dated August 28, 2012, for GB 1206841.7.	
	6	German Search Report dated November 17, 2011, for DE 102011055443.2.	
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	8	Martin Trautschold, iPhone 4 Made Simple, 2010, Apress, Pages 1-819.	
	9	Office Action in related U.S. Application Number 15/449,048, dated February 16, 2018.	
	10	US Office Action dated March 29, 2016, for 14/395,364.	
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	12	Mood indicators on electronic meeting tools" IBM, IP.com number: IPCOMOOOO1171D, Publication Date: March 12, 2003.	
	13	Final Office Action in related U.S. Application No. 14/278,442, dated June 8, 2018.	
	14	Office Action in related Chinese Application Number 201280055744.2, dated March 30, 2018.	X

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	15	Office Action in related U.S. Application Number 14/344,836, dated February 28, 2018.	☐
	16	U.S. Office Action dated October 20, 2017, for U.S. Application No. 14/344,836.	☐
	17	European Notice of Opposition dated September 27, 2017 for EP 2756668.	☐
	18	StarTech.com: USB to DVI External Dual Monitor Video Adapter/USS to VGA External Dual Monitor Video Adapter, User Manual dated May 19, 2011.	☐
	19	Microsoft Community, conversation on August 30, 2011 about USB2VGA Adapter, retrieved on September 7, 2017.	☐
	20	Webopedia Definition of Peripheral Device, retrieved on September 7, 2017.	☐
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	22	HWebPage on Availability of Trulink, retrieved on September 7, 2017.	☐
	23	Chinese Office Action dated October 31, 2017, for CN 201280001542.X, and English translation thereof.	☐
	24	European Office Communication dated June 15, 2015, for EP 12762258.7.	☐
	25	European Office Action dated August 1, 2016, for EP 12762258.7.	☐

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	26	U.S. Office Action dated June 17, 2016, for 14/278,442.	☐
	27	U.S. Office Action dated June 17, 2016, for 14/725,401.	☐
	28	Chinese Office Action dated April 5, 2017, for CN 201280055744.2, and English translation thereof.	☐
	29	U.S. Office Action dated May 3, 2017, for U.S. Application No. 14/344,836.	☐
	30	Chinese Office Action dated September 26, 2017, for CN 201280055744.2, and English translation thereof.	☒
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	32	"Quick Connect Wireless with Epson Projectors", retrieved from https://www.youtube.com/watch?v=9POz4-HyDXY, November 3, 2009.	☐
	33	"Remote Framebuffer Protocol (RFB)", Internet standard IETF RFC 6143 , March 2011.	☐
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	35	"Manual of the Epson projectors", retrieved from http://esupport.epsoneurope.com/ViewArticle.aspx?lng=sv-SE&kbid=328038&data=bOU002FRIftu7YFtMOBp2mpSKntPq1A26Wyw&cl=1, February 14, 2011.	☐
	36	Chinese Office Action dated December 27, 2016, for CN 201280074077.2, and English translation thereof.	☐

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	37	Final Office Action in corresponding U.S. App. 14/725,401 dated January 26, 2017.	☐
	38	Final Office Action in corresponding U.S. App. 14/278,442 dated January 26, 2017.	☐
	39	Chinese Office Action in Chinese Application Number 201280074077.2, dated January 4, 2018.	☒
	40	International Preliminary Report on Patentability (IPRP) dated March 27, 2014, for PCT/EP2012/068166.	☐
	41	International Preliminary Report on Patentability (IPRP) dated March 27, 2014, for PCT/EP2012/068167.	☐
	42	International Preliminary Report on Patentability (IPRP) dated March 27, 2014, for PCT/EP2012/068168.	☐
	43	Request for Reexamination of Patent No. 8,756,348, dated February 9, 2018.	☐
	44	Request for Reexamination of Patent No. 9,083,769, dated February 9, 2018.	☐
	45	Intervention according to Art. 105 EPC in corresponding European patent 2756668, dated May 3, 2018.	☐
	46	Chinese Office Action dated November 4, 2016, for CN 201280001542.X, and English translation thereof.	☐
	47	European Office Communication dated December 21, 2015, for EP 12762258.7.	☐

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	48	Chinese Office Action dated June 28, 2017, for CN 201280074077.2, and English translation thereof.	☒
	49	Chinese Office Action dated July 4, 2017, for CN 201280055667.0, and English translation thereof.	☒
	50	Chinese Office Action dated July 21, 2017, for CN 20128001542.X, and English translation thereof.	☒

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Signature	/Thomas Lee/	Date (YYYY-MM-DD)	2021-05-21
Name/Print	THOMAS LEE	Registration Number	66396

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	3	20110222556	A1	2011-09-15	Shefler et al.	

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	1	2010135894	WO	A1	2010-12-02	ZTE Corporation	Abstract.	X

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本国际公布:

— 包括国际检索报告(条约第 21 条(3))。

(54) **Title**: METHOD AND DEVICE FOR TRANSMITTING UNIVERSAL SERIAL BUS AUDIO DATA THROUGH A WIRELESS DATA TERMINAL

(54) **发明名称** : 无线数据终端通用串行总线音频数据传输的方法及装置

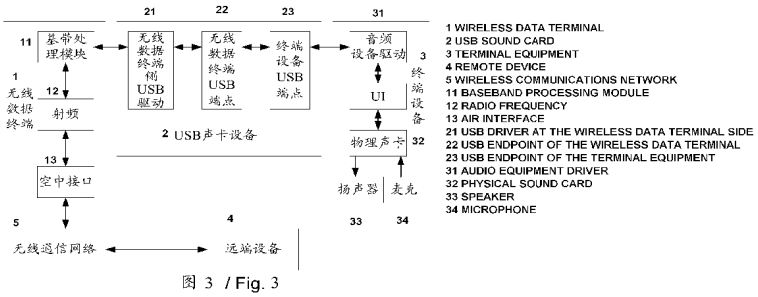


图 3 / Fig. 3

(57) **Abstract**: A method and device for transmitting universal serial bus (USB) audio data through a wireless data terminal are provided. The method enumerates an USB audio data transmission channel between a wireless data terminal and a terminal equipment into an USB sound card that adopts the USB AUDIO CLASS standard as defined by the USB specifications, so as to transmit audio data; the device includes a wireless data terminal, an USB sound card, and a terminal equipment. The USB sound card only transmits audio data, and does not process audio data; the USB audio equipment driver of the terminal equipment accesses the USB endpoint of the terminal equipment in the same manner of accessing a sound card interface. The present method and device specifically optimize USB audio data transmission channels, and fully utilize the powerful capability of terminal equipments, thereby enhancing the effectiveness of voice over USB (VOUSB) in practical application.

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(57) 摘要:

公开了一种实现无线数据终端通用串行总线音频数据传输的方法及装置。其方法为将无线数据终端与终端设备之间的ＵＳＢ音频数据传输通道，采用ＵＳＢ规范定义的标准的ＵＳＢ　ＡＵＤＩＯ　ＣＬＡＳＳ枚举成一个ＵＳＢ声卡设备，传输音频数据；该装置包括无线数据终端、ＵＳＢ声卡设备、终端设备。所述ＵＳＢ声卡设备仅传输音频数据，而不对音频数据进行处理；终端设备的ＵＳＢ音频设备驱动以访问声卡设备接口的方式访问终端设备ＵＳＢ端点。采用本发明的方法及装置，对ＵＳＢ音频数据传输通道进行专门优化，充分利用终端设备处理音频数据的强大能力，增强了 VOUSB 的实际应用效果。

无线数据终端通用串行总线音频数据传输的方法及装置

技术领域

本发明涉及音频数据传输技术，具体涉及一种实现无线数据终端通用串行总线音频数据传输的方法及装置。

背景技术

目前，时分同步的码分多址（TD-SCDMA，Time Division-Synchronous Code Division Multiple Access）技术作为中国提出的第三代移动通信标准已经日趋成熟，在 TD-SCDMA 技术支持下，从网络下载数据和向网络上传数据的速度都得到了极大的提高，而速度的提高又必然会促进用户对音频业务和视频业务需求的增加。

目前，无线数据终端在处理音频数据时，对从空口接收到的模拟音频信号，直接送到相应的射频、编解码器等硬件设备进行解调、解码，最后由扬声器播放；对麦克采集的需要发送的模拟音频信号，在相应的编解码器、射频等硬件设备进行编码、调制后发送出去。这种处理音频数据方式存在的缺陷在于：由于需要对音频数据进行编码和解码，无线数据终端就必须配有相应的编解码器，增加了硬件成本。

为克服上述音频数据处理方式存在的缺陷，目前比较流行的实现方法是通用串行总线音频传输（VOUSB，Voice Over USB），下面以广泛应用的 PC 作为终端设备为例对该方法的实现作简单说明。无线数据终端将解调后的音频数据通过通用串行总线（USB，Universal Serial BUS）接口传输到 PC 进行解码等处理；类似地，将在 PC 中完成编码等处理的音频数据通过 USB 接口传输到无线数据终端。这样，无线数据终端在硬件上就不再需要编解码器，降低了硬件成本。而且，相对于无线数据终端，PC 具有更强的

计算能力和更多的内存资源，因此对音频数据具有更强大的处理能力，能够进行更加丰富的处理，如能够进行去噪、润饰、混音等处理。

图 1 为现有技术中 VOUSB 的实现方案示意图，如图 1 所示，无线数据终端的空中接口接收远端设备经无线通信网络发来的模拟音频信号，并传输到射频进行解调，之后，由基带处理模块对解调后的音频数据进行放大和数字滤波处理，得到脉冲编码调制（PCM，Pulse Code Modulation） 码流，再将 PCM 码流传输到无线数据终端侧 USB 驱动，由该无线数据终端侧 USB 驱动将 PCM 码流传输到无线数据终端的 USB 端点，最后，按照 USB 标准的批量传输方式，PCM 码流经无线数据终端的 USB 端点传输到终端设备的 USB 端点。这里，无线数据终端侧 USB 驱动的作用是从基带处理模块接收音频数据并传输到无线数据终端的 USB 端点，或从无线数据终端的 USB 端点读出音频数据并传输到基带处理模块。所述 USB 标准的批量传输方式的特点是支持在不确定的时间内进行大量的数据传输，能够保证数据一定可以正确传输，但不保证传输的带宽和延时，因此数据传输的实时性不好。另外，对于以 USB 标准的批量传输方式传输的音频数据，终端设备没有标准设备驱动对其进行处理，如果需要对该音频数据进行处理，就需要借助于应用程序用户接口（UI，User Interface）来实现，其实现过程如下：

对无线数据终端发送到终端设备的 USB 端点的 PCM 码流，终端设备侧 USB 驱动将其读出，并进一步由终端设备的 UI 从终端设备侧 USB 驱动读取并处理，之后，将 PCM 码流传输到物理声卡。物理声卡对传输来的 PCM 码流进行解码，再经 A/D 转换等处理得到模拟音频信号，最后将模拟音频信号送至扬声器播放。所述物理声卡可以为外设组件互连（PCI，Peripheral Component Interconnect）接口的声卡或 USB 声卡等。这里，终端设备侧 USB 驱动的作用是从终端设备 USB 端点读出音频数据传输到 UI，

或从 UI 获取音频数据传输到终端设备的 USB 端点。

基于以上描述可见，VOUSB 的实现方案中，无线数据终端与终端设备之间的 USB 音频数据传输通道仅仅是作为数据的传输通道，这样带来的问题是没有针对音频数据传输的特点做专门的优化，在实时性等方面影响了 VOUSB 的实际应用效果。

发明内容

有鉴于此，本发明的主要目的在于提供一种实现无线数据终端通用串行总线音频数据传输的方法及装置，充分利用终端设备处理音频数据的强大能力，增强 VOUSB 的实际应用效果。

为解决上述技术问题，本发明的技术方案是这样实现的:

一种实现无线数据终端通用串行总线音频数据传输的方法，将无线数据终端和终端设备之间的通用串行总线（USB）音频数据传输通道枚举为 USB 声卡设备，该方法包括:

无线数据终端通过所述 USB 声卡设备向终端设备发送音频数据，终端设备通过自身的音频设备驱动访问所述 USB 声卡设备获取音频数据;

终端设备通过自身的音频设备驱动向所述 USB 声卡设备发送音频数据，无线数据终端通过所述 USB 声卡设备接收该音频数据。

所述将无线数据终端和终端设备之间的 USB 音频数据传输通道枚举为 USB 声卡设备，包括:

无线数据终端将传输音频数据的无线数据终端 USB 端点定义为声卡，并将该无线数据终端 USB 端点通过 USB 数据线连接到终端设备 USB 端点;

终端设备向无线数据终端请求获取所连接声卡的设备描述符、配置描述符、描述符集合，无线数据终端收到请求后，向终端设备发送设备描述符、配置描述符、描述符集合;

终端设备根据获取的设备描述符、配置描述符、描述符集合确定能够

提供 USB 的驱动后，加载相应符合 USB 规范的音频设备驱动，由音频设备驱动对声卡进行配置，得到 USB 声卡设备。

所述终端设备包括音频设备驱动、用户接口（UI）和物理声卡，

所述终端设备通过自身的音频设备驱动访问 USB 声卡设备获取音频数据，包括：音频设备驱动以访问 USB 声卡设备接口的方式访问所述 USB 声卡设备，对传输到 USB 声卡设备的脉冲编码调制（PCM）码流进行读取和释放；UI 通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡。

所述终端设备包括音频设备驱动、UI 和物理声卡，

所述终端设备通过自身的音频设备驱动向 USB 声卡设备发送音频数据，包括：物理声卡由模拟音频信号得到 PCM 码流；UI 从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动，音频设备驱动向 USB 声卡设备发送 PCM 码流。

所述无线数据终端通过 USB 声卡设备向终端设备发送音频数据，包括：无线数据终端的基带处理模块将处理得到的 PCM 码流传输到所述 USB 声卡设备的无线数据终端侧 USB 驱动。

所述无线数据终端通过 USB 声卡设备接收音频数据，包括：无线数据终端的基带处理模块通过所述 USB 声卡设备的无线数据终端侧 USB 驱动获取传输到无线数据终端 USB 端点的 PCM 码流。

一种实现无线数据终端通用串行总线音频数据传输的装置，包括：

无线数据终端，用于通过 USB 声卡设备向终端设备发送音频数据，还用于通过 USB 声卡设备接收来自终端设备的音频数据。

将无线数据终端和终端设备之间的 USB 音频数据传输通道枚举为 USB 声卡设备，用于在无线数据终端和终端设备之间传输音频数据；

终端设备，用于通过自身的音频设备驱动访问 USB 声卡设备获取来自

无线数据终端的音频数据，还用于通过自身的音频设备驱动向 USB 声卡设备发送音频数据。

所述 USB 声卡设备包括：无线数据终端侧 USB 驱动、无线数据终端 USB 端点和终端设备 USB 端点，

所述无线数据终端侧 USB 驱动与无线数据终端的基带处理模块相连；

所述无线数据终端 USB 端点通过 USB 数据线与终端设备 USB 端点相连；

所述终端设备 USB 端点与终端设备的音频设备驱动相连。

所述终端设备用于通过自身的音频设备驱动访问 USB 声卡设备获取来自无线数据终端的音频数据时，所述终端设备包括：

音频设备驱动，用于以访问 USB 声卡设备接口的方式访问所述终端设备 USB 端点，对传输到终端设备 USB 端点的 PCM 码流进行读取和释放；

UI，用于通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡；

物理声卡，用于由 PCM 码流得到模拟音频信号。

所述终端设备用于通过自身的音频设备驱动向 USB 声卡设备发送音频数据时，所述终端设备包括：

物理声卡，用于由模拟音频信号得到 PCM 码流；

UI，用于从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动；

音频设备驱动，用于向所述终端设备 USB 端点发送 PCM 码流。

由此可见，相比现有技术而言，本发明中提供的一种实现无线数据终端通用串行总线音频数据传输的方法及装置，针对音频数据传输的特点，对 USB 音频数据传输通道进行抽象和优化，充分利用终端设备处理音频数据的强大能力，增强了 VOUSB 的实际应用效果。

另外，本发明方案还具有以下特点和优点：

首先，将无线数据终端和终端设备之间的 USB 音频数据传输通道，采用 USB 规范定义的标准的 USB AUDIO CLASS 枚举成一个 USB 声卡设备来传输音频数据，而广泛使用的终端设备上的操作系统都默认地提供了符合 USB 规范的音频设备驱动的实现，因此，音频设备驱动以访问 USB 声卡设备接口的方式访问终端设备的 USB 端点；音频设备驱动对从 USB 端点读取的音频数据进行读取和释放。

其次，采用 USB 标准的同步传输方式传输音频数据具有很好的实时性，且终端设备具有针对该同步传输方式的标准驱动，即音频设备驱动，对终端设备 USB 端点的音频数据的读取和释放都是在音频设备驱动中完成，其处理优先级高于在应用程序 UI 中处理，因此，在终端设备的操作系统负载很重时，音频数据的处理依然具有非常好的实时性。

最后，UI 通过音频设备接口来访问音频设备驱动，将完成释放的音频数据传输到物理声卡。由于 UI 是通过音频设备接口来访问音频设备驱动，降低了 UI 对音频设备驱动的依赖；音频设备接口是标准接口，无需关注底层音频设备驱动实现的细节，且操作系统可移植性好，使 UI 实现起来更加简单、可靠。

附图说明

图 1 为现有技术中 VOUSB 的实现方案示意图；

图 2 为本发明中实现无线数据终端通用串行总线音频数据传输的装置结构示意图；

图 3 为本发明中将 USB 音频数据传输通道抽象成 USB 声卡设备的示意图；

图 4 为本发明中无线数据终端作为音频数据接收方的传输流程图；

图 5 为本发明中无线数据终端作为音频数据发送方的传输流程图。

具体实施方式

下面结合附图及具体实施例对本发明再作进一步详细的说明。

本发明中提供一种实现无线数据终端通用串行总线音频数据传输的装置，如图 2 所示，该装置主要由无线数据终端、USB 声卡设备、以及终端设备组成。其中，

无线数据终端，用于通过 USB 声卡设备向终端设备发送音频数据，还用于通过 USB 声卡设备接收来自终端设备的音频数据；

将无线数据终端和终端设备之间的 USB 音频数据传输通道枚举为 USB 声卡设备，用于在无线数据终端和终端设备之间传输音频数据；

终端设备，用于通过自身的音频设备驱动访问 USB 声卡设备来获取来自无线数据终端的音频数据，还用于通过自身的音频设备驱动向 USB 声卡设备发送音频数据。

具体地，终端设备的音频设备驱动以访问 USB 声卡设备接口的方式访问终端设备 USB 端点，对传输到该终端设备 USB 端点的音频数据进行读取和释放，之后，进一步由 UI 将音频数据传输到物理声卡进行解码、D/A 转换，最后由扬声器播放；对麦克采集、并进一步由物理声卡进行 A/D 转换、编码的音频数据，由 UI 传输到音频设备驱动进行压缩，之后，由音频设备驱动以访问 USB 声卡设备接口的方式回传到终端设备 USB 端点。

图 3 为本发明中将 USB 音频数据传输通道抽象成 USB 声卡设备的示意图，如图 3 所示，对比图 1，本发明中，根据 USB 规范中 USB 声卡应用方法将无线数据终端与终端设备之间的 USB 音频数据传输通道抽象成一个 USB 声卡设备。所述 USB 音频数据传输通道指：无线数据终端侧 USB 驱动、无线数据终端的 USB 端点、终端设备的 USB 端点、以及两个 USB 端点之间的 USB 数据线在内的音频数据传输通道。实现将 USB 音频数据传输通道抽象成一个 USB 声卡设备的关键在于：将 USB 音频数据传输通道，采

用 USB 规范定义的标准的 USB AUDIO CLASS 枚举成一个 USB 声卡设备。所述枚举通过以下步骤来实现：首先，无线数据终端侧将传输音频数据的无线数据终端 USB 端点定义为一个声卡，并将该无线数据终端 USB 端点通过 USB 数据线连接到终端设备 USB 端点；之后，终端设备向无线数据终端发送请求，请求获取所连接声卡的设备描述符、配置描述符、描述符集合等信息；无线数据终端在收到请求后，向终端设备发送所请求的设备描述符、配置描述符、描述符集合等信息；然后，终端设备在获取这些信息并根据这些信息确定能够提供 USB 的驱动以后，加载相应符合 USB 规范的音频设备驱动；最后，终端设备在得到各种描述符之后，认为所连接的声卡的信息已经齐全，便由音频设备驱动对声卡进行配置，配置成功即可实现无线数据终端与终端设备之间的音频数据传输。至此，枚举过程结束，完成了将 USB 音频数据传输通道枚举成 USB 声卡设备。无线数据终端与 USB 声卡设备的无线数据终端侧 USB 驱动相连接；终端设备与 USB 声卡设备的终端设备 USB 端点相连接。

不同于通常的 USB 声卡等物理声卡所具有的音频数据处理能力，以及能够将处理后的音频数据直接送到扬声器播放的处理能力，该 USB 声卡设备的特点是具有与物理声卡相同的访问接口和使用方式，对用户而言可以将 USB 声卡设备视作一个实际的物理声卡，但实际上，这个 USB 声卡设备只具有音频数据传输功能，而没有真实的音频数据处理能力，如果还需要对收到的音频数据进行处理，就需要借助于终端设备上的物理声卡来实现。对于终端设备发送到无线数据终端的音频数据，无线数据终端将通过无线通信网络传输到远端设备。所述远端设备可以为无线数据终端或终端设备。如果远端设备还要对收到的音频数据进行处理，对于远端设备是终端设备的情况，直接借助该终端设备上的物理声卡处理音频数据后播放；对于远端设备是无线数据终端的情况，将接收到的音频数据传输到与该无

线数据终端通过 USB 声卡设备相连的终端设备，借助于该终端设备上的物理声卡处理音频数据后播放。

由于将无线数据终端和终端设备之间的 USB 音频数据传输通道，采用 USB 规范定义的标准的 USB AUDIO CLASS 枚举成一个 USB 声卡设备，来实现音频数据传输，而广泛使用的终端设备上的操作系统都默认地提供了符合 USB 规范的音频设备驱动的实现，因此，对于由无线数据终端发送到 USB 声卡设备的终端设备 USB 端点的音频数据，音频设备驱动以访问 USB 声卡设备接口的方式访问该终端设备 USB 端点；音频设备驱动在访问终端设备 USB 端点时，对发送到该终端设备 USB 端点的音频数据进行读取和释放，相对于现有的由应用程序 UI 读取和释放音频数据，由音频设备驱动进行读取和释放优先级更高，因此，即使在终端设备的操作系统负载很重时，音频数据的处理依然具有很好的实时性；音频设备驱动除了向下访问终端设备 USB 端点，向上还可提供音频设备接口，该音频设备接口是标准接口，UI 访问该音频设备接口时，无需关注底层的音频设备驱动实现的细节，且操作系统可移植性好，UI 可通过音频设备接口访问音频设备驱动并将音频数据传送到物理声卡，减少了 UI 对音频设备驱动的依赖，使 UI 实现起来更加简单、可靠。

具体地，终端设备通过 USB 声卡设备获取音频数据时，音频设备驱动用于以访问 USB 声卡设备接口的方式访问所述终端设备 USB 端点，对传输到终端设备 USB 端点的 PCM 码流进行读取和释放；UI，用于通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡；物理声卡，用于由 PCM 码流得到模拟音频信号。

终端设备通过 USB 声卡设备发送音频数据时，物理声卡用于由模拟音频信号得到 PCM 码流；UI 用于从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动；音频设备驱动

用于向所述终端设备 USB 端点发送 PCM 码流。

利用 USB 声卡设备实现音频数据传输的过程如图 4、图 5 所示。

图 4 为无线数据终端作为音频数据接收方的传输流程图，如图 4 所示，音频数据的传输包括以下步骤：

步骤 401：无线数据终端的空中接口接收远端设备经无线通信网络发来的模拟音频信号，并传送到射频等硬件进行解调，之后，由基带处理模块对解调后的音频数据进行放大和数字滤波处理，得到 PCM 码流。

步骤 402：处理后得到的 PCM 码流由无线数据终端的基带处理模块传输到 USB 声卡设备的无线数据终端侧 USB 驱动；之后，按照 USB 标准的同步传输方式，PCM 码流经无线数据终端 USB 端点和 USB 数据线被传输到 USB 声卡设备的终端设备 USB 端点。

步骤 403：在 PCM 码流传输到终端设备 USB 端点之后，终端设备的音频设备驱动以访问 USB 声卡设备接口的方式访问该终端设备 USB 端点，并对传输到终端设备 USB 端点的 PCM 码流进行读取和释放，之后，UI 通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡。

步骤 404：物理声卡对传送来的 PCM 码流进行解码、D/A 转换等处理后得到模拟音频信号，最后，将该模拟音频信号传输到扬声器播放。

图 5 为无线数据终端作为音频数据发送方的传输流程图，如图 5 所示，音频数据的传输包括以下步骤：

步骤 501：终端设备的麦克将采集的模拟音频信号传送到物理声卡，由物理声卡对其进行 A/D 转换、编码等处理，得到 PCM 码流形式的数字音频信号。

步骤 502：终端设备的 UI 从物理声卡获取 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动，由音频设备驱动对 PCM 码流进行压缩，之后，音频设备驱动以访问 USB 声卡设备接口的

方式将 PCM 码流回传到 USB 声卡设备的终端设备 USB 端点。

步骤 503：在 PCM 码流传输到 USB 声卡设备的终端设备 USB 端点之后，按照 USB 标准的同步传输方式， PCM 码流经 USB 数据线传输到 USB 声卡设备的无线数据终端 USB 端点。

步骤 504：无线数据终端的基带处理模块通过无线数据终端侧 USB 驱动获取传输到无线数据终端 USB 端点的 PCM 码流，进行放大和数字滤波处理，再经射频进行调制，得到模拟音频信号，最后，由空中接口经无线通信网络发送到远端设备。

以上所述，仅为本发明的较佳实施例而已，并非用于限定本发明的保护范围。

权利要求书

1、一种实现无线数据终端通用串行总线音频数据传输的方法，其特征在于，将无线数据终端和终端设备之间的通用串行总线（USB）音频数据传输通道枚举为 USB 声卡设备，该方法包括:

无线数据终端通过所述 USB 声卡设备向终端设备发送音频数据，终端设备通过自身的音频设备驱动访问所述 USB 声卡设备获取音频数据;

终端设备通过自身的音频设备驱动向所述 USB 声卡设备发送音频数据，无线数据终端通过所述 USB 声卡设备接收该音频数据。

2、根据权利要求 1 所述的方法，其特征在于，所述将无线数据终端和终端设备之间的 USB 音频数据传输通道枚举为 USB 声卡设备，包括:

无线数据终端将传输音频数据的无线数据终端 USB 端点定义为声卡，并将该无线数据终端 USB 端点通过 USB 数据线连接到终端设备 USB 端点;

终端设备向无线数据终端请求获取所连接声卡的设备描述符、配置描述符、描述符集合，无线数据终端收到请求后，向终端设备发送设备描述符、配置描述符、描述符集合;

终端设备根据获取的设备描述符、配置描述符、描述符集合确定能够提供 USB 的驱动后，加载相应符合 USB 规范的音频设备驱动，由音频设备驱动对声卡进行配置，得到 USB 声卡设备。

3、根据权利要求 1 所述的方法，其特征在于，所述终端设备包括音频设备驱动、用户接口（UI）和物理声卡，

所述终端设备通过自身的音频设备驱动访问 USB 声卡设备获取音频数据，包括: 音频设备驱动以访问 USB 声卡设备接口的方式访问所述 USB 声卡设备，对传输到 USB 声卡设备的脉冲编码调制（PCM）码流进行读取和释放; UI 通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡。

4、根据权利要求 1 所述的方法，其特征在于，所述终端设备包括音频设备驱动、UI 和物理声卡，

所述终端设备通过自身的音频设备驱动向 USB 声卡设备发送音频数据，包括：物理声卡由模拟音频信号得到 PCM 码流；UI 从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动，音频设备驱动向 USB 声卡设备发送 PCM 码流。

5、根据权利要求 1 至 4 任一所述的方法，其特征在于，所述无线数据终端通过 USB 声卡设备向终端设备发送音频数据，包括：无线数据终端的基带处理模块将处理得到的 PCM 码流传输到所述 USB 声卡设备的无线数据终端侧 USB 驱动。

6、根据权利要求 1 至 4 任一所述的方法，其特征在于，所述无线数据终端通过 USB 声卡设备接收音频数据，包括：无线数据终端的基带处理模块通过所述 USB 声卡设备的无线数据终端侧 USB 驱动获取传输到无线数据终端 USB 端点的 PCM 码流。

7、一种实现无线数据终端通用串行总线音频数据传输的装置，其特征在于，包括：

无线数据终端，用于通过 USB 声卡设备向终端设备发送音频数据，还用于通过 USB 声卡设备接收来自终端设备的音频数据。

将无线数据终端和终端设备之间的 USB 音频数据传输通道枚举为 USB 声卡设备，用于在无线数据终端和终端设备之间传输音频数据；

终端设备，用于通过自身的音频设备驱动访问 USB 声卡设备获取来自无线数据终端的音频数据，还用于通过自身的音频设备驱动向 USB 声卡设备发送音频数据。

8、根据权利要求 7 所述的装置，其特征在于，所述 USB 声卡设备包括：无线数据终端侧 USB 驱动、无线数据终端 USB 端点和终端设备 USB

端点，

所述无线数据终端侧 USB 驱动与无线数据终端的基带处理模块相连；

所述无线数据终端 USB 端点通过 USB 数据线与终端设备 USB 端点相连；

所述终端设备 USB 端点与终端设备的音频设备驱动相连。

9、根据权利要求 8 所述的装置，其特征在于，所述终端设备用于通过自身的音频设备驱动访问 USB 声卡设备获取来自无线数据终端的音频数据时，所述终端设备包括:

音频设备驱动，用于以访问 USB 声卡设备接口的方式访问所述终端设备 USB 端点，对传输到终端设备 USB 端点的 PCM 码流进行读取和释放；

UI，用于通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡；

物理声卡，用于由 PCM 码流得到模拟音频信号。

10、根据权利要求 8 所述的装置，其特征在于，所述终端设备用于通过自身的音频设备驱动向 USB 声卡设备发送音频数据时，所述终端设备包括:

物理声卡，用于由模拟音频信号得到 PCM 码流；

UI，用于从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动；

音频设备驱动，用于向所述终端设备 USB 端点发送 PCM 码流。

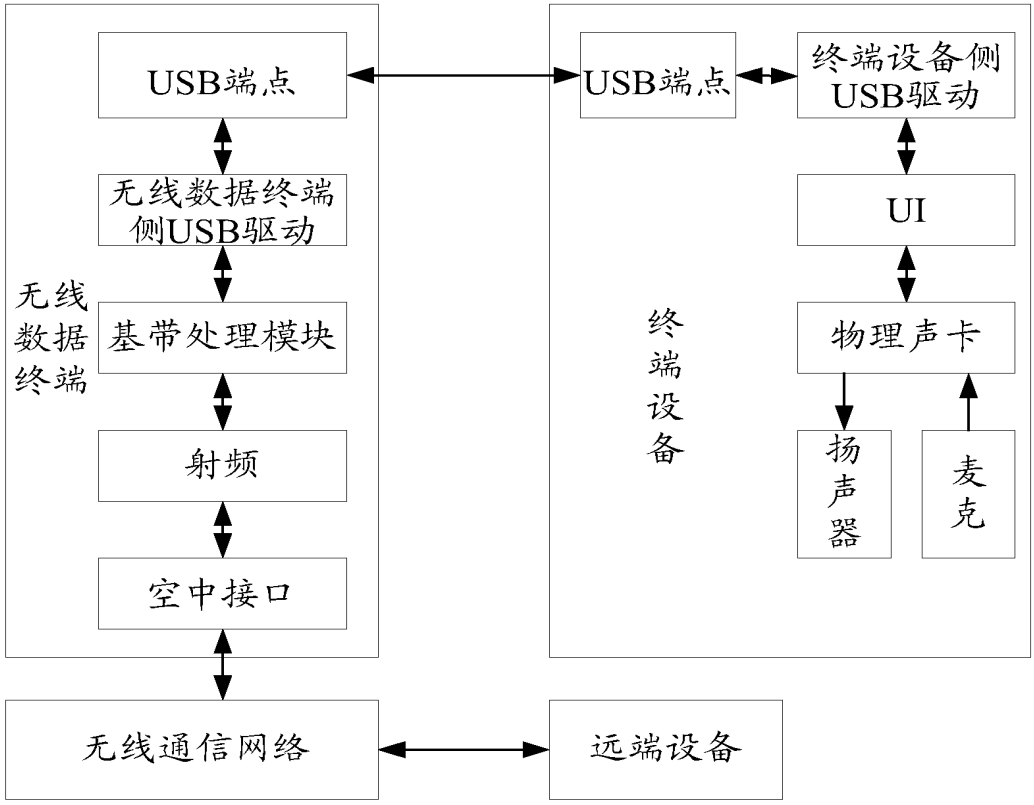

USB端点
无线数据终端侧USB驱动
无线数据终端
基带处理模块
射频
空中接口
USB端点
终端设备侧USB驱动
UI
终端设备
物理声卡
扬声器
麦克
无线通信网络
远端设备

图 1


无线数据终端
USB声卡设备
终端设备

图 2

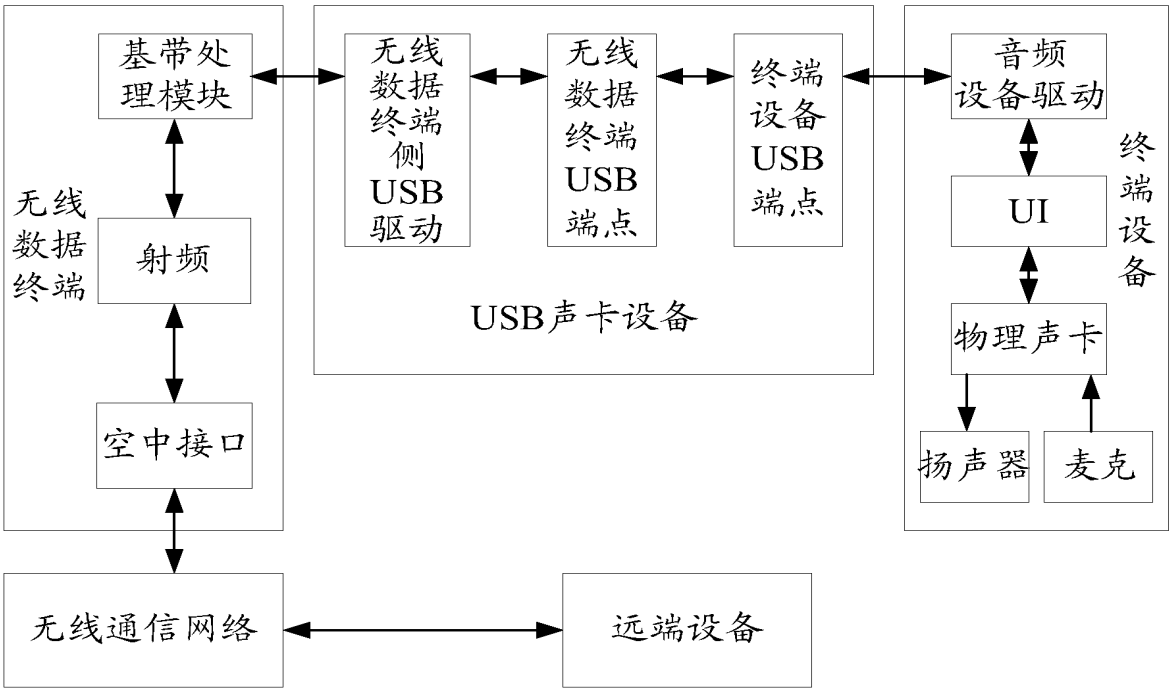

基带处理模块
射频
空中接口
无线数据终端
无线数据终端侧USB驱动
无线数据终端USB端点
终端设备USB端点
USB声卡设备
音频设备驱动
UI
物理声卡
扬声器
麦克
终端设备
无线通信网络
远端设备

图 3

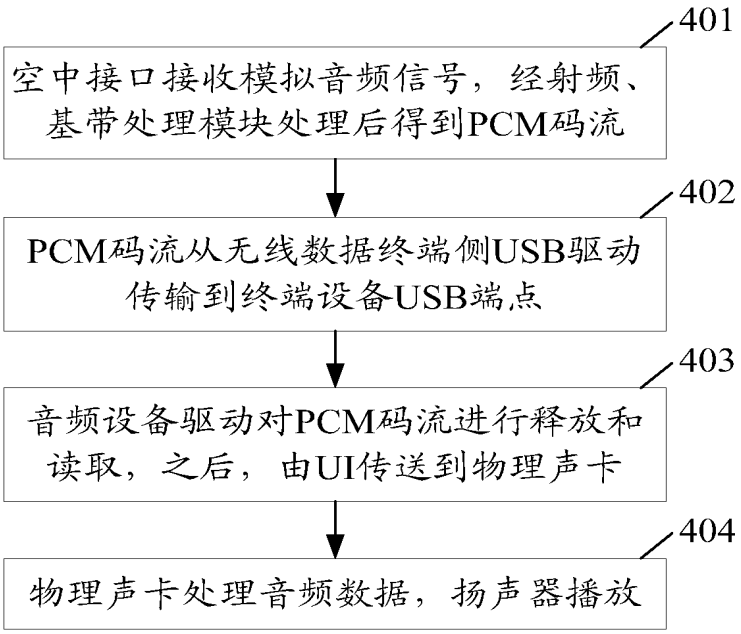

401
空中接口接收模拟音频信号，经射频、基带处理模块处理后得到PCM码流
402
PCM码流从无线数据终端侧USB驱动传输到终端设备USB端点
403
音频设备驱动对PCM码流进行释放和读取，之后，由UI传送到物理声卡
404
物理声卡处理音频数据，扬声器播放

图 4

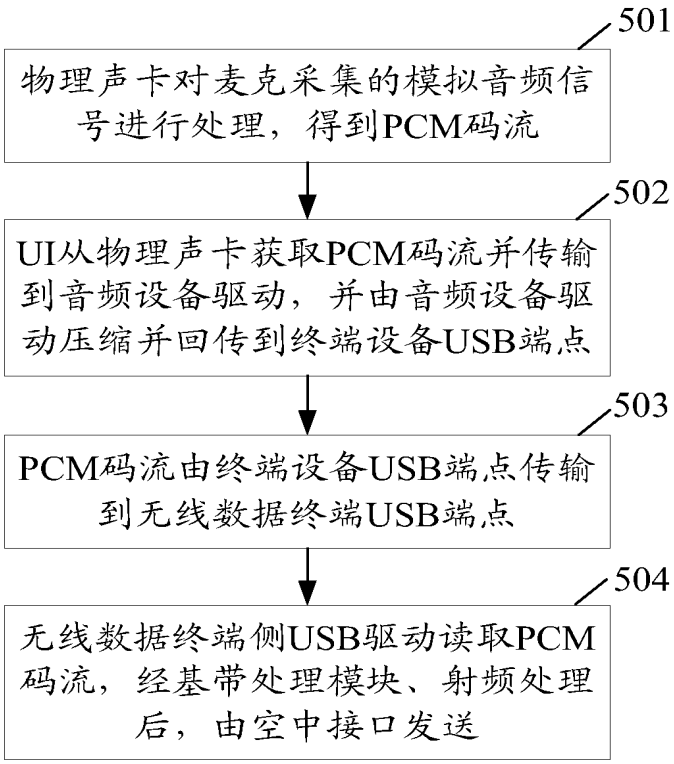

501
物理声卡对麦克采集的模拟音频信号进行处理，得到PCM码流
502
UI从物理声卡获取PCM码流并传输到音频设备驱动，并由音频设备驱动压缩并回传到终端设备USB端点
503
PCM码流由终端设备USB端点传输到无线数据终端USB端点
504
无线数据终端侧USB驱动读取PCM码流，经基带处理模块、射频处理后，由空中接口发送

图 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2009/075508

A. CLASSIFICATION OF SUBJECT MATTER

see the extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: G06F3/-; H04W; G06F13/-; H04B1/-; H04M; H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT,CNKI,WPI,EPODOC,PAJ: USB, wireless+, audio, card, universal, serial, bus, voice, transmit+, transmission, terminal, channel, driv+, own, access+, code, stream, PCM, interface, radio, frequency

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	CN101566940A, (ZHONGXING COMMUNICATION CO LTD SHENZHEN), 28 Oct. 2009(28.10.2009), the whole document	1-10
Y	CN200950579Y, (LI Y), 19 Sep. 2007(19.09.2007), the description page 1 line 11 to page 4 line 1, and figures 1-2	1, 7
A		2-6, 8-10
Y	US20080104289A1, (D-BOX TECHNOLOGIES INC et al.), 01 May 2008(01.05.2008), the description paragraphs 37-44 and figure 3	1, 7
A		2-6, 8-10
A	CN101212750A, (LEJIN ELECTRONICS CHINA RES & DEV CENT), 02 Jul. 2008(02.07.2008), the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 Mar. 2010(01.03.2010)	**11 Mar. 2010 (11.03.2010)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer ZHAO, Xiaoning Telephone No. (86-10)62412071

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2009/075508

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN101566940A	28.10.2009	none	
CN200950579Y	19.09.2007	none	
US20080104289A1	01.05.2008	WO2008049217A1	02.05.2008
		KR20090074260A	06.07.2009
		EP2092518 A1	26.08.2009
		CN101611443A	23.12.2009
		CA2667575A1	02.05.2008
CN101212750A	02.07.2008	none	

Form PCT/ISA /210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2009/075508

CLASSIFICATION OF SUBJECT MATTER

G06F3/16(2006.01) i
H04W88/02(2009.01) i

国际检索报告

国际申请号
PCT/CN2009/075508

A. 主题的分类

参见附加页

按照国际专利分类(IPC)或者同时按照国家分类和 IPC 两种分类

B. 检索领域

检索的最低限度文献(标明分类系统和分类号)

IPC: G06F3/-; H04W; G06F13/-; H04B1/-; H04M; H04Q

包含在检索领域中的除最低限度文献以外的检索文献

在国际检索时查阅的电子数据库(数据库的名称，和使用的检索词（如使用）) CNPAT,CNKI,WPI,EPODOC,PAJ

无线，声卡，音频，USB，传输，传送，终端，通用，串行，总线，声音，通道，驱动，自身，访问，端点，码流，PCM，接口，射频

wireless+, audio, card, universal, serial, bus, voice, transmit+, transmission, terminal, channel, driv+, own, access+, code, stream, PCM, interface, radio, frequency

C. 相关文件

类　型*	引用文件，必要时，指明相关段落	相关的权利要求
P, X	CN101566940A，(中兴通讯股份有限公司)，28.10 月 2009(28.10.2009)，全文	1-10
Y	CN200950579Y，(李宇波)，19.9 月 2007(19.09.2007)，说明书第 1 页第 11 行—第 4 页第 1 行及附图 1-2	1, 7
A		2-6, 8-10
Y	US20080104289A1，(D-BOX TECHNOLOGIES INC 等)，01.5 月 2008(01.05.2008)，说明书第 37-44 段及附图 3	1, 7
A		2-6, 8-10
A	CN101212750A，(乐金电子（中国）研究开发中心有限公司)，02.7 月 2008(02.07.2008)，全文	1-10

☐ 其余文件在 C 栏的续页中列出。　　☒ 见同族专利附件。

* 引用文件的具体类型：

"A" 认为不特别相关的表示了现有技术一般状态的文件

"E" 在国际申请日的当天或之后公布的在先申请或专利

"L" 可能对优先权要求构成怀疑的文件，或为确定另一篇引用文件的公布日而引用的或者因其他特殊理由而引用的文件（如具体说明的）

"O" 涉及口头公开、使用、展览或其他方式公开的文件

"P" 公布日先于国际申请日但迟于所要求的优先权日的文件

"T" 在申请日或优先权日之后公布，与申请不相抵触，但为了理解发明之理论或原理的在后文件

"X" 特别相关的文件，单独考虑该文件，认定要求保护的发明不是新颖的或不具有创造性

"Y" 特别相关的文件，当该文件与另一篇或者多篇该类文件结合并且这种结合对于本领域技术人员为显而易见时，要求保护的发明不具有创造性

"&" 同族专利的文件

国际检索实际完成的日期	国际检索报告邮寄日期
01.3 月 2010(01.03.2010)	**11.3 月 2010 (11.03.2010)**
ISA/CN 的名称和邮寄地址： 中华人民共和国国家知识产权局 中国北京市海淀区蓟门桥西土城路 6 号 100088 传真号：　(86-10)62019451	受权官员 赵小宁 电话号码：(86-10) **62412071**

国际检索报告
关于同族专利的信息

国际申请号
PCT/CN2009/075508

检索报告中引用的专利文件	公布日期	同族专利	公布日期
CN101566940A	28.10.2009	无	
CN200950579Y	19.09.2007	无	
US20080104289A1	01.05.2008	WO2008049217A1	02.05.2008
		KR20090074260A	06.07.2009
		EP2092518 A1	26.08.2009
		CN101611443A	23.12.2009
		CA2667575A1	02.05.2008
CN101212750A	02.07.2008	无	

主题的分类

G06F3/16(2006.01) i

H04W88/02(2009.01) i

Electronic Acknowledgement Receipt

EFS ID:	42513379
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Shelly Darrenkamp
Filer Authorized By:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TL
Receipt Date:	22-APR-2021
Filing Date:	11-AUG-2020
Time Stamp:	07:32:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_IDS.pdf	1034482 2d5927470579374b8af1026cc75e54724fb13d20	no	4

Warnings:

Information:					
2	Non Patent Literature	EP_OA4_19Apr2021.pdf	638990 a90f485694db254ccb175b811deb1022df013cb3	no	15
Warnings:					
Information:					
3	Foreign Reference	WO2010135894A1.pdf	1123396 89d46a9711f28b0f35124e5e8416fba9d5ac36ca	no	25
Warnings:					
Information:					
			Total Files Size (in bytes):	2796868	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16990215
Filing Date	2020-08-11
First Named Inventor	Koen Simon Herman BEEL
Art Unit	3600
Examiner Name	TBD
Attorney Docket Number	BEEL3001C4/TL

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20100079783	A1	2010-04-01	Naganuma et al.	
	2	20050036509	A1	2005-02-17	Acharya et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	1187480	EP	A1	2002-03-13	TeleSuite Corporation		
	2	1462998	EP	A2	2004-09-29	Microsoft Corporation		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	3600
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

If you wish to add additional Foreign Patent Document citation information please click the Add button [Add]

NON-PATENT LITERATURE DOCUMENTS [Remove]

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	European Search Report in corresponding European Application No. 20212054.9, dated April 7, 2021.	

If you wish to add additional non-patent literature document citation information please click the Add button [Add]

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	3600
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas Lee/	Date (YYYY-MM-DD)	2021-04-07
Name/Print	THOMAS LEE	Registration Number	66396

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	42385583
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Shelly Darrenkamp
Filer Authorized By:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TL
Receipt Date:	07-APR-2021
Filing Date:	11-AUG-2020
Time Stamp:	09:33:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	EP1187480A1.pdf	1879462 d263422cc3acbf4cb99d3dab262059aa4ffd3be0	no	30

Warnings:

Information:					
2	Foreign Reference	EP1462998A2.pdf	3272703 27854a80eb58b3698861270b932ed5eaf0e57ba2	no	78
Warnings:					
Information:					
3	Non Patent Literature	ESR_7Apr2021.pdf	472421 6364ec0674c847addf72eab2c2b761059460f494	no	12
Warnings:					
Information:					
4	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_IDS.pdf	1034474 0d65007176707015c48e718f1ec7458b059bf04a	no	4
Warnings:					
Information:					
		Total Files Size (in bytes):	6659060		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 187 480 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.03.2002 Bulletin 2002/11

(51) Int Cl.7: **H04N 7/15**

(21) Application number: **01128723.2**

(22) Date of filing: **18.09.1995**

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IE IT LI NL PT SE

(30) Priority: **19.09.1994 US 308603**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
95933837.7 / 0 806 115

(71) Applicant: **TeleSuite Corporation**
Englewood, Ohio 45322 (US)

(72) Inventors:
- **Allen, David Lee**
Arcanum, Ohio 45304 (US)
- **Williams, Herold**
Huber Heights, Ohio 45424 (US)

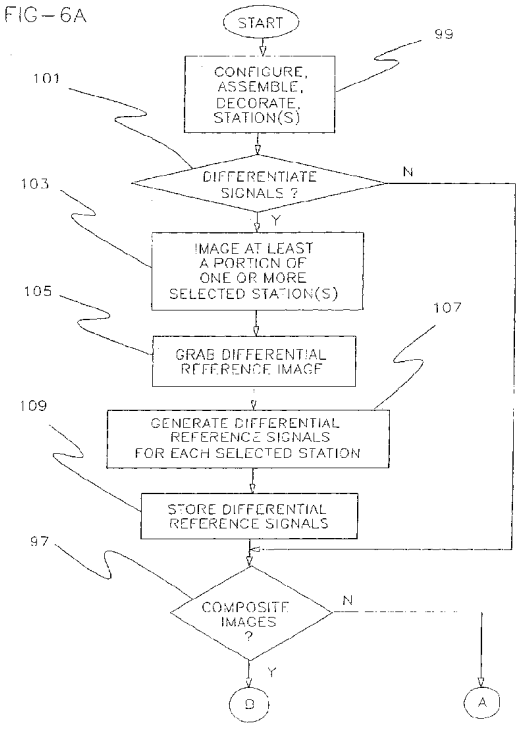
(74) Representative: **Vollmann, Heiko, Dipl.-Ing. et al**
Patentanwälte Wilcken & Vollmann,
Bei der Lohmühle 23
23554 Lübeck (DE)

Remarks:
This application was filed on 03 - 12 - 2001 as a divisional application to the application mentioned under INID code 62.

(54) Teleconferencing method and system

(57) A method and system (10) provides a face-to-face video conference utilizing a video mirror comprising a first station (12) having a first predetermined sensory setting; at least a second station (14) having a second sensory setting; the second station being remote from the first station; and an imaging system for capturing an image or sub-image at the first station, displaying at least a portion of said image or sub-image at the first station. The imaging system includes a differentiator for generating a differential signal (101) in response to a comparison of a differential referecnce signal to an input signal generally corresponding to the image captured at the first station. The imaging system also include a compositor for compositing the differential signal with one or more other image signals and/or a predetermined composite signal to provide a composited video image (97) which appears visually contiguous and seamless.

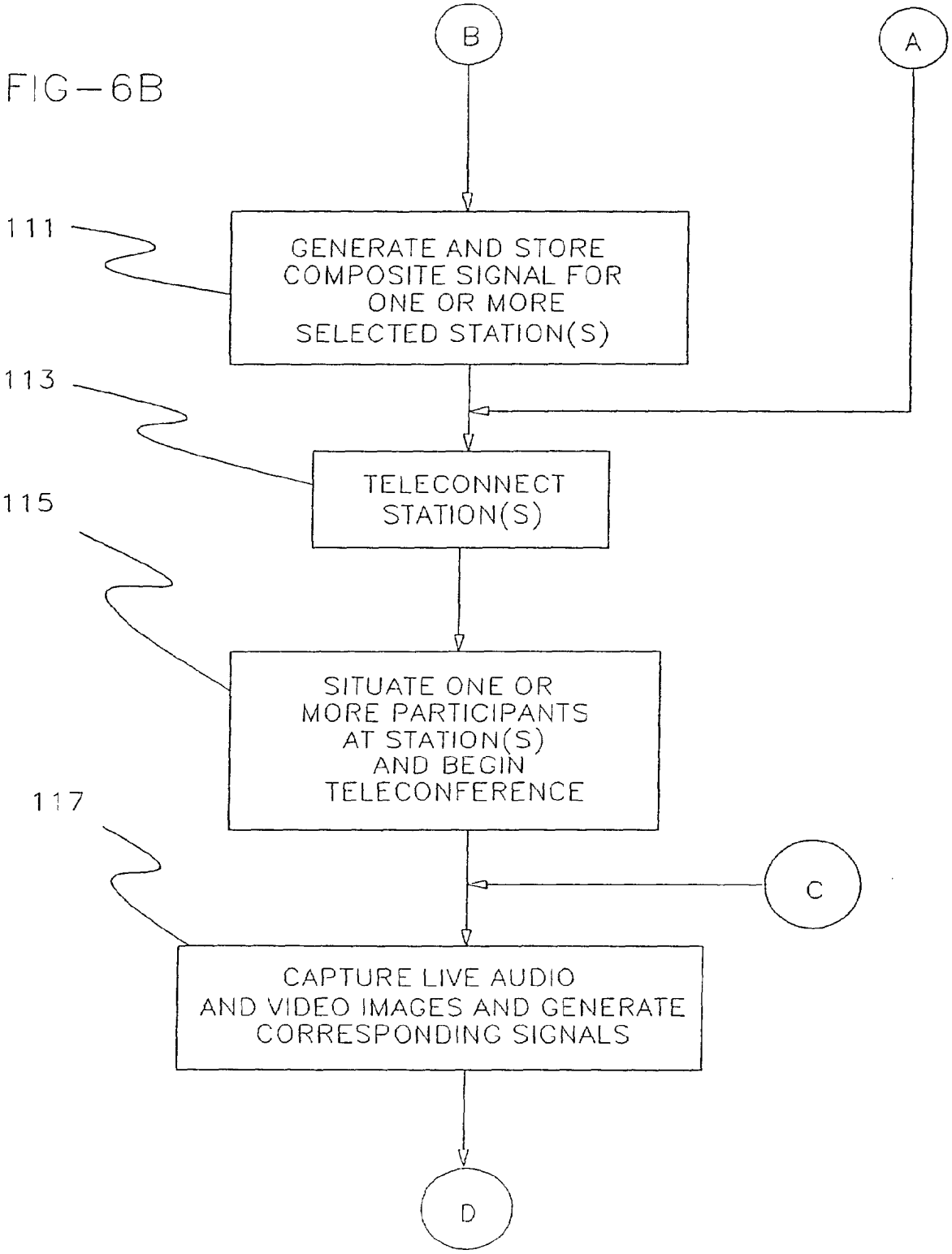
FIG-6A



EP 1 187 480 A1

(Cont. next page)

FIG-6B


B
A
111
GENERATE AND STORE COMPOSITE SIGNAL FOR ONE OR MORE SELECTED STATION(S)
113
TELECONNECT STATION(S)
115
SITUATE ONE OR MORE PARTICIPANTS AT STATION(S) AND BEGIN TELECONFERENCE
117
C
CAPTURE LIVE AUDIO AND VIDEO IMAGES AND GENERATE CORRESPONDING SIGNALS
D

Description

Background of the Invention

[0001] The present invention is related to a video conferencing system and method and, more particularly, to a teleconferencing system which is capable of producing a "video mirror" at a station such that any participants at one or more remote stations may be imaged and displayed in the video mirror at the station so that they appear to be present or face-to-face with any participants at the station.

[0002] Visual telephone systems presently provide communication between at least two locations for allowing a video conference among participants situated at each station. An objective in some video conferencing arrangements is to provide a plurality of television cameras at one location. The outputs of those cameras are transmitted along with audio signals to a corresponding plurality of television monitors at a second location such that the participants at the first location are perceived to be present or face-to-face with participants at the second location. In achieving good face-to-face presence, the number of conferees included in the video picture from each camera is normally limited to a few people, typically one to four. There are usually a like number of monitors at the receiving station, each strategically focused, aligned and positioned so that their displays appear contiguous, seamless and properly aligned. The apparatuses and methods employed heretofore to achieve proper positioning, focus and alignment have been complex and costly.

[0003] Further, the images captured by the plurality of cameras must be arranged and displayed so that they generate a non-overlapping and/or contiguous field of view, for example, as described in U. S. Patent No. 4,890,314 which issued to Judd et al. on December 26, 1989 and which is hereby incorporated by reference and made a part hereof.

[0004] The prior art systems have also been deficient because they have failed to provide means for generating an image, such as an image of a plurality of participants, at one station, differentiating the image to provide a differentiated image and subsequently compositing the differentiated image with a predetermined composite image to provide a composited image which complements or becomes visually complementary, contiguous or integrated with the remote station when the image is displayed at the remote station.

[0005] Another problem with prior art video conferencing systems is eye contact among participants at the stations. Typically, a camera is placed somewhere above the display monitor at which a participant is observing a display of the participant from the remote station. Consequently, the camera captures the participant at an angle above the participants viewing level or head. Thus, when an image of that participant is displayed at the remote station, it appears as if the participant is looking down (e.g., towards the ground). Previous solutions to this problem have required complex optical systems and methods using, for example, a plurality of lenses and mirrors. The solutions have usually been designed for use when the camera is capturing an image of a single participant, and they fall short when simultaneously capturing images of multiple participants.

[0006] The prior art stations themselves were not architecturally designed in a modular form so that they could be easily assembled, decorated and combined with a video image or sub-image from the remote station in a manner which would enhance the virtual presence environment.

Summary of the Invention

[0007] It is, therefore, a primary object of the present invention to provide a face-to-face teleconferencing system which enables a plurality of participants at a plurality of stations to teleconference such that the participants generally appear face-to-face with one or more participants at remote stations in the teleconferencing system.

[0008] Another object of this invention is to provide a differentiator or differentiating means which facilitates differentiating at least one image captured at a station into a differentiated image which will ultimately be transmitted to at least one remote station.

[0009] Another object of this invention is to provide a method and system for compositing an image or sub-image received from a remote station with a predetermined composite image to provide a composited image, at least a portion of which is displayed at the station.

[0010] Still another object of the invention is to provide a system or method which provides a display having wide aspect ratio while utilizing cameras which generate images having smaller aspect ratios.

[0011] Still another object of the invention is to provide a method and system for defining a predetermined sensory setting at one or more stations in order to enhance the virtual presence environment at that station.

[0012] Still another object of the present invention is to provide a method and apparatus for imaging subjects at one station, processing such images, and displaying such images at a remote station such that such images complement and become and/or become visually integrated with the remote station.

[0013] Another object of this invention is to provide a method and apparatus which is capable of generating a composite image having a plurality of different resolutions.

[0014] Still another object of the present invention is to provide a "video mirror" at a station.

[0015] Yet another object of the invention is to provide an imaging system which provides a simplified means capturing substantially eye level images of participants at stations while also providing means for simultaneously displaying images at such stations.

[0016] Still another object of this invention is to pro-

vide a system and method for compositing a plurality of signals corresponding to a plurality of images from at least one station to provide a contiguous or seamless composite image.

[0017] Still another object is to provide a method and system for providing a plurality of teleconferencing stations that have complementary predetermined sensory settings which facilitate creating a face-to-face environment when images of such settings and participants are displayed at remote stations.

[0018] Another object of the invention is to provide a method and apparatus for generating a video mirror such that an image having a predetermined sensory setting of participants or subjects captured at one station may be displayed at a remote station having a different predetermined sensory setting, yet the remote participants will appear face-to-face in the same predetermined setting as the participants or subjects at the one station.

[0019] In one aspect, this invention comprises an image generator for use in a teleconferencing system comprising a differentiator for comparing a differential reference image to an input video image from a station and for generating a differential image in response thereto, and a compositor associated with a remote station for receiving the differential image and for combining that differential image with a predetermined composite image to provide a composite image.

[0020] In another aspect, this invention comprises a conferencing system comprising a first station comprising a first sensory area defining a first aura, a second station comprising a second sensory area defining a second aura, and an image system for generating a first station image of at least a portion of the first sensory area and also for displaying a composite image corresponding to the first station image at the second station such that the first and second auras become visually combined to provide an integrated face-to-face environment at the second station.

[0021] In another aspect, this invention comprises an image system for use in a conference environment comprising a station having a first conference area and a remote station having a remote video area, the image system comprising a compositor for compositing a first signal which generally corresponds to a video image of a portion of the first conference area with a composite reference signal to provide a composite image signal; and a display for displaying the composited image signal at the remote video area such that the first and second stations appear complementarily integrated.

[0022] In still another aspect of the invention, this invention comprises a teleconferencing system comprising a sensory setting, a second station having a second predetermined sensory setting; and an imaging system for capturing an image at the first station and displaying at least a portion of the image at the second station such that it becomes generally visually integrated with the second predetermined sensory setting.

[0023] In another aspect of this invention, this invention comprises a station for use in a teleconferencing environment comprising a first station predetermined setting, first image sensing means associated with the first station predetermined setting for capturing images at the station for transmission to a remote station, audio means for transmitting and/or receiving audio signals from at least one remote station, and display means for displaying an image including at least one sub-image transmitted to the station from the remote station so that the image becomes integrated with the first station predetermined setting to facilitate providing a face-to-face presence teleconference.

[0024] In still another aspect of the invention, this invention comprises a method for providing a virtual presence conference in a teleconferencing system having a first station and a second station comprising the step of displaying an image formed from at least one sub-image from the first station at a predetermined location in the second station such that the image becomes visually integrated with the second station to define a single predetermined aura at the second station.

[0025] In yet another aspect of the invention, this invention comprises a method for teleconferencing comprising the steps of teleconnecting a first station having a first setting to a second station having a second setting; and displaying a composite image including an image of at least a portion of the first station at the second station such that when the composite image is displayed at the second station it cooperates with the second setting to facilitate providing a face-to-face environment at the second station.

[0026] In still another aspect, this invention comprises a method for teleconferencing comprising generating at least one first station signal generally corresponding to a first station image of the first station, comparing the at least one first station signal to a differential reference signal corresponding to a first reference image and generating at least one differential signal comprising a portion of the first station image in response thereto, compositing the at least one differential signal with a predetermined composite signal corresponding to a predetermined image to provide at least one composite image, and displaying the at least one composite image corresponding to the composite signal at a second station.

[0027] In yet another aspect, this invention comprises a method for generating a seamless image at a station from a plurality of sub-images at least one of which is received from a remote station comprising the steps of generating the plurality of sub-images, and combining the plurality of sub-images with a predetermined composite image to provide the seamless image.

[0028] These advantages and objects, and others, may be more readily understood in connection with the following specification, claims and drawings.

Brief Description of the Accompanying Drawings

[0029] Figs. 1A and 1B, taken together, show a teleconferencing system according to one embodiment of this invention;

[0030] Fig. 2 is a partly broken away top view of a first station of the teleconferencing system shown in Fig. 1A;

[0031] Figs. 3A and 3B, taken together, show another embodiment of the present invention wherein the stations have different predetermined sensory settings;

[0032] Figs. 4A and 4B, taken together, show still another embodiment of the invention having stations which have predetermined sensory settings which are designed, decorated and defined to be complementary and/or substantially identical;

[0033] Figs. 5A and 5B, taken together, provide a visual illustration of the images corresponding to some of the signals generated by the teleconferencing system; and

[0034] Figs. 6A-6D, taken together, show a schematic diagram of a method according to an embodiment of this invention.

Detailed Description of Preferred Embodiment

[0035] Referring now to Figs. 1A and 1B, a teleconferencing system 10 is shown having a first station or suite 12 and a second station or suite 14. The first station 12 comprises a first conference or sensory area 16, and the second station 14 comprises a second conference or sensory area 18-1, respectively. The first and second stations 12 and 14 also comprise a first video area 20 and a second video area 22-1, respectively, associated with the first and second conference areas 16 and 18-1. The first video area 20 is generally integral with a wall 32h in the first station 12. Likewise, the second video area 22-1 is generally integral with a wall 32h-1 in the second station 14. In the embodiment being described, the first and second stations are geographically remote from each other, but they could be situated on the same premises if desired.

[0036] For ease of illustration, the construction and modular assembly of the stations in teleconferencing system 10 will be described in relation to the first station 12. As shown in the sectional top view of Fig. 2, the first station 12 is shown assembled or constructed into a generally elongated octagonal shape. The first station 12 comprises a plurality of modular members 32a-32h which include walls 32a, 32c-e, 32g-h, doors in wall members 32b and 32f and entry facade 32f-1. The first station 12 also comprises a ceiling 34 (Fig. 1A) which is mounted on the members 32a-32h with suitable fasteners, such as nuts, bolts, adhesives, brackets, or any other suitable fastening means. Notice that the ceiling 34 has a dropped or sunken portion 34a which supports appropriate lighting fixtures 56.

[0037] In the embodiment being described, each of the members 32a-32h and the ceiling 34 is molded or formed to provide or define an environment having a unique architectural setting and/or sensory setting. For example, as illustrated in Fig. 1A, the wall member 32a may be formed to provide a plurality of stones 36, a plurality of columns 38, and an arch 40 to facilitate defining a first predetermined setting 12a having a Roman/Italian motif, theme or aura. One or more of the members 32a-32h may be provided with inlays, wall decorations (like picture 58 in Figs. 1A and 2), or even a permanent frosted glass window and frame arrangement 42 mounted therein. Furthermore, members 32b and 32f (Fig. 2) may be provided with sliding doors 44 which facilitate entering and exiting the first station 12 and which are designed to complement or further enhance the Roman/Italian motif.

[0038] In the embodiment being described, notice that member 32h (Figs. 1A and 2) is formed to provide a stone and pillar appearance and texture complementary to the stone and pillar appearance and texture of the wall members, such as member 32a. Also, the member 32a may be shaped to frame or mask a rear projection screen 46, as shown. The function and operation of the rear projection screen 46 will be described later herein. In the embodiment being described, the rear projection screen 46 comprises a high resolution lenticular rear projection screen which is either integral with or mounted directly to member 32h to provide a first video area 20 having a usable projection area of about 52 inches by 92 inches (1,32m×2,34m) with an associated aspect ratio of 16:9.

[0039] Each of the members 32a-32h and ceiling 34 are created in separate modular units using a plurality of molds (not shown). In the embodiment being described, a suitable material for molding the members 32a-32h and ceiling 34 to provide a granite-like appearance may be Gypsum, but they could be formed from other suitable material such as stone or clay-based materials, ceramic, paper, cardboard, foam, wood, Styrofoam and the like. As illustrated in 1A and 2, the member 32d may be provided with a shelf or mantle 33. The various members 32a-32h are assembled together as shown in Fig. 2 and secured together with suitable support braces 48 which may be secured to the walls 32a-32h with any suitable fastener such as screws, bolts, an adhesive or the like. After the first station 12 is assembled and the ceiling 34 is secured thereto, it has a length of about 14 feet, 6 inches (4,42m) (indicated by double arrow L in Fig. 2) and a width of about 12 feet, 0 inches (3,66m) (indicated by double arrow W in Fig. 2). The first station 12 has an approximate height from floor to ceiling 34 of about 8 feet, 6 inches (2,59m). Further, the members 32a, 32c, 32e and 32g have a width (indicated by double arrow Y in Fig. 2) of about 5 feet, 0 inch (1,52m). Finally, the back wall member 32d and front wall member 32h comprises a width of about 7 feet, 8 inches (2,33m) (indicated by double arrow X in Fig. 2).

[0040] After the members 32a-32h and ceiling 34 are assembled, the first station 12 may be further decorated,

designed or ornamented with a plurality of subjects, decorations or ornaments which facilitate providing the first predetermined sensory setting 12a which defines a first aura, motif or theme. Likewise, the second station 14 maybe further provided or ornamented with a plurality of subjects, decorations or ornaments which facilitate providing a second predetermined sensory setting 14a which defines a second aura, motif or theme. For example, as illustrated in Fig. 1A, the predetermined sensory setting 12a of the first station 12 may be further decorated with a table 50, table decorations, pillar and wall decorations, carpet (not shown), plants 54 and other wall decorations (not shown) to further enhance the Roman/Italian motif, theme or aura. The first and second predetermined sensory settings 12a and 14a may also comprise appropriate lighting fixtures 56 and appropriate furnishings, such as chairs 60 and tables 61, which complement the predetermined setting to further facilitate defining the Roman/Italian theme or motif for the stations 12 and 14.

[0041] It should be appreciated that once the first and second stations 12 and 14 are assembled and ornamented or decorated to provide their respective first and second predetermined sensory settings 12a and 14a, they define an aura, theme or motif which facilitates providing or creating a very sensual and impressionable environment. Providing such a station, such as station 12, with a strong sensory environment facilitates enhancing the virtual presence illusion created by teleconferencing system 10 of the present invention.

[0042] It should also be appreciated, however, that although the first station 12 and second station 14 are shown in the embodiment in Figs. 1A and 1B as having complementary or similar first and second predetermined sensory settings 12a and 14a, they could be provided with first and second predetermined sensory settings 12a and 14a having different themes, motifs or auras. Thus, while the embodiment described in relation to Figs. 1A and 1B illustrate a first and second set of stations 12 and 14 having a Roman/Italian motif, another set of stations, such as station 12' and station 14' in the embodiment illustrated in Figs. 3A and 3B, may have at least one station having a different predetermined setting. For example, the second station 14' in Fig. 3B provides a setting 14a' which defines a Chinese aura, theme or motif.

[0043] It should also be appreciated that the members 32a-32h, ceiling 34 and associated predetermined sensory setting are provided to be transportable and capable of being assembled at any suitable location, such as an existing rectangular room, suite or conference area having dimensions of at least 20 feet x 20 feet x 9 feet. (6,10m×6,10m×2,74m). While it may be desirable to provide the first and second stations 12 and 14 in the teleconferencing system 10 with substantially the same dimensions, it should be appreciated that they could be provided with differing dimensions, depending on, for example, the number of participants at each station. It should also be appreciated that the second station 14 and other stations described herein would preferably be manufactured and assembled in the same or similar manner as the first station 12. Also, the stations in the teleconference system 10 may be decorated with wall, ceiling and floor coverings to provide, for example, the first predetermined sensory setting 12a without using the preformed or molded modular members 32a-32h described above, although the use of such members may be preferable in this embodiment.

[0044] The teleconferencing system 10 also comprises conferencing means or a conferencing system means for teleconnecting the first and second stations 12 and 14 together to facilitate capturing an image or images at one of said stations and displaying at least a portion of the image or a sub-image at another of the stations such that it becomes generally visually integrated with the predetermined sensory setting at that station, thereby facilitating creating a "video mirror" and a "face-to-face" environment for the participant situated at that station. As shown in Fig. 1a, the conferencing system associated with the first station 12 comprises image sensor means, imager or image sensors for sensing images at the first station 12. For the embodiment shown in Figs. 1A and 2, the image sensor means comprises a plurality of cameras which are operably associated with the rear projection screen 46 of first station 12. In this regard, the plurality of cameras comprise a first camera head 62 and second camera head 64 which are operatively coupled to a first camera control unit 66 and second camera control unit 68, respectively. Notice that the first and second camera control units 66 and 68 are remotely situated from the first and second camera heads 62 and 64. This facilitates permitting the first and second cameras 62 and 64 to be placed directly in the projection path of the rear projection screen 46, without substantially interfering with the video image being projected.

[0045] In the embodiment being described, the first camera head 62 and second camera head 64 are situated approximately 16 inches (40,6cm) above he surface of table 50 which generally corresponds to the eye level of the seated participants situated at table 50. As illustrated in Fig. 2, the first and second cameras 62 and 64 are situated behind the rear projection screen 46 in operative relationship with a pair of 1-1/4 inch (31,8mm) diameter openings 66 and 68, respectively. The first and second cameras 62 and 64 are mounted on a suitable narrow or non-interfering bracket (not shown) such that they can be positioned behind the rear projection screen 46 in operative relationship with openings 66 and 68, respectively. In the embodiment being described, the first and second cameras 62 and 64 are 1-1/4 inch by 1-1/4 inch (31,8×31,8mm) 3-CCD camera heads which generate images having an aspect ratio of about 3:4 and a picture resolution of about 494 x 700 pixels. One suitable 3-CCD camera heads 62 and 64 and associated camera control units 66 and 68 may be Model No.

GP-US502 manufactured by Panasonic Broadcast and Television Systems Company of Japan. It should be appreciated that while the teleconferencing system 10 shown and described in relation to Figs. 1A and 1B show image sensor means comprising a plurality of camera heads 62 and 64 and camera control units 66 and 68 situated at a station, a single camera may be used (as shown and described relative to the embodiment shown in Figs, 4A and 4B) or even multiple cameras could be used depending on such things as the size of the station, the number of participants situated at the station, and/or the aspect ratio of each camera head selected. It should also be appreciated that the camera heads 62 and 64 and associated camera control units 66 and 68 are configured and positioned at the first station 12 to facilitate providing maximum vertical eye contact among participates in the teleconference, while minimally interrupting the substantially life-size video projection on the rear projection screen 46.

[0046] The conferencing means also comprises a first differentiator or differential key generator 70 (Fig. 1A) and a second differentiator or differential key generator 72, respectively. The camera control unit 66 generates an RGB analog signal I-62 which is received by the first differentiator 70, and the camera control unit 68 generates an RGB signal I-64 which is received by the second differentiator 72. The first and second differentiators 70 and 72 provide means for processing the image signals generated by the camera control units 66 and 68 to remove or differentiate any undesired portion of the images corresponding to the signals I-62 and I-64. For example, as described in detail later herein, it is desired in this embodiment to separate the image of the participants situated at the first station 12 from at least a portion of the first predetermined sensory setting 12a, such as the background behind the participants, in order to provide a differential signal VS-1 that has that portion of the first predetermined sensory setting 12A removed. This, in turn, facilitates transmitting the video image of the participants at the first station 12 to the remote second station 14 and also facilitates compositing the image with other images, as described below.

[0047] Suitable differentiators 70 and 72 may comprise the differential key generator shown and described in U.S. Patent No. 4,800,432, issued on January 24, 1989 to Barnett et al. and assigned to The Grass Valley Group, Inc., which is incorporated herein by reference and made a part hereof.

[0048] The differential key generators 70 and 72 convert the I-62 and I-64 signals from RGB analog signals to digital image signals having corresponding images 104 and 106 (Fig. 5A), respectively. The differential key generators 70 and 72 compare the digital image signals to an associated differential reference signals DRS-62 and DRS-64, respectively, which generally corresponds to images 108 and 110 in Fig. 5A. As described in detail later herein, these images 108 and 110 comprise at least a portion of the first predetermined sensory setting 12a such as the background. The differential reference signals DRS-62 and DRS-64 are stored in appropriate storage 74 and 76 (Fig. 1A) associated with the differential key generators 70, 72, respectively. In the embodiment being described, the differential reference signals DRS-62 and DRS-64 comprise a reference frame of a video image grabbed by one or both cameras 62 or 64 situated at the first station 12 from a video sequence of the first predetermined sensory setting 12a of the first station 12 background where no participants, chairs, or other foreground elements are in place.

[0049] In response to the comparison, the first and second differentiators 70 and 72 generate differentiated video signals VS-1 and VS-2 (Fig. 1A), respectively. As illustrated in Fig. 5, the VS-1 and VS-2 signals generally correspond to the individuals situated at the first station 12 when viewed in the direction of arrow A in Fig. 2. As illustrated in the images 112 and 114 (Fig. 5) associated with the VS-1 and VS-2 signals, respectively, notice that the background area shown in images 104 and 106 has been removed and is tagged as a "zero" image area.

[0050] Advantageously, tagging at least a portion of the image represented by the VS-1 signal as "zero" background facilitates compressing the VS-1 and VS-2 signals and providing corresponding compressed CDS-1 and CDS-2 signals, thereby reducing the amount of transmission band width needed. This tagging also facilitates compositing or overlaying another predetermined image to provide a seamless composited image as described in detail below.

[0051] The video signals VS-1 and VS-2 are received by a first compression/decompression means or CODEC 78 and a second compression/decompression means or CODEC 80, respectively. The CODECs 78 and 80 also receive an audio signal AS-A1 and AS-A2 from suitable microphones 82 and 83, respectively, which may be positioned or concealed at an appropriate location in the first station 12, such as underneath or on top of table 50, as illustrated in Fig. 1A. The function of the first and second CODEC 78 and 80 is to compress video and audio signals for transmitting to remote stations, such as the second station 14, and also to decompress compressed video and audio signals received from remote stations. Consequently, the CODECs 78 and 80 are configured with suitable compression and decompression algorithms which are known to those of ordinary skill in the art. The CODEC Model No. Rembrandt II VP available from Compression Labs, Inc. of San Jose, California is suitable for use in the embodiment described herein, but it should be noted that other suitable compression/decompression means may be employed.

[0052] The CODEC 78 receives the video signal VS-1 and audio signal AS-A1, and CODEC 80 receives the video signal VS-2 and audio signal AS-A2. The CODECs 78 and 80, generate digital signals CDS-1 and CDS-2, respectively, in response thereto which are in turn transmitted to remote station 14 via a transmission

network 84.

[0053] The transmission network 84 may be configured as a private network, public circuit switch service, and it may utilize telecommunication and/or satellite technology. In the embodiment being described, the transmission network 84 preferably includes a plurality of T-1 lines (not shown) which are capable of accommodating bit streams having a suitable band width, such as 1.544 megabytes per second.

[0054] The teleconferencing system 10 and conference means associated with the first station 12 also comprises enhancing means for enhancing the resolution of an image or sub-image received from a remote station, such as the second station 14. In the embodiment being described, enhancing means comprises a first line doubler 86 and a second line doubler 88 which are operatively coupled to the first CODEC 78 and second CODEC 80, respectively. In this embodiment, the first and second line doublers 86 and 88 enhance the resolution and picture quality of at least a portion of the image corresponding to video signals VS-3 and VS-4 received from the CODECs 78 and 80, respectively, by about 50-150%. The VS-3 and VS-4 signals correspond to images or sub-images received from remote station (s), such as station 14, as described in detail below. One suitable line doubler is the Model No. LD 100 available from Faroudja Laboratories, Inc. of Sunnyvale, California, but other suitable enhancing means may be provided to provide greater or less enhancement of the images to be displayed. For example, lenses, mirrors, optical pixel interpolation or other electrical means may be employed as desired. It should also be noted that the present invention may be performed without the use of any enhancing means without departing from the scope of the invention.

[0055] The first and second line doublers 86 and 88 generate enhanced video signals which are input into compositing means, compositor or video compositing multiplexer 92 for compositing the enhanced video signals associated with the images or sub-images received from the remote station(s) with one or more predetermined composite signals, such as predetermined composite signal A, corresponding to a predetermined composite image or sub-image which are stored in a suitable storage device 94 associated with the compositor 92. In the embodiment being described, the predetermined composite signal A corresponds to an image of at least a portion of first predetermined sensory setting 12a, such as the background of the first station 12. The video compositing multiplexer 92 composites the signals received from the first and second line doublers 86 and 88 with the predetermined composite signal A and generates a RGB analog composite signal in response thereto. It has been found that Model No. E-Space-1 available from Miranda Technologies, Inc. of Montreal and Quebec, Canada, is one suitable video compositing multiplexer 92.

[0056] The teleconferencing system 10 comprises a projector 96 coupled to the video compositing multiplexer 92 which receives the RGB composite signal and projects a corresponding image 90 (Fig. 1A) corresponding to the composite signal on the rear projection screen 46. The Model No. 3300 available from AMPRO Corporation of Titusville, Florida has been found to be a suitable projector 96. Although the embodiment has been described using projector 96 and rear projection screen 46, other suitable means may be employed for projecting or displaying the composited image. For example, a liquid crystal display (LCD) or other electronic screen may be suitable to display images at a station. This may eliminate the need for the projector 96.

[0057] The projector 96 could be used with an optical system or a plurality of mirrors (not shown), or prisms (not shown) such that the projector can be positioned, for example, to the side or below the rear projection screen 46 or in a manner that permits the projector 96 to project the image towards a mirror (not shown), which causes the image to be projected on the rear projection screen 46.

[0058] As described in detail below, the composite signal and its corresponding image 90 generally comprise a video image of at least a portion of the first predetermined sensory setting 12a combined or composited with a differentiated image, such as an image of the participants from the second station 14 which correspond to the VS-3 and VS-4 (Fig. 1B) signals. Consequently, the resultant image 90 projected on screen 46 at the first station 12 complements or blends with the architectural motif, aura, theme or design defined by the first predetermined sensory setting 12a at the first station 12, such that the projected image 90 appears visually integrated with the first predetermined sensory setting 12a of the first station 12. This, in turn, causes any image of the participants situated at the second station 14 and included in the image 90 to appear to be face-to-face with participants at the first station 12 during the teleconference. The operation of the compositor 92 is described in more detail later herein.

[0059] It should be appreciated that the sub-images or images received from the remote station(s) typically have a resolution on the order of about 352 x 288 pixels and the predetermined composite signal A comprises a resolution on the order of about 1280 x 1024 pixels. Thus, the resultant composite image 90 may comprise, for example, an image of the participants situated at the second station 14 having a first resolution and a background image of the first station 12 having a second resolution, which is higher than the first resolution. This enables compositor 92 to provide a composite image 90 which, when displayed on screen 46, gives the illusion or effect of a "video mirror" to the participants situated at the first station 12.

[0060] The teleconferencing system 10 also includes audio means comprising a plurality of speakers 100 and 102 (Figs. 1A and 2) which, in turn, receive audio signals AS-B1 and AS-B2 from CODECs 78 and 80, respective-

ly. It should be appreciated that the audio signal AS-B1 and AS-B2 generally correspond to the audio associated with the sound (e.g., voices, music and the like) associated with the remote station(s), such as second station 14.

[0061] It should also be appreciated that the rear projection screen 46 and projector 96 are configured and selected to enable the teleconferencing system 10 to project the composited image 90 (Fig.1A) at a predetermined scale, such as substantially full scale. In this regard, the compositor 92 comprises a scaler 95 which is integral therewith for scaling the composited signal associated with the composited image 90 to a desired or predetermined scale, such as substantially full scale.

[0062] Referring now to Fig. 1B, the second station 14 comprises similar components as the first station and such like components are labelled with the same reference numeral as their corresponding component in the first station 12, except that the components associated with the second station 14 have a "-1" designator added thereto. Such components operate and function in substantially the same manner as described above with regard to the first station 12 with the following being some differences. The differential reference signals DRS-3 and DRS-4 (Fig. 5) associated with the second station 14 generally correspond to an image or sub-image of at least a portion of the second predetermined sensory setting 14a, such as the background 98-1, of the second station 14. Such sub-image or image may include at least a portion of the background 98-1 without any participants, chairs or other foreground subjects situated in the second station 14. Also, like the predetermined composite signal A stored in the storage 94 associated with the first station 10, a predetermined composite signal B may be stored in the storage 94-1 associated with the compositor 92-1 second station 14. The predetermined composite signal B may correspond to an image or sub-image of at least a portion of the second predetermined sensory setting 14a of the second station 14. Such sub-image or image may include, for example, an image of the walls 32a-1 to 32h-1 and conference area 18 or background of the second station 14. Notice that in the embodiment shown in Figs. 1A and 1B, the second station 14 has a second predetermined sensory setting 14a which mirrors or is complementary to the first predetermined sensory setting 12a. As described above, however, the first and second predetermined sensory settings 12a and 14a may be different.

[0063] A method of operating the teleconferencing system 10 will now be described in relation to Figs. 6A-6D. The modular components, such as members 32a to 32h and ceiling 34 for first station 10, decorations and the like, are configured, assembled and decorated (block 99 in Fig. 6A) at a desired location to provide a conference station comprising a predetermined sensory setting defining a predetermined theme, motif or aura. As mentioned earlier herein, the theme, motif or aura may be complementary (as shown in Figs. 1A and 1B) or they can be completely different, as shown in Figs. 3A and 3B (described below). For ease of illustration, it will be assumed that the stations are assembled and decorated as shown and described relative to the embodiment in Figs. 1A and 1B.

[0064] Once the modular stations 12 and 14 are assembled and decorated, it may be desired (decision point 101 in Fig. 6A) to use differentiator (e.g., differentiator 72 in Fig. 1A). As discussed herein relative to the embodiments shown in Figs. 4A and 4B, it may not always be desired to generate a differential reference image, thereby making it unnecessary to generate the differential reference signal. If differentiation is desired, then the camera heads 62 or 64 generate at least one video image (block 103) of at least a portion of the first predetermined sensory setting 12A at the first station 12. The differentiators 72 and 74 grab or capture at least one differential reference image or sub-image from those images and generate (block 107) the differential reference signals DRS-62 and DRS-64, respectively. These signals are stored in suitable storage 74 and 76 for use by the differentiators 70 and 72, respectively. Likewise, cameras 62-1 and 64-1 at the second station 14 generate video images of at least a portion of the second predetermined setting 14a at the second station 14. The differentiators 70-1 and 72-1 grab or capture at least one differential reference image or sub-image from those images and generate differential reference signals (not shown) corresponding thereto. These signals are then stored (block 109) in suitable storage 74-1 and 76-1 for use by differential key generators 70-1 and 72-1, respectively.

[0065] As mentioned above, it is preferred that the differential reference signals DRS-62 and DRS-64 comprise an image of at least a portion of the first predetermined sensory setting 12a, such as an image of the first station 12 without any participants, chairs or other subjects which are not stationary during the teleconference. Likewise, it is preferred that the differential reference signals associated with the differentiators 70-1 and 72-1 comprise at least a portion of the second predetermined sensory setting 14a at the second station 14, such as an image of the background 98-1 without the participants, chairs and other subjects which are not stationary during the teleconference.

[0066] If differentiation of signals is not selected or at the end of the differentiation process, it may be desired to generate a composite image (decision point 97) for one or more of the stations. As discussed below, however, this may not always be required to achieve certain advantages of the invention. Such predetermined composite image would preferably include a substantial portion of the first predetermined sensory setting 12a, including the background and/or conference area 16 of the first station 12. If compositing is desired, then the predetermined composite signal A is generated (block 111 in Fig. 6B). The corresponding predetermined composite signal A may then be stored in suitable storage

94. In the same manner, the predetermined composite image at the second station 14 and corresponding predetermined composite signal B may be generated and stored as predetermined composite signal B in suitable storage 94-1. In the embodiment being described, the predetermined composite image associated with the second station 14 includes an image of at least a portion of the second predetermined sensory setting 14a, including the background 98-1.

[0067] In the embodiment being described, the predetermined composite signals A and B are generated by a suitable still camera (not shown) to provide a still image (not shown) of the station 12 or 14 being photographed. The still image would subsequently be scanned and digitized for storage by a suitable scanner (not shown). The still camera and scanner would preferably be capable of generating images having a resolution on the order of about 1280 x 1024 pixels. Thus, if compositing is performed, the resultant composite image (such as image 90 in Fig. 1A) may comprise an image having a high resolution background, for example, combined with a comparatively lower resolution image of the remote station participants. This, in turn, facilitates enhancing the "video mirror" effect wherein a mimic or replication of a common architectural technique of mirroring a wall of a given room which makes the overall room appear to be extended beyond its actual wall line.

[0068] Once the stations 12 and 14 are configured and the differential reference signals and predetermined composite signals A and B are generated and stored, the first and second suites 12 and 14 may then be teleconnected (block 113) or connected by satellite or other suitable means via the transmission network 84.

[0069] Next, one or more participants may be situated at the first and second stations 12 and 14. As illustrated in Fig. 2, notice that the participants seated at the first station 12 are situated a predetermined distance B from a participant's side 46a of the rear projection screen 46. The predetermined distance B generally corresponds to a preferred or optimum focal distance at which optimum imaging by cameras 62 and 64 may be performed. In the embodiment being described, it has been found that the predetermined distance should be about 5 feet, 6 inches (1,67m). The participants are situated at the second station 14 in a similar manner and the face-to-face teleconference may then begin.

[0070] For ease of illustration, the imaging and display of first station 12 participants at the second station 14 will be described. The first and second cameras 62 and 64 capture (block 117 in Fig. 6B) live images of the participants situated at the first station 12 and generate corresponding RGB analog signals I-62 and I-64 which are received by the differential key generators 70 and 72, respectively. If differentiation was selected (decision point 147 in Fig. 6C), processing continues at block 119 otherwise it proceeds at block 123. The differential key generators 70 and 72 generate (block 121 in Fig. 6C) the digital differential signal VS-1 and VS-2, respectively, after comparing (block 119 in Fig. 6C) the I-62 and I-64 signals received from cameras 62 and 64 to their respective differential reference signals DRS 62 and DRS-64 which are received from storages 74 and 76.

[0071] The differential signals VS-1 and VS-2 are then received by CODECs 78 and 80 which also receive the audio signals AS-A1 and AS-A2 which correspond to the audio, including sounds, music and voices, associated with the first station 12. The CODECs 78 and 80 digitize the audio signals AS-A1 and AS-A2, combine the audio signals with their respective video signal VS-1 or VS-2, and generate (block 123) the compressed CDS-1 and CDS-2 signals in response thereto. The CDS-1 and CDS-2 signals are then transmitted (block 125) to the second station 14 via the transmission network 84 (Fig. 1B).

[0072] The CDS-1 and CDS-2 signals are received and decompressed (block 127 in Fig. 6C) by CODECs 78-1 and 80-1, respectively, associated with the second station 14 to provide decompressed VS-1 and VS-2 signals. The CODECs 78-1 and 80-1 also decompress the audio signals AS-A1 and AS-A2 received from the first station 10 which are transmitted to speakers 100-1 and 102-1, respectively, at the second station 14.

[0073] Substantially simultaneously with the broadcasting of the audio signals at the second station 14, CODECs 78-1 and 80-1 decompress the CDS-1 and CDS-2 signals to provide VS-1 and VS-2 signals. The decompressed video signals VS-1 and VS-2 are then received by line doublers 86-1 and 88-1. If it is desired to enhance the signals (decision point 129), then the line doublers 86-1 and 88-1 process or manipulate the signals (block 131) in order to enhance the resolution of the image corresponding to those signals. After the signals VS-1 and VS-2 are processed, it may be desired to composite (decision point 133 in Fig. 6D) those signals with one or more other signals. In this illustration, for example, the video compositor 92-1 composites images (block 135) corresponding to those signals with at least one predetermined composite image, such as image 122 (Fig. 5B) corresponding to the predetermined composite signal B provided from storage 94-1 (Fig. 1B) to provide a composite signal. As mentioned above, the composite signal generally corresponds to the composited image 91-1 to be displayed on the rear projection screen 46-1 at the second station 14.

[0074] The compositor 92-1 may (decision point 137, block 139 in Fig. 6D) scale the composited image to a desired scale, such as full scale, using scaler 95-1. Thereafter, the compositor 95-1 transmits a corresponding RGB analog signal to projector 96-1 which displays (block 141) the scaled, composited image on the rear projection screen 46-1 (Fig. 1B).

[0075] The teleconference may then be continued or terminated as desired (decision point 143, block 145).

[0076] Because the composited image is substantially full scale when projected and includes a high resolution image of at least a portion of the second predeter-

mined sensory setting 14a, the image appears to blend or become visually integrated with the second predetermined sensory setting 14a. This, in turn, gives the participants situated at the second station 14 the perception that the first station participants are present or face-to-face with them in the second station 14.

[0077] In the same or similar manner, images and signals relative to the second station 14 images are captured, processed and displayed at the first station 12. So that images of the participants at the second station 14 are displayed at the first station 12 such that they appear to have a face-to-face presence at the first station 12. Thus, images of the second station 14 participants may be differentiated and composited such that, when they are displayed at the first station 12, the image completes or provides "the other half" of the first station 12 and becomes generally visually integrated therewith. Although not required, it may be desirable to enhance the face-to-face presence by providing, for example, first and second predetermined sensory settings 12a and 14a which define a dining environment wherein food or meals may be served. For example, the face-to-face presence may be further enhanced if the participants at both stations 12 and 14 order food and drinks from identical menus. Also, trained maitre-de and/or waiters may be used to actively promote the perception of a face-to-face dinner using a scripted dialog and interaction with remote participants, maitre-de and/or waiters.

[0078] Once the teleconferencing is terminated, the stations 12 and 14 may be used by the same or different participants without the need to reconstruct or reassemble the stations.

[0079] Figs. 5A and 5B provide a visual illustration of the images corresponding to some of the signals described above utilizing the method and embodiment described above. In this regard, images 104 and 106 generally correspond to the actual images captured by the first and second cameras 62 and 64, respectively. As described above, associated image signals I-62 and I-64 are transmitted to the differential key generators 70 and 72, respectively. The differential key generators 70 and 72 compare the images 104 and 106 to the images 108 and 110 associated with the differential reference signals DRS-62 and DRS-64 which are received from storages 74 and 76, respectively, and which were previously generated by cameras 62 and 64 from an identical fixed camera position.

[0080] As illustrated in Fig. 5A, the differential key generators 70 and 72 generate differential signals VS-1 and VS-2 which have corresponding images 112 and 114. Notice that these images 112 and 114 comprise an image of the participants which are situated at the first station 12 with the background area having been removed or tagged as a "zero" area. As described herein, this "zero" area becomes "filled-in" with the desired or predetermined composite image which may include, for example, an image of at least a portion of the predetermined setting or background of the second station 14. It has been found that removing a portion of the image, such as the background, by tagging it as zero, in the manner described herein, facilitates compressing the signals VS-1 and VS-2 and reducing the amount of bandwidth needed to transmit the images over transmission network 84 and between the first and second stations 12 and 14.

[0081] As mentioned above, the video signals VS-1 and VS-2 are fed into CODECs 78 and 80 which compresses the signals along with audio signal AS-A1 and AS-A2 and generates signals CDS-1 and CDS-2. The CDS-1 and CDS-2 signals are then transmitted, via transmission network 84, to the second station 14 and received by the CODECs 78-1 and 80-1 associated with the second station 14. As-illustrated in Fig. 5B, the CODEC 78-1 and 80-1 decompresses the CDS-1 and CDS-2 signals, respectively, from the first station 12 and feeds them into associated line doublers 86-1 and 88-1. As mentioned earlier herein, the line doublers 86-1 and 88-1 facilitate enhancing the images associated with the video signals to provide enhanced video signals EVS-1 and EVS-2 (Fig. 5B), respectively.

[0082] As stated earlier, the enhanced video signals EVS-1 and EVS-2 are then received by the video compositing multiplexer 92-1 associated with the second station 14 wherein the signals are combined to provide an intermediate composite signal ICS having an associated intermediate composite signal image 120 having an aspect ratio of about 8:3.

[0083] The video compositing multiplexer 92-1 also receives the predetermined composite signal B having a predetermined composite signal B image 122 from storage 94-1. The video compositing multiplexer 92-1 composites or combines the images 120 and 122 to generate the composite signal having an associated or corresponding composite image 124 as shown in Fig. 5B. As stated earlier, the predetermined composite signal B image 122 generally corresponds to at least a portion of the predetermined setting or background of the second station 14 and has an aspect ratio of 16:9.

[0084] Notice that when the predetermined composite signal B image 122 is combined with the intermediate composite signal image 120, the video compositing multiplexer 92-1 causes the "zero" area of the intermediate composite signal image 120 to be "filled in" with the predetermined composite signal B image.

[0085] The composite image 124 may then be scaled to a predetermined size or scale, such as full scale, using scaler 94-1, so that the composite image 124 may be scaled to a substantially full scale or real-life size image as desired. The composite image signal corresponding to the composite image 124 is transmitted to the projector 96-1 and then displayed on the rear projection screen 46-1 at the second station 14. As illustrated in Figs. 1B and 5B, the composite image 124 may be appropriately framed or masked (such as with an archway 125 in Figs. 1B and 5B) when it is projected at the second station 14 to enhance the face-to-face, real time

environment.

[0086] The audio and video signals transmitted between the first and second stations 12 and 14 may be, in this illustration, transmitted over separate T-1 lines (not shown) in the transmission network 84 in order to effect a substantially simultaneous and/or "real time" video conference. Thus, in the illustration shown in Figs. 1A and 1B, the participants may be geographically remotely located, yet the participants situated at the first station 12 will feel as if the second station 14 participants are located face-to-face or present with them at the first station 12, while the participants situated at the second station 14 will feel as if the first station participants are face-to-face or present with them at the second station.

[0087] It should be appreciated that when the predetermined composite signal B and associated predetermined composite signal image 122 is composited with the intermediate composite signal and associated intermediate composite signal image 120, it overlays that signal to provide a seamless composite image 124, which facilitates reducing or eliminating the need to match up the borders or seams of the camera images with any high degree of accuracy. In this regard, it is preferable that cameras 62 and 64 and 62-1 and 64-1 preferably be situated such that they capture an entire participant rather than, for example, half of a participant. Thus, it may be desired to position the participants in a location such that any particular participants will not be in the field of view of more than one camera.

[0088] Advantageously, the invention provides an apparatus and method for providing a video mirror at each station 12 and 14 which facilitates creating a face-to-face and non-interrupted image of any participants in the video conference. Because the image of the participants is differentiated, less transmission bandwidth, computer memory and the like is required. Also, the differentiators and compositors of the present invention enable a user to create a composite image 124 (Fig. 5B) having at least a portion thereof imaged at a greater resolution than the portion which was transmitted over transmission network 84. This facilitates reducing the effect of limitations or transmission restrictions of the transmission network 84 which, in turn, facilitates increasing the quality of images displayed at a station.

[0089] In addition, notice that the composite image 124 (Fig. 5B) may have an aspect ratio which is different from the aspect ratio of the cameras 62 and 64. This enables the system and method of the present invention to utilize cameras which generate images having smaller or even larger aspect ratios. This also enables the system and method to use cameras having standard or common aspect ratios, such as 4:3.

[0090] Figs. 3A and 3B, when taken together, illustrate another embodiment of the invention. The operation and components of the embodiment shown in Figs. 3A and 3B are substantially the same as the operation of components of the embodiment described above relative to Figs. 1A and 1B with the same reference numerals being used for the same components with the addition of single prime (') designator. Consequently this embodiment is similar to the embodiment shown in Figs. 1A and 1B, except that the second predetermined setting 14a' in Fig. 3B and its associated theme, aura or motif is substantially different from the second predetermined setting 14a shown in Fig. 1B. In Fig. 3B, the first predetermined sensory setting 12a' comprises a plurality of decorations 120 defining the Chinese theme, motif or aura. Also, the predetermined composite signal A stored in storage 94-1' and the differential reference signals stored in storages 74-1' and 76-1 would generally correspond to an image of least a portion of that setting 14a'.

[0091] As with the illustration described above relative to Figs. 1A and 1B, the video and audio signals would be processed in substantially the same manner. In general, an image of the participants situated at the first station 12' is composited by compositor 92-1' with a predetermined composite image of at least a portion of the second predetermined sensory setting 14a' of the second station 14' and projected onto the rear projection screen 46-1' at the second station 14'. The first station 12' participants appear to be face-to-face with the second station 14' participants because they have a relatively high resolution video image behind them which complements or becomes integrated with the second predetermined sensory setting 14a'. Thus, as shown in Fig. 3B, the image 91-1' (Fig. 3B) of the ladies at the first station 12' includes a Chinese background which blends or complements the actual predetermined sensory setting 14a'.

[0092] Likewise, when the image of the participants situated at the second station 14' is projected on the rear projection screen 46' at the first station 12', they appear to be in the same room as the participants situated at the first station 12' because the Roman/Italian video background which is seen behind the second station 14' participants generally complements and becomes visually integrated with the actual Roman/Italian theme, motif or aura defined by the first predetermined sensory setting 12' of the first station 12'.

[0093] Figs. 4A and 4B, when taken together, illustrate another embodiment of the invention. The components of the embodiment shown in Figs. 4A and 4B which are substantially identical to the components in the embodiment shown in Figs. 1A and 1B which have the same reference numerals with the addition of a double prime (") designators. As illustrated in Figs. 4A and 4B, two remote modular stations such as stations 12" and 14" may be provided and designed to have first and second predetermined sensory settings 12a" and 14a" which are substantially identical. Thus, as shown in Figs. 4A and 4B, images may be captured in the manner described above at station 12" received by CODECs 78" and 80" and then transmitted, via transmission 84", to associated CODECs 78-1" and 80-1", respectively. The CODECs 78-1" and 80-1" then generate a decom-

pressed signal which may be enhanced by line doublers 86-1" and 88-1", respectively; scaled to an appropriate scale by scaler 95-1"; and then projected by projector 96-1" onto rear projection screen 46-1".

[0094] Notice that the image comprising the second station 14" participants and second predetermined sensory setting 14a" is displayed on screen 46" at the first station 12". Thus, this embodiment does not utilize the differentiating and compositing features of the previous embodiment, but may still achieve a face-to-face conference environment because the second predetermined sensory setting 14a" is configured to be identical to or complementary with the first predetermined sensory setting 12a". In this embodiment, entire images or sub-images of the stations 12 and 14 (including images of both participants and background) are displayed at remote station(s). Because the stations 12" and 14" are assembled, decorated and designed to be complementary or identical, they appear visually integrated to participants situated in the stations 12 and 14. Accordingly, the first and second predetermined sensory settings 12a" and 14a", including the background, are designed and arranged in a geometric fashion such that as cameras 62" and 64" capture images of the participants, they also capture images of the first and second predetermined sensory setting 12a" and 14a", respectively, at the most advantageous perspective for display at the remote station(s). As with prior embodiments, this causes the first station 12" participants to perceive that the second station 14" participants are situated or present with the first station 12" participants at the first station 14". Likewise, the first station 12" participants appear to be face-to-face with the second station 14" participants at the second station 14" when the images associated with the first station 12" are displayed on screen 46-1". Consequently, by providing complementary or identical first and second predetermined sensory settings 12a" and 14a", a face-to-face conference may be created. As with previous embodiments, it may also be desired to differentiate, enhance, composite or scale the images as described with previous embodiments, but this is not required with the embodiment being described.

[0095] Thus, it should be apparent that stations can be provided with predetermined settings which are completely different, yet, by utilizing the apparatus and method of the present invention, the images of the participants in these stations may be projected at remote stations so that they appear to be virtually face-to-face with the remote station participants at or one more remote station.

[0096] Various changes or modifications in the invention described may occur to those skilled in the art without departing from the spirit or scope of the invention. For example, the screen 46 for station 12 has been shown as being integral with a portion of a wall 32h (Figs. 1A and 2A), it could comprise a larger or smaller portion of that wall 32h, or it could be provided as part of one or more other walls, or even as part of the ceiling 34.

[0097] It should also be appreciated that while the embodiments have been shown and described comprising two stations, images from more than two remote stations may be displayed at a station, thereby permitting a teleconference convention among more than two stations.

[0098] Although not shown, one or more of the compositors, such as compositors 12 or 12-1 (Fig. 1A) may comprise a stationary or moving image database (not shown) for providing a plurality of predetermined composite signals which define a particular or desired video background. For example, participants may elect to use the arched background of their proximity, choose an event-related scene, or decide to meet in a setting completely unrelated to their site or station. For example, a station having a Manhattan eatery motif may be provided with a screen configured as a window (not shown). Certain moving video backgrounds of a busy New York avenue may be deposited and displayed on the screen to give the illusion that the participants situated at the station are dining in a popular Manhattan eatery.

[0099] It should also be appreciated that while the embodiments being shown and described herein refer to teleconferencing environments that have predetermined settings and motifs or auras relating to dining, the predetermined settings could define any type of aura, theme or motif which is suitable for video conferencing and in which it is desired to provide a "real-life" or face-to-face presence illusion. For example, the apparatus and method of this invention could be used in a business setting, education setting, seminar setting, home environment, religious setting, celebration setting (such as a birthday, retirement party, holiday or anniversary), or any other suitable setting as desired.

[0100] The above description of the invention is intended to be illustrative and not limiting, and is not intended that the invention be restricted thereto but that it be limited only by the spirit and scope of the appended claims.

Claims

1. A teleconferencing system (10)comprising two or more teleconferencing stations (12; 14) remote from each other, each of said stations being equipped with:

audio devices (82, 100; 83, 102) and video devices including a plurality of cameras (62, 64) for the exchange of audio and video transmissions between said teleconferencing stations;

a screen (46) having a first side and a second side said second side being opposite said first side,for displaying a first image (104) of at least one first remote subject and a second image

(106) of at least one second remote subject, said at least one first subject including a remote participant who is not included in said at least one second subject and said first and second images are not entirely overlaid on top of each other when they are displayed on said screen (46);
a first plurality of furnishings (60) on which participants situated at said teleconferencing station (12) may be seated, and which are situated on said second side of said screen;
said first image and said second images are being displayed on said screen (46) to give any of the participants seated on said first plurality of furnishings the feeling of being in the same room and face-to-face with said remote participant;

characterized in that said plurality of cameras (62, 64) of a first station (12) are situated behind said first side of said screen (46) for capturing a plurality of images at said first station, said plurality of cameras capturing images of different participants situated on said second side of said screen (46), and **in that** said first station (12) further comprises at least one wall 32 (a-h), at least one ceiling (34) and/ or a second plurality of furnishings (50) so that, when the first or second images are being displayed on said screen (46) of said first station (12) participants seated at said first station feel as if they are in the same room with said remote participant of participants.

2. The teleconferencing system as recited in claim 1, wherein said second plurality of furnishings (50) in the first station (12) comprises at least one table having one side associated with said screen (46) and configured to cause said participants to be situated a predetermined distance (B) from said screen.

3. The teleconferencing system as recited in claim 1, wherein said screen (46)of the first station (12) comprises at least one aperture (66, 68), said plurality of cameras (62, 64) are capturing said plurality of images through said at least one aperture.

4. The teleconferencing system as recited in claim 1, wherein said first image comprises at least one remote participant which is substantially life-size when shown on said screen (46) of said first station (12).

5. The teleconferencing system as recited in claim 1, wherein said plurality of cameras (62, 64) of said first station (12) are situated directly in a projection path of said screen (46).

15. A method for teleconferencing in a teleconferencing system (10) having two or more teleconferencing stations (12, 14) remote from each other and being equipped with audio devices (82, 100; 83, 102) and video devices including a plurality of cameras (62, 64) for the exchange of audio and video transmissions between said teleconferencing stations, the method comprising, in each of said stations (12, 14), the steps of:

providing a screen (46) having a first side and a second side said second side being opposite said first side, for displaying a first image of a least one first remote subject and a second image of at least one second remote subject; said at least one first remote subject including a participant who is not included in said at least one second remote subject and said images are not entirely overlaid on top of each other when they are displayed on said screen;
providing a first plurality of furnishings (60) on which participants situated at said teleconferencing station (12,14) may be seated and which are to be placed on said second side of said screen (46);
displaying said first image and said second image on said screen (46) to give participants seated on said first plurality of furnishings the feeling of being in the same room and face-to-face with said remote participant; said method being **characterized by** comprising the further steps of:

situating said plurality of cameras (62, 64) of a first station (12) behind said first side of the screen (46) for capturing a plurality of images at said first station (12), said plurality of cameras capturing images of different participants situated on said second side of said screen of said first station (12);
providing at least one wall (32a-h), at least on ceiling (34) and/or a second pluarlity of furnishings (50) in said first station (12), and
displaying on said screen (46)of said first station at least one of said first image (104) or said second image (106) so that participants seated in said first station (12) feel as if they are in the same room with said remote participant or participants.

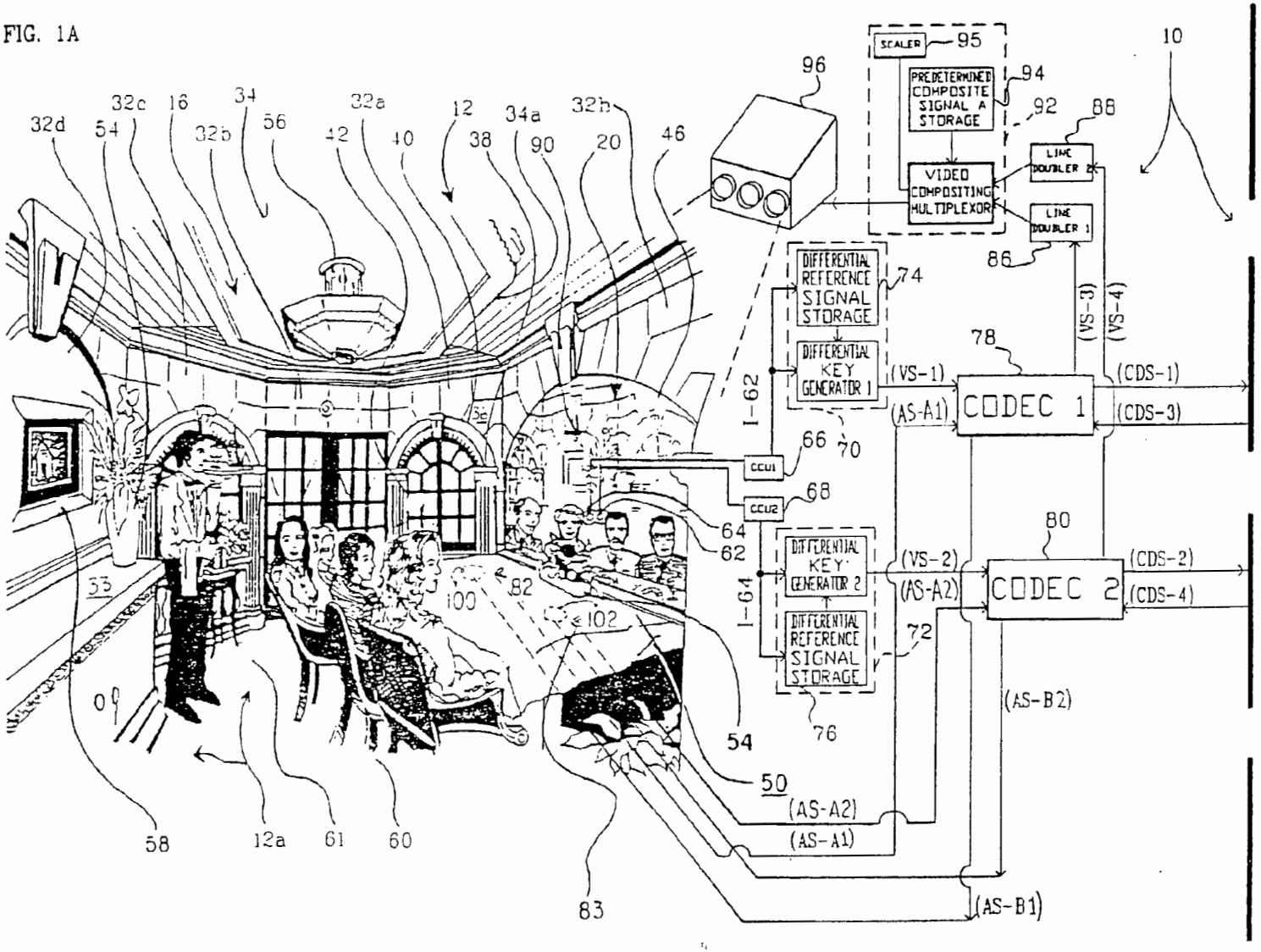
7. The method as recited in claim 6, wherein said step of providing said second plurality of furnishings (50) further comprises the step of providing at least one table having one side associated with said screen (46) and configured to cause said participants to be situated a predetermined distance (B) from said screen.

8. The method as recited in claim 6, wherein said screen (46)of said first station (12) is provided with least one aperture (66, 68) and wherein said plurality of cameras (62, 64) situated behind said screen captures said plurality of images through said at least one aperture.

9. The method as recited in claim 6, wherein either said first image or said second image comprises at least one remote participant in substantially life-size when said first image or said second image, respectively, is shown on said screen (46) of said first station (12).

10. The method as recited in claim 6, wherein said method further comprises the step of situating said plurality of cameras (62, 64) directly in a projection path of said screen (46) of said first station (12).

FIG. 1A



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FIG. 1B

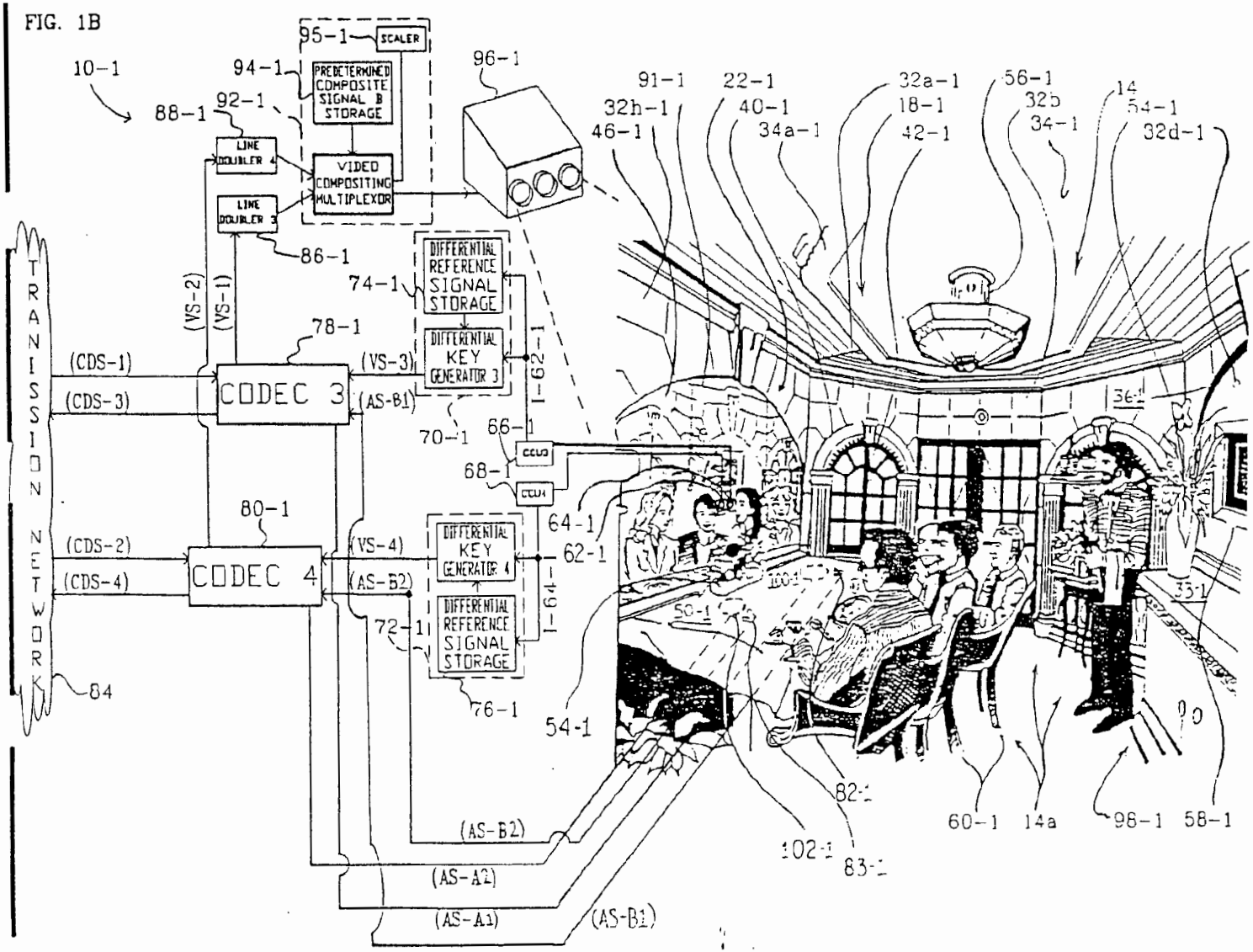

10-1
95-1
SCALER
94-1
PREDETERMINED COMPOSITE SIGNAL B STORAGE
96-1
88-1
92-1
LINE DOUBLER 4
VIDEO COMPOSITING MULTIPLEXOR
LINE DOUBLER 3
86-1
91-1
22-1
32a-1
56-1
32h-1
40-1
18-1
32b
46-1
34a-1
42-1
34-1
54-1
32d-1
DIFFERENTIAL REFERENCE SIGNAL STORAGE
74-1
DIFFERENTIAL KEY GENERATOR 3
78-1
(VS-2)
(VS-1)
(VS-3)
1-62-1
(CDS-1)
(CDS-3)
CODEC 3
(AS-B1)
70-1
66-1
68-1
CCU3
CCU4
64-1
62-1
80-1
(CDS-2)
(CDS-4)
CODEC 4
(VS-4)
(AS-B2)
DIFFERENTIAL KEY GENERATOR 4
DIFFERENTIAL REFERENCE SIGNAL STORAGE
72-1
1-64-1
76-1
TRANSMISSION NETWORK
84
54-1
(AS-B2)
(AS-A2)
(AS-A1)
(AS-B1)
60-1
14a
98-1
58-1

FIG. 2

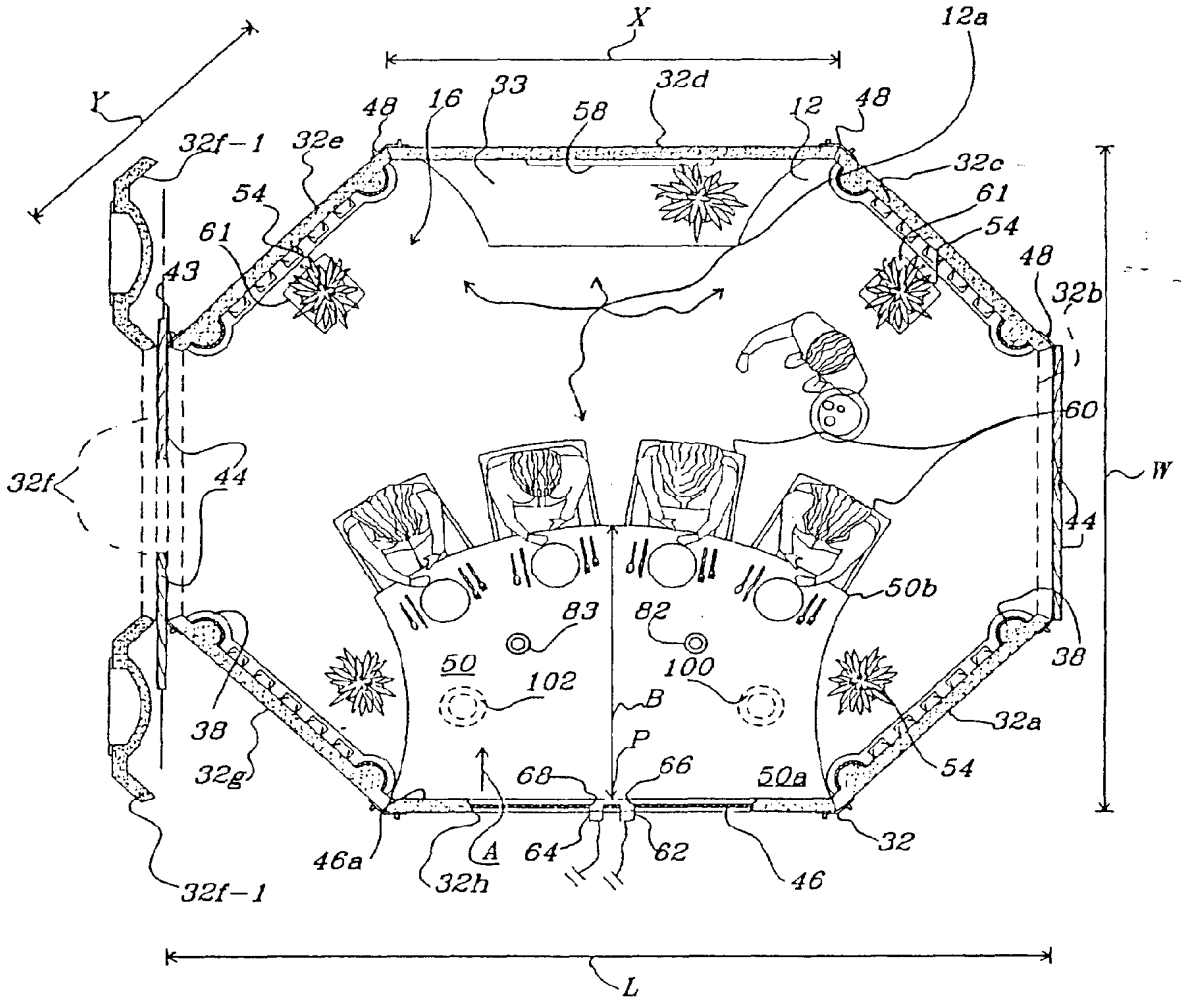
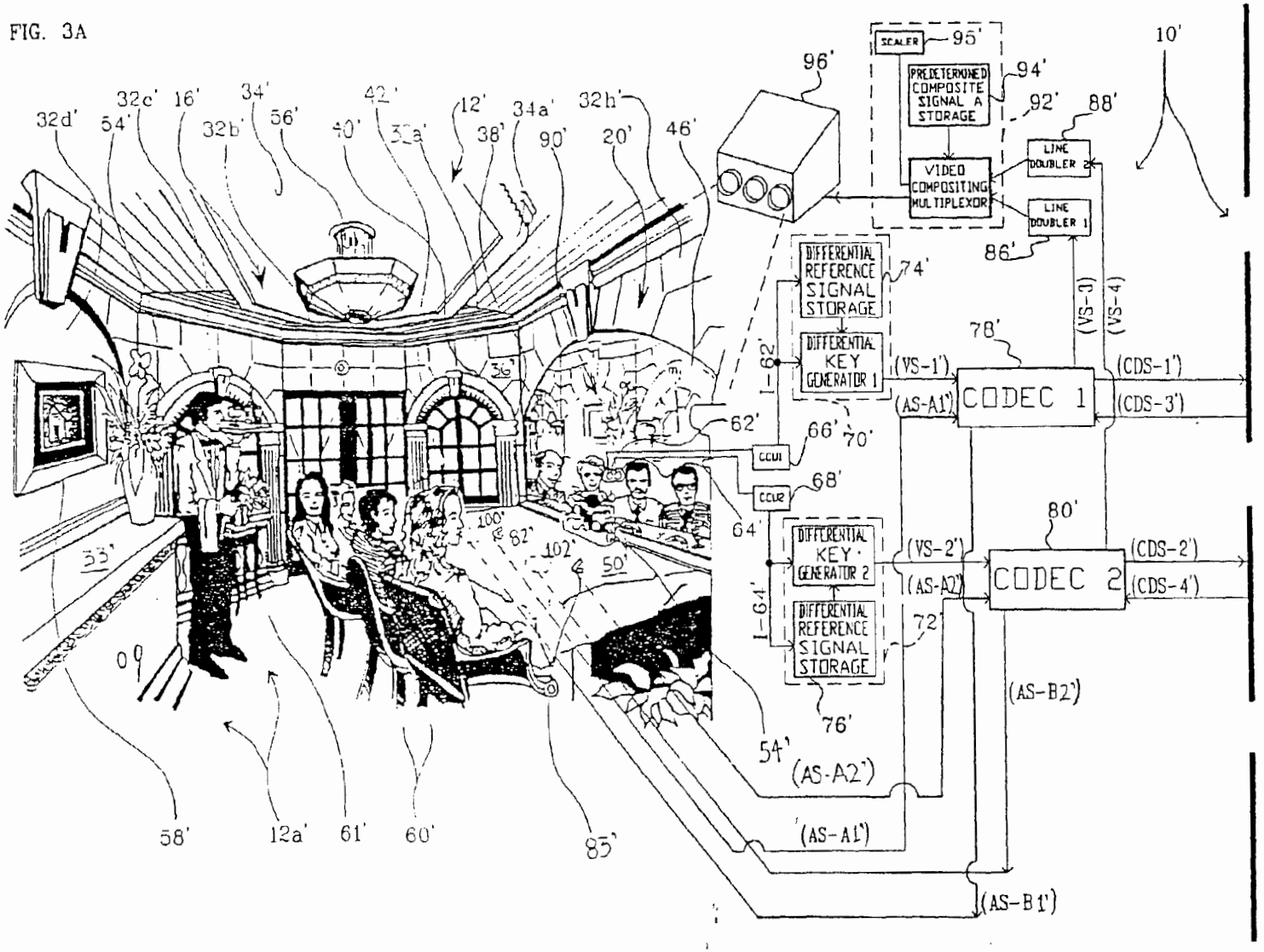

X
Y
12a
33
32d
16
48
58
12
48
32f-1
32e
54
61
43
32c
61
54
48
32b
60
W
32f
44
44
50b
83
82
38
50
102
100
B
P
38
32g
68
66
50a
54
32a
A
64
62
46
32
46a
32h
32f-1
L

FIG. 3A


SCALER
95'
PREDETERMINED COMPOSITE SIGNAL A STORAGE
94'
VIDEO COMPOSITING MULTIPLEXOR
LINE DOUBLER 2
LINE DOUBLER 1
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR 1
DIFFERENTIAL KEY GENERATOR 2
CODEC 1
CODEC 2
(VS-1')
(AS-A1')
(CDS-1')
(CDS-3')
(VS-2')
(AS-A2')
(CDS-2')
(CDS-4')
(AS-B2')
(AS-B1')
(VS-3)
(VS-4)
I-62'
I-64'
CCU1
CCU2
10'
96'
88'
86'
74'
78'
80'
72'
76'
68'
66'
70'
62'
64'
54'
32d'
54'
32c'
16'
32b'
34'
56'
40'
42'
32a'
12'
38'
34a'
90'
32h'
20'
46'
36'
55'
09
100'
82'
102'
50'
58'
12a'
61'
60'
85'

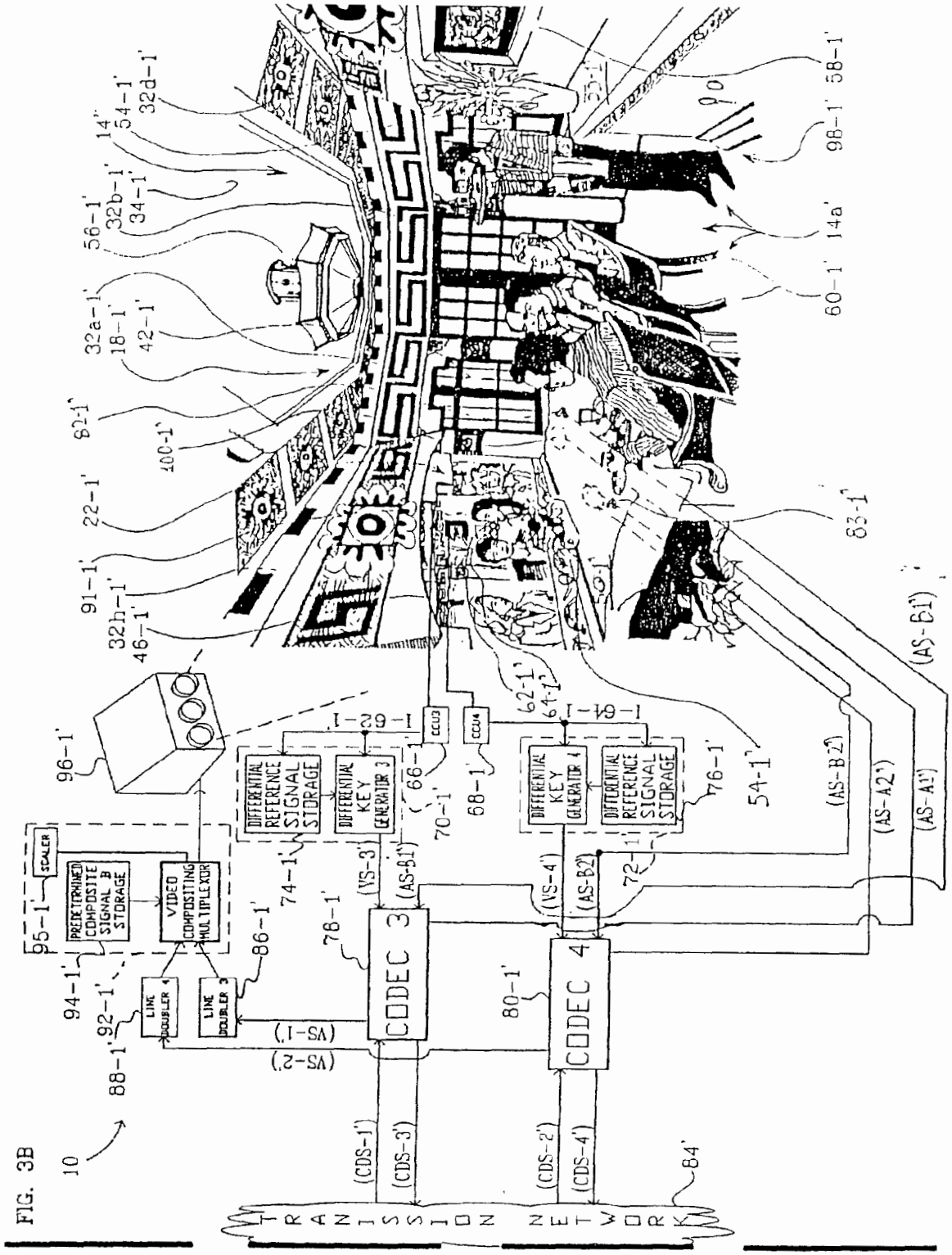
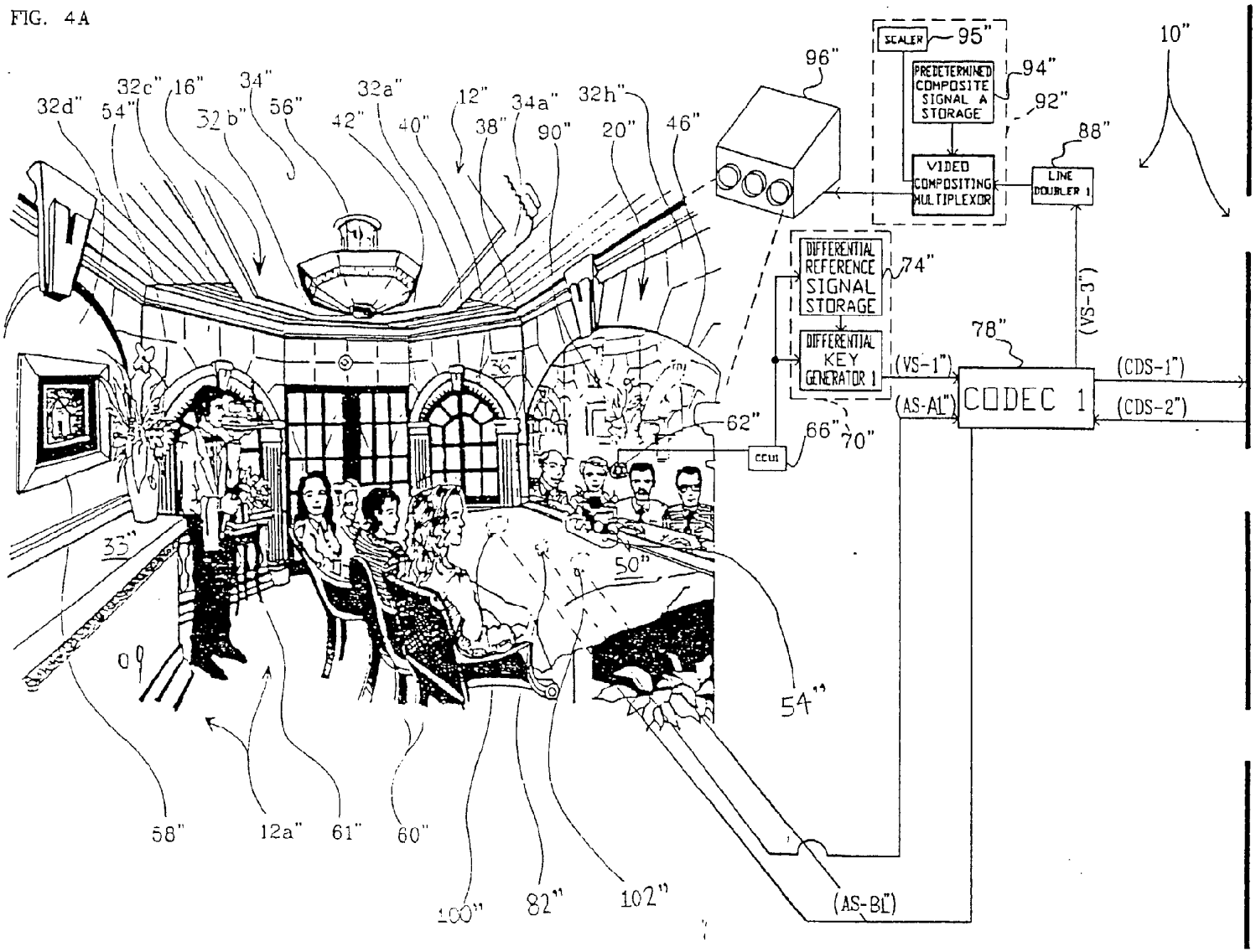

TRANSMISSION NETWORK
CODEC 3
CODEC 4
VIDEO COMPOSITING MULTIPLEXOR
PREDETERMINED COMPOSITE SIGNAL B STORAGE
SCALER
LINE DOUBLER
DIFFERENTIAL REFERENCE SIGNAL STORAGE
DIFFERENTIAL KEY GENERATOR
CCU3
CCU4
(CDS-1')
(CDS-3')
(CDS-2')
(CDS-4')
(VS-1')
(VS-2')
(VS-3')
(VS-4')
(AS-B1')
(AS-B2')
(AS-A2')
(AS-A1')
10
14'
14a'
18-1'
22-1'
32a-1'
32b-1'
32d-1'
34-1'
42-1'
46-1'
54-1'
56-1'
58-1'
60-1'
62-1'
63-1'
64-1'
66-1'
68-1'
70-1'
72-1'
74-1'
76-1'
78-1'
80-1'
84'
86-1'
88-1'
91-1'
92-1'
94-1'
95-1'
96-1'
98-1'
100-1'

FIG. 3B

FIG. 4A



EP 1 187 480 A1

FIG. 4B

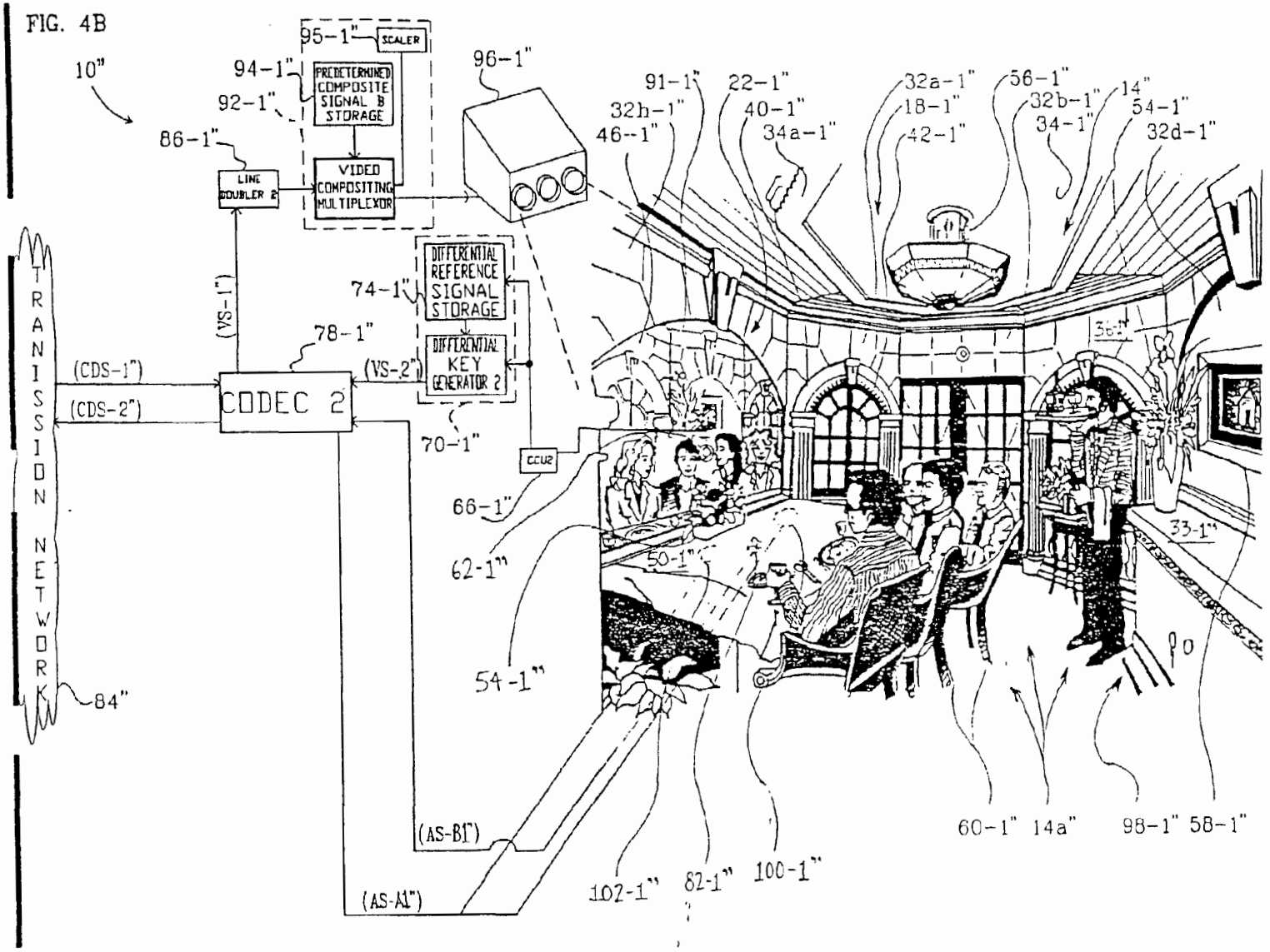

10"
95-1"
SCALER
94-1"
PREDETERMINED COMPOSITE SIGNAL B STORAGE
92-1"
86-1"
LINE DOUBLER 2
VIDEO COMPOSITING MULTIPLEXOR
96-1"
91-1"
32h-1"
46--1"
22-1"
40-1"
34a-1"
32a-1"
18-1"
42-1"
56-1"
32b-1"
34-1"
14"
54-1"
32d-1"
DIFFERENTIAL REFERENCE SIGNAL STORAGE
74-1"
DIFFERENTIAL KEY GENERATOR 2
(VS-1")
78-1"
(VS-2")
(CDS-1")
(CDS-2")
CODEC 2
70-1"
CCU2
66-1"
62-1"
54-1"
TRANSMISSION NETWORK
84"
50-1"
33-1"
(AS-B1")
(AS-A1")
102-1"
82-1"
100-1"
60-1"
14a"
98-1"
58-1"

FIG. 5A

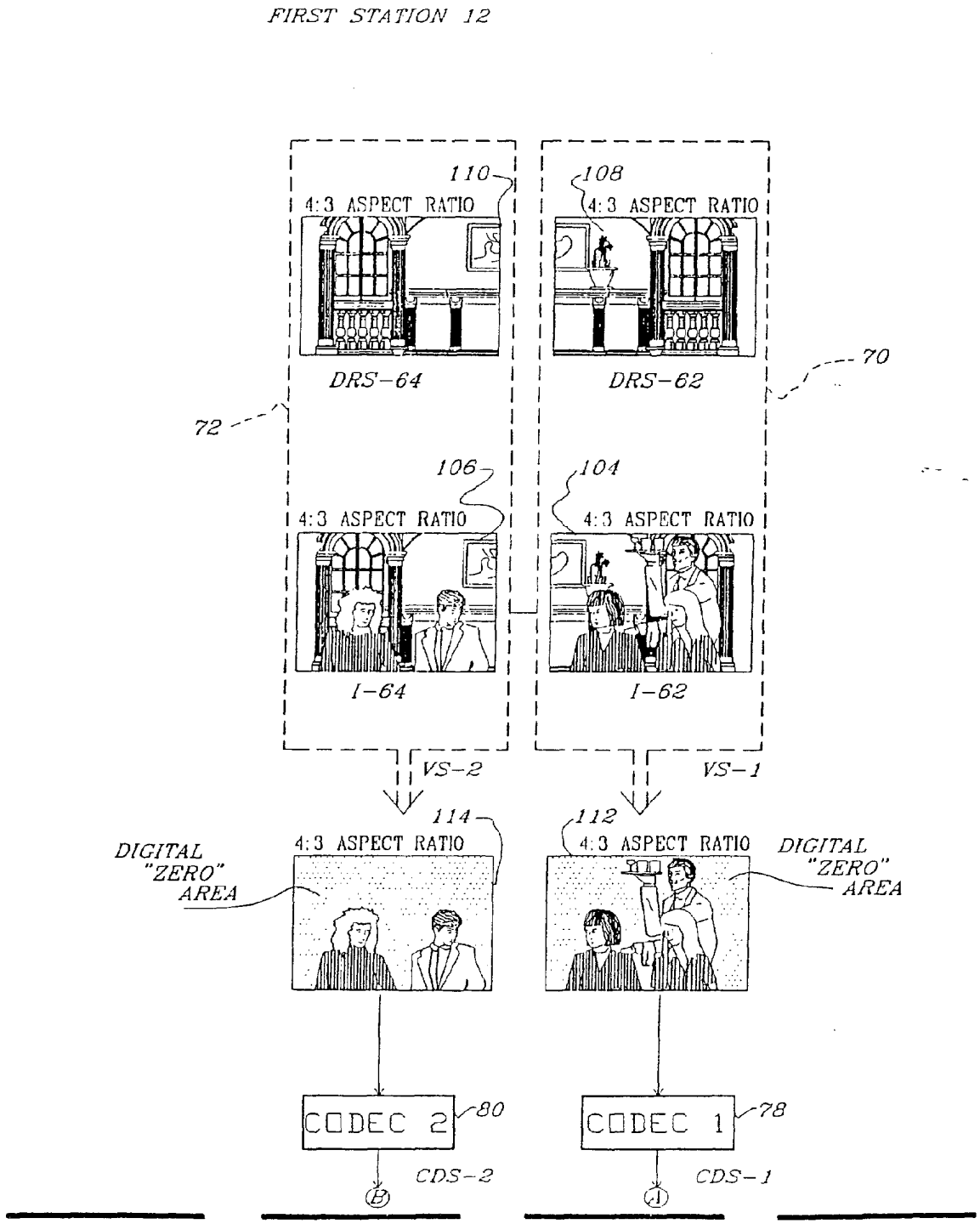

FIRST STATION 12
110
4:3 ASPECT RATIO
108
4:3 ASPECT RATIO
DRS-64
DRS-62
70
72
106
4:3 ASPECT RATIO
104
4:3 ASPECT RATIO
I-64
I-62
VS-2
VS-1
114
4:3 ASPECT RATIO
112
4:3 ASPECT RATIO
DIGITAL "ZERO" AREA
DIGITAL "ZERO" AREA
CODEC 2
80
CODEC 1
78
CDS-2
CDS-1
B
A

FIG. 5B
SECOND STATION 14

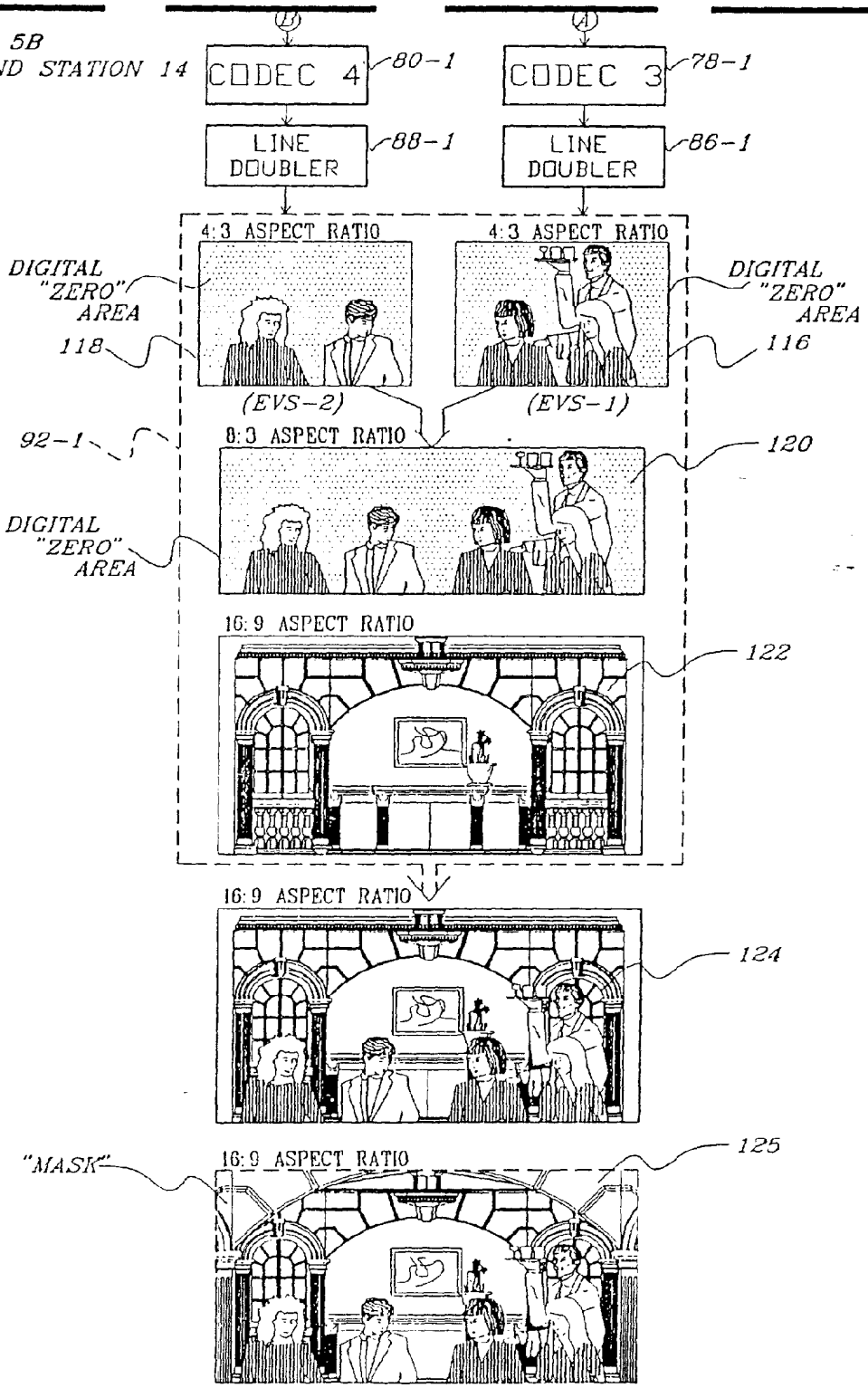


FIG-6A

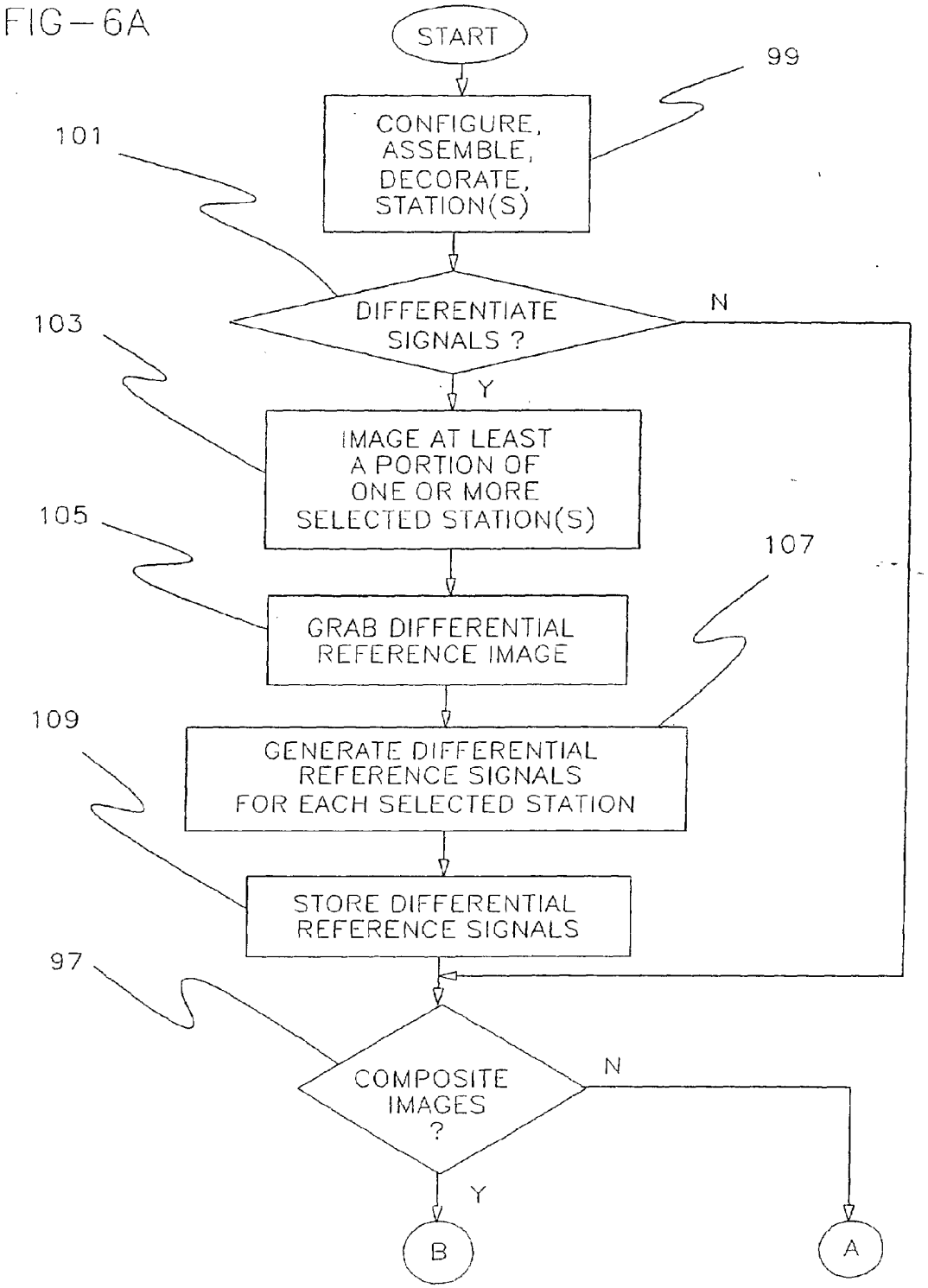

START
99
CONFIGURE, ASSEMBLE, DECORATE, STATION(S)
101
DIFFERENTIATE SIGNALS ?
N
Y
103
IMAGE AT LEAST A PORTION OF ONE OR MORE SELECTED STATION(S)
105
GRAB DIFFERENTIAL REFERENCE IMAGE
107
109
GENERATE DIFFERENTIAL REFERENCE SIGNALS FOR EACH SELECTED STATION
STORE DIFFERENTIAL REFERENCE SIGNALS
97
COMPOSITE IMAGES ?
N
Y
B
A

FIG-6B

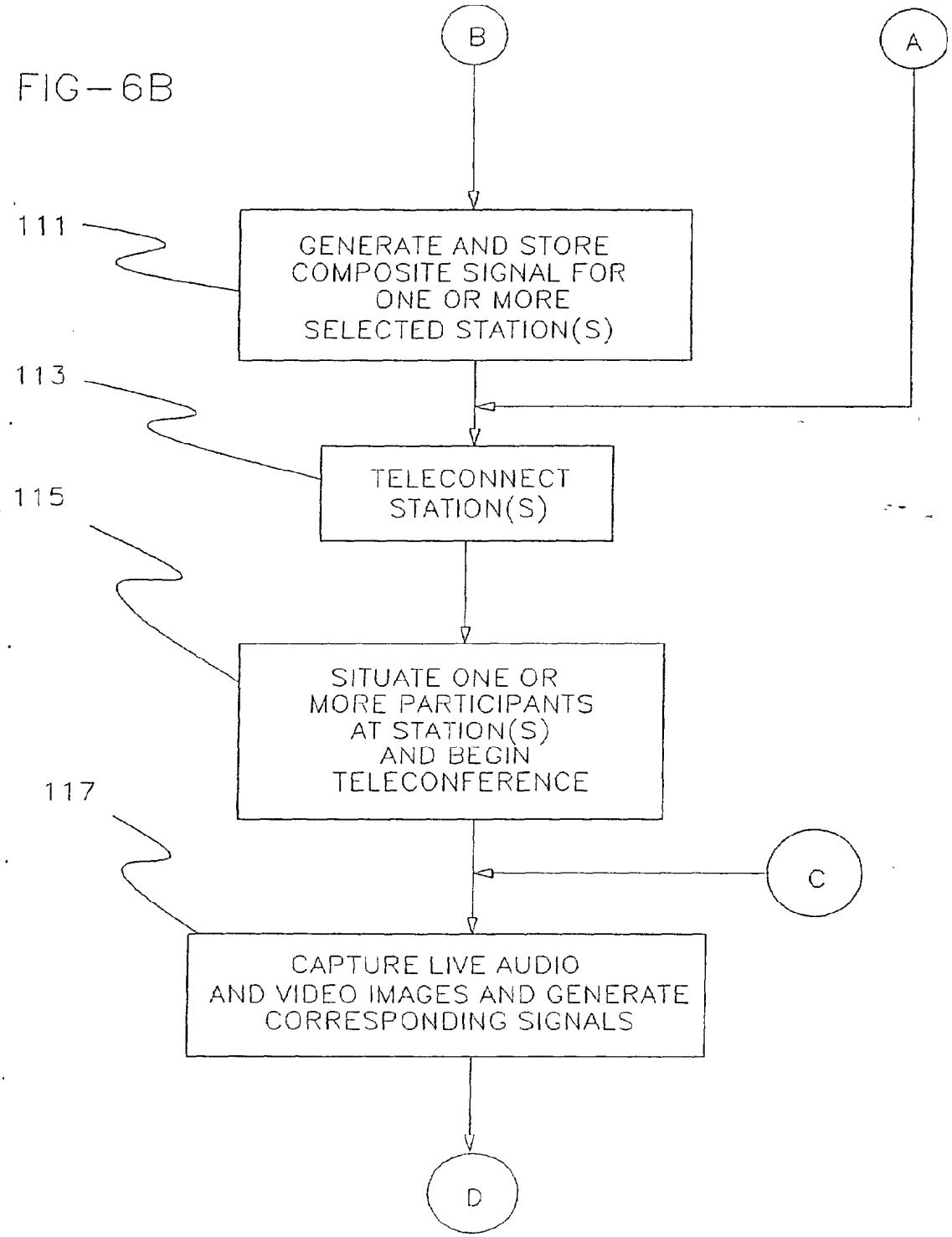

B
A
111
GENERATE AND STORE COMPOSITE SIGNAL FOR ONE OR MORE SELECTED STATION(S)
113
TELECONNECT STATION(S)
115
SITUATE ONE OR MORE PARTICIPANTS AT STATION(S) AND BEGIN TELECONFERENCE
117
C
CAPTURE LIVE AUDIO AND VIDEO IMAGES AND GENERATE CORRESPONDING SIGNALS
D

FIG-6C

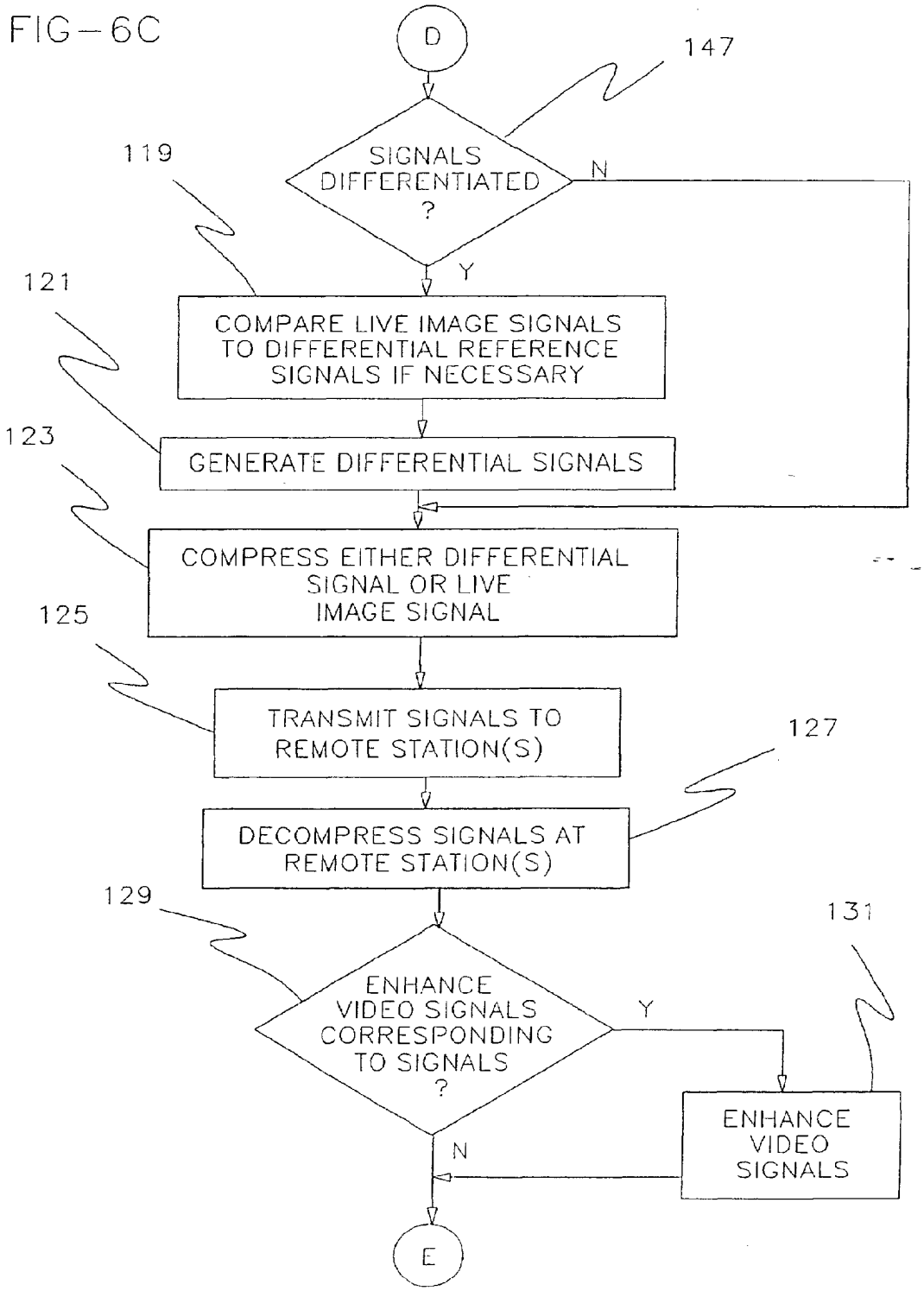
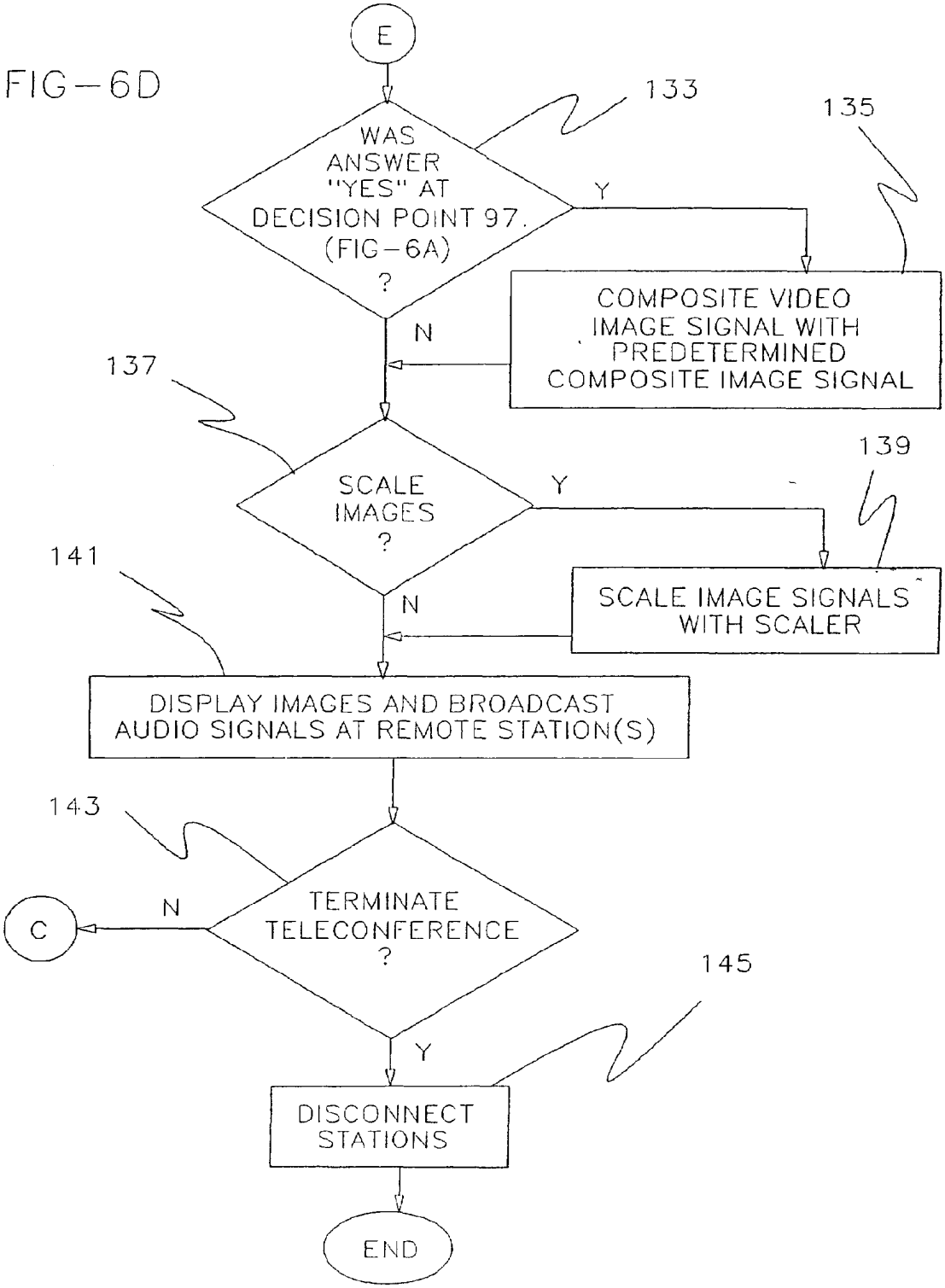

D
147
SIGNALS DIFFERENTIATED ?
N
Y
119
121
COMPARE LIVE IMAGE SIGNALS TO DIFFERENTIAL REFERENCE SIGNALS IF NECESSARY
123
GENERATE DIFFERENTIAL SIGNALS
COMPRESS EITHER DIFFERENTIAL SIGNAL OR LIVE IMAGE SIGNAL
125
TRANSMIT SIGNALS TO REMOTE STATION(S)
127
DECOMPRESS SIGNALS AT REMOTE STATION(S)
129
131
ENHANCE VIDEO SIGNALS CORRESPONDING TO SIGNALS ?
Y
N
ENHANCE VIDEO SIGNALS
E

FIG-6D


E
133
WAS ANSWER "YES" AT DECISION POINT 97. (FIG-6A) ?
Y
135
COMPOSITE VIDEO IMAGE SIGNAL WITH PREDETERMINED COMPOSITE IMAGE SIGNAL
N
137
SCALE IMAGES ?
Y
139
SCALE IMAGE SIGNALS WITH SCALER
N
141
DISPLAY IMAGES AND BROADCAST AUDIO SIGNALS AT REMOTE STATION(S)
143
TERMINATE TELECONFERENCE ?
N
C
Y
145
DISCONNECT STATIONS
END

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 12 8723

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	EP 0 459 419 A (SONY CORP) 4 December 1991 (1991-12-04)	1,6	H04N7/15
A	* the whole document *	2-5,7-10	
Y	US 5 187 571 A (BRAUN DAVID A ET AL) 16 February 1993 (1993-02-16)	1,6	
A	* the whole document *	2-5,7-10	
A	PATENT ABSTRACTS OF JAPAN vol. 017, no. 393 (E-1402), 22 July 1993 (1993-07-22) & JP 05 068246 A (NIPPON TELEGR & TELEPH CORP), 19 March 1993 (1993-03-19) * abstract *	1-10	
A	US 5 127 078 A (TERRY JOYCE E ET AL) 30 June 1992 (1992-06-30) * abstract; figure 9 *	1,3,6,8	
A	US 4 928 301 A (SMOOT LANNY S) 22 May 1990 (1990-05-22) * the whole document *	1-10	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
H04N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	16 January 2002	Greve, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 12 8723

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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16-01-2002

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EPO FORM P3459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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European Patent Office
Office européen des brevets

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(54) Markup language and object model for vector graphics

(57) An element object model and a vector graphics markup language for using that element object model in a manner that allows program code developers to consistently interface with a scene graph data structure to produce graphics. The vector graphics element object model generally corresponds to shape elements and other elements including image and video elements that correlate with a scene graph object model of the scene graph. Markup may be parsed into data including elements in an element tree that is translated into the objects of a scene graph data structure. Other markup may be translated directly into data and calls that create the scene graph objects. The markup language provides distinct ways to describe an element, including a simple string format or complex property syntax, which may be named, enabling reuse in other locations in the markup.

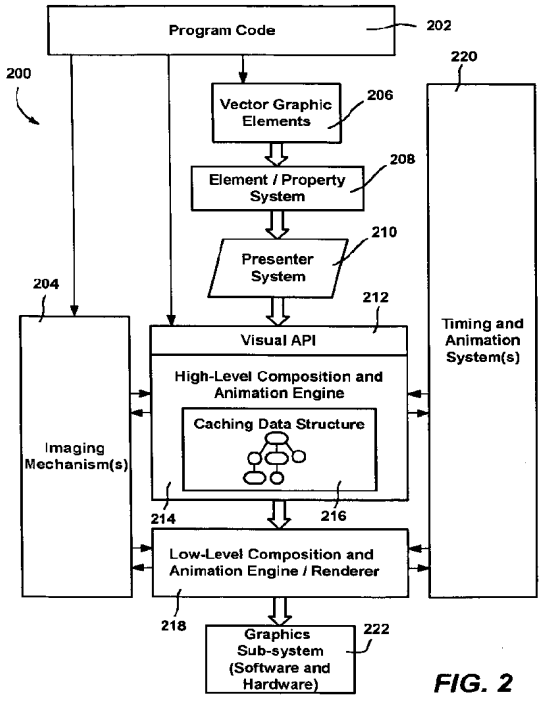


FIG. 2

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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present invention is related to the following copending United States Patent Applications: Serial No. 10/184,795 entitled Multiple-Level Graphics Processing System and Method; Serial No. 10/184,796, entitled Generic Parameterization for a Scene Graph; Serial No. 10/185,775 entitled "Intelligent Caching Data Structure for Immediate Mode Graphics;" each filed on June 27, 2002; and United States Patent Application entitled "Visual and Scene Graph Interfaces" (Attorney Docket No. 3470), filed concurrently herewith. Each related application is assigned to the assignee of the present patent application and hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The invention relates generally to computer systems, and more particularly to the processing of graphical and other video information for display on computer systems.

BACKGROUND OF THE INVENTION

[0003] The limits of the traditional immediate mode model of accessing graphics on computer systems are being reached, in part because memory and bus speeds have not kept up with the advancements in main processors and/or graphics processors. In general, the current (e.g., WM_PAINT) model for preparing a frame requires too much data processing to keep up with the hardware refresh rate when complex graphics effects are desired. As a result, when complex graphics effects are attempted with conventional graphics models, instead of completing the changes that result in the perceived visual effects in time for the next frame, the changes may be added over different frames, causing results that are visually and noticeably undesirable.

[0004] A new model for controlling graphics output is described in the aforementioned United States Patent Application Serial Nos. 10/184,795, 10/184,796, and 10/185,775. This new model provides a number of significant improvements in graphics processing technology. For example, U.S. Serial No. 10/184,795 is generally directed towards a multiple-level graphics processing system and method, in which a higher-level component (e.g., of an operating system) performs computationally intensive aspects of building a scene graph, updating animation parameters and traversing the scene graph's data structures, at a relatively low operating rate, in order to pass simplified data structures and/or graphics commands to a low-level component. Because the high-level processing greatly simplifies the data, the low-level component can operate at a faster rate, (relative to the high-level component), such as a rate that corresponds to the frame refresh rate of the graphics subsystem, to process the data into constant output data for the graphics subsystem. When animation is used, instead of having to redraw an entire scene with changes, the low-level processing may interpolate parameter intervals as necessary to obtain instantaneous values that when rendered provide a slightly changed scene for each frame, providing smooth animation.

[0005] U.S. Serial No. 10/184,796 describes a parameterized scene graph that provides mutable (animated) values and parameterized graph containers such that program code that wants to draw graphics (e.g., an application program or operating system component) can selectively change certain aspects of the scene graph description, while leaving other aspects intact. The program code can also reuse already-built portions of the scene graph, with possibly different parameters. As can be appreciated, the ability to easily change the appearance of displayed items via parameterization and/or the reuse of existing parts of a scene graph provide substantial gains in overall graphics processing efficiency.

[0006] U.S. Serial No. 10/185,775 generally describes a caching data structure and related mechanisms for storing visual information via objects and data in a scene graph. The data structure is generally associated with mechanisms that intelligently control how the visual information therein is populated and used. For example, unless specifically requested by the application program, most of the information stored in the data structure has no external reference to it, which enables this information to be optimized or otherwise processed. As can be appreciated, this provides efficiency and conservation of resources, e.g., the data in the cache data structure can be processed into a different format that is more compact and/or reduces the need for subsequent, repeated processing, such as a bitmap or other post-processing result.

[0007] While the above improvements provide substantial benefits in graphics processing technology, there still needs to be a way for programs to effectively use this improved graphics model and its other related improvements in a straightforward manner. What is needed is a comprehensive yet straightforward way for programs to take advantage of the many features and graphics processing capabilities provided by the improved graphics model and thereby output complex graphics in an efficient manner.

SUMMARY OF THE INVENTION

[0008] Briefly, the present invention provides an element object model and a vector graphics markup language for accessing that element object model in a manner that allows program code developers to consistently interface with a scene graph data structure to produce graphics. The vector graphics markup language comprises an interchange format for expressing vector graphics via the element object model. When interpreted, the markup is parsed into data including elements in an element tree that is translated into the objects of a scene graph data structure. At the element tree level, a property system and presenter system are provided to provide rich programmability features, including inheritance characteristics and eventing, making it straightforward for scene designers to design possibly complex scenes. In general, the vector graphics elements correspond to shape elements and other elements including image and video elements that correlate with scene graph objects of the scene graph object model. The properties and other resources of the vector graphics elements also correlate with similar properties and resources the scene graph object model.

[0009] The vector graphics system can thus program to an element level, in which each of the drawing shapes is represented as an element at the same level as the rest of the programmable elements in a page/screen, allowing interaction with the presenter system, events and properties. The vector graphics system also provides a mechanism for programming to a resource level, by which scene designers can essentially shortcut the element tree and presenter system and program directly to the visual API layer that interfaces with the scene graph data structure. This provides a more efficient and lightweight way to output the appropriate object, although losing of some of the programmability of the element level. In one implementation, when a fill of type "visual brush" is programmed, the parser can directly call the API layer with resource level data to create a corresponding visual paint object (which is also a correlation between the element object model and the scene graph object model). In this two-tiered system, element level vector graphics get parsed into created elements, which need later translation to the objects, while resource level vector graphics get parsed and directly stored in an efficient manner. At the same time, the resource level data or the objects created thereby can be referenced by elements and part of the element tree. To this end, elements including visual paint elements may be named. The scene designer thus has the ability to balance efficiency against programmability as needed.

[0010] The element class hierarchy includes a shape class, an image class, a video class and a canvas class. Elements of the shape class include rectangle, polyline, polygon, path, line and ellipse. Each element may include or be associated with fill (property) data, stroke data, clipping data, transform data, filter effect data and mask data. Shapes correspond to geometry (of the scene graph object model) that is drawn with inherited and cascaded presentation properties that are used to construct the pen and the brush needed to draw the shapes. The image class is more specific than a shape and can include more raster graphical data, while the video class allows video (or similar multimedia) to be played within a displayed element. The canvas class may act as a container for shapes, to keep shapes lightweight.

[0011] In one implementation the markup code is interpreted by a parser / translator which generally adds element-level elements to an element tree / property system and attaches presenters to those elements. The presenter system then takes the element tree with the attached presenters and translates the data to objects (via a builder) and calls to a visual API layer that interfaces with the scene graph and creates the scene graph objects.

[0012] The markup language provides distinct ways to describe an element, including a simple string format or a complex object notation (a complex property syntax). For a simple string format, the parser / translator and/or presenter system uses a type converter for converting a string to an appropriate visual API object. When the fill attribute is too complex to fit into a single string, complex property syntax, which may be inline in the markup, is used to describe the property set. Because the same rendering model is shared between the element level and the API level, many of the objects are the same, which makes parsing / translation highly efficient and provides other benefits. A resource instance also may be located elsewhere (e.g., in the markup or a file), and referenced by a name. In this manner, a scene designer can reuse an element in the element tree throughout a scene, including elements described by the complex property syntax.

[0013] Other benefits and advantages will become apparent from the following detailed description when taken in conjunction with the drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

FIGURE 1 is a block diagram representing an exemplary computer system into which the present invention may be incorporated;

FIG. 2 is a block diagram generally representing a graphics layer architecture into which the present invention may

be incorporated;
FIG. 3 is a representation of a scene graph of visuals and associated components for processing the scene graph such as by traversing the scene graph to provide graphics commands and other data in accordance with an aspect of the present invention;
FIG. 4 is a representation of a scene graph of validation visuals, drawing visuals and associated drawing primitives constructed in accordance with an aspect of the present invention;
FIG. 5 is a representation of a visual class, of an object model, in accordance with an aspect of the present invention;
FIG. 6 is a representation of various other objects of the object model, in accordance with an aspect of the present invention;
FIG. 7 is a diagram representing transformation of a visual's data in accordance with an aspect of the present invention;
FIGS. 8A and 8B are representations of transformations of a visual's data in a geometry scale and a non-uniform scale, respectively, in accordance with an aspect of the present invention;
FIGS. 9A-9C are block diagrams of surface visual objects and other visuals and components in accordance with an aspect of the present invention;
FIGS. 10A and 10B are diagrams representing HWnd visual objects in accordance with an aspect of the present invention;
FIG. 11 is a diagram representing a layered visual object in accordance with an aspect of the present invention;
FIG. 12 is a representation of geometry classes of the object model, in accordance with an aspect of the present invention;
FIG. 13 is a representation of a PathGeometry structure, in accordance with an aspect of the present invention;
FIG. 14 is a representation of a scene graph of visuals and drawing primitives showing example graphics produced by the primitives, in accordance with an aspect of the present invention;
FIG. 15 is a representation of brush classes of the object model, in accordance with an aspect of the present invention;
FIG. 16 is a representation of rendered graphics resulting from data in a linear gradient brush object, in accordance with an aspect of the present invention;
FIG. 17 is a representation of rendered graphics resulting from data in a radial gradient brush object, in accordance with an aspect of the present invention;
FIG. 18 is a representation of rendered graphics resulting from having various stretch values, in accordance with an aspect of the present invention;
FIG. 19 is a representation of rendered graphics resulting from having various tile values, in accordance with an aspect of the present invention;
FIG. 20 is a flow diagram generally representing logic for interpreting a visual, including a brush object, to generate graphics in accordance with an aspect of the present invention;
FIG. 21 is a representation of a grid and transformed grid, resulting from data in a visual brush object, in accordance with an aspect of the present invention;
FIG. 22 is a representation of the grid and transformed grid, with rendered graphics therein drawn from a visual, in accordance with an aspect of the present invention;
FIG. 23 is a representation of a rendered nine grid brush object in accordance with an aspect of the present invention;
FIG. 24 is a representation of transform classes of the object model, in accordance with an aspect of the present invention;
FIG. 25 is a representation of element classes of the element object model, in accordance with an aspect of the present invention;
FIG. 26 is a representation of components for interpreting markup language code to interface with the visual API layer, in accordance with an aspect of the present invention; and
FIG. 27 is a representation of clipping via a geometry path in accordance with an aspect of the present invention.

DETAILED DESCRIPTION

EXEMPLARY OPERATING ENVIRONMENT

[0015] FIGURE 1 illustrates an example of a suitable computing system environment 100 on which the invention may be implemented. The computing system environment 100 is only one example of a suitable computing environment and is not intended to suggest any limitation as to the scope of use or functionality of the invention. Neither should the computing environment 100 be interpreted as having any dependency or requirement relating to any one or combination of components illustrated in the exemplary operating environment 100.

[0016] The invention is operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well known computing systems, environments, and/or configurations that may be suitable for use with the invention include, but are not limited to, personal computers, server computers, hand-held or laptop devices, tablet devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

[0017] The invention may be described in the general context of computer-executable instructions, such as program modules, being executed by a computer. Generally, program modules include routines, programs, objects, components, data structures, and so forth, which perform particular tasks or implement particular abstract data types. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote computer storage media including memory storage devices.

[0018] With reference to FIG. 1, an exemplary system for implementing the invention includes a general purpose computing device in the form of a computer 110. Components of the computer 110 may include, but are not limited to, a processing unit 120, a system memory 130, and a system bus 121 that couples various system components including the system memory to the processing unit 120. The system bus 121 may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, Accelerated Graphics Port (AGP) bus, and Peripheral Component Interconnect (PCI) bus also known as Mezzanine bus.

[0019] The computer 110 typically includes a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by the computer 110 and includes both volatile and nonvolatile media, and removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes both volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can accessed by the computer 110. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of the any of the above should also be included within the scope of computer-readable media.

[0020] The system memory 130 includes computer storage media in the form of volatile and/or nonvolatile memory such as read only memory (ROM) 131 and random access memory (RAM) 132. A basic input/output system 133 (BIOS), containing the basic routines that help to transfer information between elements within computer 110, such as during start-up, is typically stored in ROM 131. RAM 132 typically contains data and/or program modules that are immediately accessible to and/or presently being operated on by processing unit 120. By way of example, and not limitation, FIG. 1 illustrates operating system 134, application programs 135, other program modules 136 and program data 137.

[0021] The computer 110 may also include other removable/non-removable, volatile/nonvolatile computer storage media. By way of example only, FIG. 1 illustrates a hard disk drive 141 that reads from or writes to non-removable, nonvolatile magnetic media, a magnetic disk drive 151 that reads from or writes to a removable, nonvolatile magnetic disk 152, and an optical disk drive 155 that reads from or writes to a removable, nonvolatile optical disk 156 such as a CD ROM or other optical media. Other removable/non-removable, volatile/nonvolatile computer storage media that can be used in the exemplary operating environment include, but are not limited to, magnetic tape cassettes, flash memory cards, digital versatile disks, digital video tape, solid state RAM, solid state ROM, and the like. The hard disk drive 141 is typically connected to the system bus 121 through a non-removable memory interface such as interface 140, and magnetic disk drive 151 and optical disk drive 155 are typically connected to the system bus 121 by a removable memory interface, such as interface 150.

[0022] The drives and their associated computer storage media, discussed above and illustrated in FIG. 1, provide storage of computer-readable instructions, data structures, program modules and other data for the computer 110. In FIG. 1, for example, hard disk drive 141 is illustrated as storing operating system 144, application programs 145, other program modules 146 and program data 147. Note that these components can either be the same as or different from

operating system 134, application programs 135, other program modules 136, and program data 137. Operating system 144, application programs 145, other program modules 146, and program data 147 are given different numbers herein to illustrate that, at a minimum, they are different copies. A user may enter commands and information into the computer 110 through input devices such as a tablet (electronic digitizer) 164, a microphone 163, a keyboard 162 and pointing device 161, commonly referred to as mouse, trackball or touch pad. Other input devices (not shown) may include a joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit 120 through a user input interface 160 that is coupled to the system bus, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB). A monitor 191 or other type of display device is also connected to the system bus 121 via an interface, such as a video interface 190. The monitor 191 may also be integrated with a touch-screen panel 193 or the like that can input digitized input such as handwriting into the computer system 110 via an interface, such as a touch-screen interface 192. Note that the monitor and/or touch screen panel can be physically coupled to a housing in which the computing device 110 is incorporated, such as in a tablet-type personal computer, wherein the touch screen panel 193 essentially serves as the tablet 164. In addition, computers such as the computing device 110 may also include other peripheral output devices such as speakers 195 and printer 196, which may be connected through an output peripheral interface 194 or the like.

[0023] The computer 110 may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer 180. The remote computer 180 may be a personal computer, a server, a router, a network PC, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer 110, although only a memory storage device 181 has been illustrated in FIG. 1. The logical connections depicted in FIG. 1 include a local area network (LAN) 171 and a wide area network (WAN) 173, but may also include other networks. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

[0024] When used in a LAN networking environment, the computer 110 is connected to the LAN 171 through a network interface or adapter 170. When used in a WAN networking environment, the computer 110 typically includes a modem 172 or other means for establishing communications over the WAN 173, such as the Internet. The modem 172, which may be internal or external, may be connected to the system bus 121 via the user input interface 160 or other appropriate mechanism. In a networked environment, program modules depicted relative to the computer 110, or portions thereof, may be stored in the remote memory storage device. By way of example, and not limitation, FIG. 1 illustrates remote application programs 185 as residing on memory device 181. It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

GRAPHICS ARCHITECTURE

[0025] One aspect of the present invention is generally directed to allowing program code, such as an application or operating system component, to communicate drawing instructions and other information (e.g., image bitmaps) to graphics components in order to render graphical output on the system display. To this end, the present invention provides a markup language along with a set of shape elements and other elements, a grouping and compositing system, and integration with a general property system in an object model to enable programs to populate a scene graph with data structures, drawing primitives (commands), and other graphics-related data. When processed, the scene graph results in graphics being displayed on the screen.

[0026] FIG. 2 represents a general, layered architecture 200 into which the present invention may be implemented. As represented in FIG. 2, program code 202 (e.g., an application program or operating system component or the like) may be developed to output graphics data in one or more various ways, including via imaging 204, via vector graphic elements 206, and/or via function / method calls placed directly to a visual application programming interface (API) layer 212. Direct interaction with the API layer is further described in the aforementioned copending patent application entitled "Visual and Scene Graph Interfaces."

[0027] In general, imaging 204 provides the program code 202 with a mechanism for loading, editing and saving images, e.g., bitmaps. These images may be used by other parts of the system, and there is also a way to use the primitive drawing code to draw to an image directly.

[0028] In accordance with an aspect of the present invention, vector graphics elements 206 provide another way to draw graphics, consistent with the rest of the object model (as described below). Vector graphic elements 206 may be created via a markup language, which an element / property system 208 and presenter system 210 processes to make appropriate calls to the visual API layer 212. As described below with reference to FIG. 26, in general the vector graphic elements 206 are parsed into objects of the object model from which a scene graph is drawn, which may be provided to the scene graph via an element level via the element / property system 208 and presenter system 210, or may be provided in a more efficient manner at a resource level, as also described below.

[0029] In one implementation, the graphics layer architecture 200 includes a high-level composition and animation

engine 214, which includes or is otherwise associated with a caching data structure 216. The caching data structure 216 contains a scene graph comprising hierarchically-arranged objects that are managed according to a defined object model, as described below. In general, the visual API layer 212 provides the program code 202 (and the presenter system 210) with an interface to the caching data structure 216, including the ability to create objects, open and close objects to provide data to them, and so forth. In other words, the high-level composition and animation engine 214 exposes a unified media API layer 212 by which developers may express intentions about graphics and media to display graphics information, and provide an underlying platform with enough information such that the platform can optimize the use of the hardware for the program code. For example, the underlying platform will be responsible for caching, resource negotiation and media integration.

[0030] In one implementation, the high-level composition and animation engine 214 passes an instruction stream and possibly other data (e.g., pointers to bitmaps) to a fast, low-level compositing and animation engine 218. As used herein, the terms "high-level" and "low-level" are similar to those used in other computing scenarios, wherein in general, the lower a software component is relative to higher components, the closer that component is to the hardware. Thus, for example, graphics information sent from the high-level composition and animation engine 214 may be received at the low-level compositing and animation engine 218, where the information is used to send graphics data to the graphics subsystem including the hardware 222.

[0031] The high-level composition and animation engine 214 in conjunction with the program code 202 builds a scene graph to represent a graphics scene provided by the program code 202. For example, each item to be drawn may be loaded with drawing instructions, which the system can cache in the scene graph data structure 216. As will be described below, there are a number of various ways to specify this data structure 216, and what is drawn. Further, the high-level composition and animation engine 214 integrates with timing and animation systems 220 to provide declarative (or other) animation control (e.g., animation intervals) and timing control. Note that the animation system allows animate values to be passed essentially anywhere in the system, including, for example, at the element property level 208, inside of the visual API layer 212, and in any of the other resources. The timing system is exposed at the element and visual levels.

[0032] The low-level compositing and animation engine 218 manages the composing, animating and rendering of the scene, which is then provided to the graphics subsystem 222. The low-level engine 218 composes the renderings for the scenes of multiple applications, and with rendering components, implements the actual rendering of graphics to the screen. Note, however, that at times it may be necessary and/or advantageous for some of the rendering to happen at higher levels. For example, while the lower layers service requests from multiple applications, the higher layers are instantiated on a per-application basis, whereby is possible via the imaging mechanisms 204 to perform time-consuming or application-specific rendering at higher levels, and pass references to a bitmap to the lower layers.

SCENE GRAPH OBJECT MODEL

[0033] As described below, the rendering model is shared by the higher-level, control-based vector graphics elements 206, and the lower-level objects created by the visual API layer 212 used in the scene graph data structure 216. This provides a significant amount of correlation between the higher-level elements of the present invention, and the lower-level objects. The following describes one implementation of the scene graph object model.

[0034] FIGS. 3 and 4 show example scene graphs 300 and 400, respectively, including a base object referred to as a visual. In general, a visual comprises an object that represents a virtual surface to the user and has a visual representation on the display. As represented in FIG. 5, a base class visual provides the base functionality for other visual types, that is, the visual class 500 is an abstract base class from which visual types (e.g., 501-506) derive.

[0035] As represented in FIG. 3, a top-level (or root) visual 302 is connected to a visual manager object 304, which also has a relationship (e.g., via a handle) with a window (HWnd) 306 or similar unit in which graphic data is output for the program code. The VisualManager 304 manages the drawing of the top-level visual (and any children of that visual) to that window 306. FIG. 6 shows the VisualManager as one of a set of other objects 620 in the object model of the graphics system described herein.

[0036] To draw, the visual manager 304 processes (e.g., traverses or transmits) the scene graph as scheduled by a dispatcher 308, and provides graphics instructions and other data to the low level component 218 (FIG. 2) for its corresponding window 306, such as generally described in U.S. Patent Application Serial Nos. 10/184,795, 10/184,796, and 10/185,775. The scene graph processing will ordinarily be scheduled by the dispatcher 308 at a rate that is relatively slower than the refresh rate of the lower-level component 218 and/or graphics subsystem 222. FIG. 3 shows a number of child visuals 310-315 arranged hierarchically below the top-level (root) visual 302, some of which are represented as having been populated via drawing contexts 316, 317 (shown as dashed boxes to represent their temporary nature) with associated instruction lists 318 and 319, respectively, e.g., containing drawing primitives and other visuals. The visuals may also contain other property information, as shown in the following example visual class:

```
public abstract class Visual : VisualComponent
 {
     public Transform Transform { get; set; }
     public float Opacity { get; set; }
     public BlendMode BlendMode { get; set; }
     public Geometry Clip { get; set; }
     public bool Show { get; set; }
     public HitTestResult HitTest(Point point);
     public bool IsDescendant(Visual visual);
     public static Point TransformToDescendant(
         Visual reference,
         Visual descendant,
         Point point);
     public static Point TransformFromDescendant(
         Visual reference,
         Visual descendant,
         Point point);
     public Rect CalculateBounds(); // Loose bounds
     public Rect CalculateTightBounds(); //
     public bool HitTestable { get; set; }
     public bool HitTestIgnoreChildren { get; set; }
     public bool HitTestFinal { get; set; }
 }
```

[0037] A transformation, set by the transform property, defines the coordinate system for the sub-graph of a visual. The coordinate system before the transformation is called pre-transform coordinate system, the one after the transform is called post-transform coordinate system, that is, a visual with a transformation is equivalent to a visual with a transformation node as a parent. FIG. 7 generally provides an example of transformation, identifying the pre-transformation and post-transformation coordinate systems relative to a visual. To get or set the transformation of a visual, the Transform property may be used.

[0038] Note that the coordinate transforms may be applied in a uniform way to everything, as if it were in a bitmap. Note that this does not mean that transformations always apply to bitmaps, but that what gets rendered is affected by transforms equally. By way of example, if the user draws a circle with a round pen that is one inch wide and then applies a scale in the X direction of two to that circle, the pen will be two inches wide at the left and right and only one inch wide at the top and bottom. This is sometimes referred to as a compositing or bitmap transform (as opposed to a skeleton or geometry scale that affects the geometry only). FIG. 8A is a representation of scaling transformation, with a non-transformed image 800 appearing on the left and a transformed image 802 with a non-uniform scale appearing on the right. FIG. 8B is a representation of scaling transformation, with the non-transformed image 800 appearing on the left and a transformed image 804 with geometry scaling appearing on the right.

[0039] With respect to coordinate transformation of a visual, TransformToDescendant transforms a point from the reference visual to a descendant visual. The point is transformed from the post-transformation coordinate space of the reference visual to the post-transformation coordinate space of the descendant visual. TransformFromDescendant transforms a point from the descendant visual up the parent chain to the reference visual. The point is transformed from post-transformation coordinate space of the descendant visual to post-transformation coordinate space of the reference visual. The CalculateBounds method returns the bounding box of the content of the Visual in Post-Transformation coordinate space. Note that there may be an alternative version of the API where more specific specifications are allowed as to how the transform on a visual is interpreted during a coordinate transformation. For example, the transform on the reference and descendant visual may or may not be taken into account. In this alternative, there are thus four options, e.g., coordinates can be transformed from pre-transformation to pre-transformation space, pre-transformation to post-transformation space, post-transformation to pre-transformation space, and post-transformation to post-transformation space. The same concept applies to hit-testing, e.g., hit-testing may be started in pre-transformation or post-transformation transform coordinate space, and the hit-test results might be in pre-transformation or post-transformation coordinate space.

[0040] The clip property sets (and gets) the clipping region of a visual. Any Geometry (the geometry class is described below with reference to FIG. 12) can be used as a clipping region, and the clipping region is applied in Post-Transfor-

mation coordinate space. In one implementation, a default setting for the clipping region is null, i.e., no clipping, which can be thought of as an infinite big clipping rectangle from (-∞, -∞) to (+∞, +∞) .

[0041] The Opacity property gets/sets the opacity value of the visual, such that the content of the visual is blended on the drawing surface based on the opacity value and the selected blending mode. The BlendMode property can be used to set (or get) the blending mode that is used. For example, an opacity (alpha) value may be set between 0.0 and 1.0, with linear alpha blending set as the mode, e.g., Color = alpha * foreground color + (1.0-alpha) * background color). Other services, such as special effects properties, may be included in a visual, e.g., blur, monochrome, and so on.

[0042] The various services (including transform, opacity, clip) can be pushed and popped on a drawing context, and push/ pop operations can be nested, as long as a pop call matches a push call. For example PushTransform(...); PushOpacity (...) ; PopTransform(...); is illegal, because before the PopTransform call, PopOpacity needs to be called.

[0043] The PushTransform method pushes a transformation. Subsequent drawing operations are executed with respect to the pushed transformation. The PopTransform pops the transformation pushed by the matching PushTransform call:

```
void PushTransform(Transform transform);
void PushTransform(Matrix matrix);
void PopTransform();.
```

[0044] Similarly, the PushOpacity method pushes an opacity value. Subsequent drawing operations are rendered on a temporary surface with the specified opacity value and then composite into the scene. PopOpacity pops the opacity pushed by the matching PushOpacity call:

```
void PushOpacity(float opacity);
void PushOpacity(NumberAnimationBase opacity);
void PopOpacity();.
```

[0045] The PushClip method pushes a clipping geometry. Subsequent drawing operations are clipped to the geometry. The clipping is applied in post transformation space. PopClip pops the clipping region pushed by the matching PushClip call:

```
void PushClip(Geometry clip);
void PopClip();.
```

[0046] Note that push operations can be arbitrarily nested as long as the pop operations are matched with a push. For example, the following is valid:

```
PushTransform(...);
DrawLine(...);
PushClip(...);
DrawLine(...);
PopClip();
PushTransform(...);
DrawRect(...);
PopTransform();
PopTransform();
```

[0047] Hit-testing is performed in the Post-Transformation coordinate space, and returns an identity of each hit-testable visual that is hit, e.g., when a pen or mouse click is detected. An alternate version of the interface may allow for hit-testing to start at a Pre-Transformation coordinate space relative to the visual where the hit test is started. Visuals that are hit are returned in right-to-left, depth-first order. Hit-testing may be controlled with various flags, including HitTestable, which determines if the visual is hit-testable (the default is true), and HitTestFinal, which determines if hit-testing stops when the visual is hit, i.e. if a Visual is hit and the HitTestFinal property of the visual is true, hit-testing aborts and returns the results collected up to this point (the default is false). Another flag is HitTestIgnoreChildren, which determines if the children of a visual should be considered when hit-testing is performed on a visual (the default is false).

[0048] A ProxyVisual is a visual that may be added more than once into the scene graph. Since any visual referred

to by a ProxyVisual may be reached by multiple paths from the root, read services (TransformToDescendent, TransformFromDescendent and HitTest) do not work through a ProxyVisual. In essence, there is one canonical path from any visual to the root of the visual tree and that path does not include any ProxyVisuals.

[0049] As represented in FIG. 5, various types of visuals are defined in the object model, including ContainerVisuals 501, DrawingVisuals 502, ValidationVisuals 503, SurfaceVisuals 504 and HwndVisuals 505. The table below sets forth example methods of a DrawingVisual:

```
public class DrawingVisual : Visual
{
    public DrawingVisual();
    public IDrawingContext Open();
    public IDrawingContext Append();
}
```

[0050] A DrawingVisual is a container for graphical content (e.g. lines, text, images, and so forth). Note that it is possible to add a Visual into a DrawingVisual, but in some implementations this is not allowed. The DrawingVisual 502 includes an Open method, which returns an IDrawingContext that can be used to populate the DrawingVisual, e.g., with other visuals and drawing primitives, as described below. In one implementation, for various reasons also described below, a DrawingVisual may be only opened once to populate its drawing context; in other words, such a DrawingVisual is immutable. After the DrawingVisual has been populated, the DrawingVisual is closed using a Close method, e.g., on the drawing context. Note that an Open call may clear any contents (children) of a visual, however in one alternative implementation, there is provided an Append method, to open a current visual in a manner that appends to that visual. In other words, an OpenForAppend call works like Open, except the current content of the DrawingVisual is not cleared out on the open.

[0051] The following is an example of how a drawing context is used to populate a visual:

```
ContainerVisual cv1 = new ContainerVisual();
DrawingVisual dv1 = new DrawingVisual();
```

```
// Open a drawing context.  The context
// will automatically be closed when
// exiting the using block.  This will also
// replace any contents that might already
// be in dv1.
using (IDrawingContext dc = dv1.Open())
{
    dc.DrawLine(new Pen(Brushes.Blue), new Point(...), new Point(...));
}

// Add dv1 to the child collection of cv1
cv1.Children.Add(dv1);

// Add another arbitrary visual to cv1
cv1.Children.Add(someOtherVisual);

// Create another DrawingVisual
DrawingVisual dv2 = new DrawingVisual();

using (IDrawingContext dc = dv2.Open())
{
    // This sets up a new coordinate system
    // where everything is twice as big
    dv.PushTransform(new Scale(2.0, 2.0));

    // This line is drawn in the new scaled
    // coordinate system.
    dc.DrawLine(new Pen(Brushes.Red), new Point(...), new Point(...));

    // This reverts to the original coordinate system.
    dv.PopTransform();

    dc.DrawLine(new Pen(Brushes.Green), new Point(...), new Point(...));
}

// Add dv2 to the child collection of cv1;
cv1.Children.Add(dv2);
```

[0052] In general, a ValidationVisual 503 is conceptually similar to a DrawingVisual, except that a ValidationVisual is populated when the system requests that it be filled, instead of when the program code wants to populate it. For example, as described in U.S. Serial No. 10/185,775, the high-level composition and animation engine 214 (FIG. 2) may invalidate scene graph data as resources are needed, such as when part of a scene graph is not visible. For example if some parts are scrolled off the display, clipped, and so on. If the invalidated scene graph data is later needed, the program code 202 called will be called back to redraw (validate) the invalidated portion of the scene graph. To this end, one typical usage scenario is for a program code to subclass the ValidationVisual and override the OnValidate method. When the system calls the OnValidate method, a drawing context is passed in, and the program the uses the drawing context repopulate the ValidationVisual.

[0053] The example below shows one way to implement a simple ValidationVisual, e.g., one that draws a line with a certain color. The color of the line can be changed by calling SetColor. To force the update of the ValidationVisual, SetColor calls Invalidate to force the graphics sub-system to revalidate the ValidationVisual:

```
public class MyValidationVisual : ValidationVisual
{
    public override void OnValidate(IDrawingContext dc)
    {
        dc.DrawLine(m_color, ...);
    }

    public void SetColor(Color newColor)
    {
        m_color = color;
        Invalidate(); // Force a redraw of the ValidationVisual to
                      // reflect the color change.
    }
    private Color m_color
}
```

[0054] This example shows how to use the ValidationVisual:

```
MyValidationVisual myVV = new MyValidationVisual();

container.Children.Add(myVV);

myVV.SetColor(new Color(...));
```

[0055] FIG. 4 shows an example scene graph 400 in which ContainerVisuals and DrawingVisuals are related in a scene graph, and have associated data in the form of drawing primitives, (e.g., in corresponding drawing contexts). The ContainerVisual is a container for Visuals, and ContainerVisuals can be nested into each other. The children of a ContainerVisual can be manipulated with a VisualCollection returned from a Children property of the VisualContainer. The order of the Visuals in the VisualCollection determines in which order the Visuals are rendered, i.e. Visuals are rendered from the lowest index to the highest index from back to front (painting order). For example, with proper parameters with three drawing visuals representing red, green, and blue rectangles hierarchically under a container visual, the following code would result in three rectangles being drawn (translating to the right and down), a red rectangle in back, a green rectangle in the middle and a blue rectangle in front:

```
VisualCollection vc = m_cv.Children;
vc.Add(new DrawingVisual());
vc.Add(new DrawingVisual());
vc.Add(new DrawingVisual());

for (int i = 0; i < vc.Count; i++)
```

```
{
      DrawingVisual v = (DrawingVisual)(vc[i]);
      if (v != null)
      {
            v.Transform = Transform.CreateTranslation(i * 20.0f, i*20f);
            IDrawingContext dc = v.Open();
            dc.DrawRectangle(
                  new Brush(colors[i]),
                  null,
                  new Point2D(0, 0),
                  new Point2D(100.0f, 100.0f));
            v.Close(dc);
      }
}
```

[0056] As represented in FIG. 5, another type of visual object is a SurfaceVisual 504. In general, as represented in FIG. 3, a SurfaceVisual object 315 references an in-memory surface (bitmap) 322 that the program code 202 (FIG. 2) can access. The client program code 202 can supply its own surface memory, or it can request that the memory be allocated by the surface object.

[0057] The program code 202 has the option to open a SurfaceVisual and get a drawing context 323, into which the program code 202 can write pixel data 324 or the like and directly put those pixels onto the surface. This is represented in FIG. 3 by the dashed line between the surface object 322, the drawing context 323 (shown as a dashed box to represent its temporary nature) and the pixel data 324.

[0058] The program code 202 also has an option to create a surface visual manager 330 and associate a visual subgraph 332 with the SurfaceVisual 315. This option is represented in FIG. 3 by the dashed line between the surface object 322 and the surface visual manager 330. Note that the visual subgraph 332 can also nest other surface visuals, as also shown in FIG 3. The surface visual manager 330 (also shown as a type of other object in the set 620 of FIG. 6) walks the visual subgraph 332 to update the SurfaceVisual bitmap 322. Further, note that this traversal is scheduled by the dispatcher 308, and for efficiency may be throttled to control how often this bitmap 322 is updated. The surface visual manager 330 does not have to traverse the visual subgraph 322 each time and/or at the same rate that the top level visual manager 302 walks the rest of the scene graph.

[0059] With respect to surfaces, as further described with reference to FIGS. 9A-9C, in general, the present graphics model thus allows compositing a set of visuals to a surface, immediate-mode rendering of vector and bitmap primitives into a surface, compositing a surface onto the desktop or onto another surface, and controlling which surface in a surface list is used to composite into or to draw into. A surface list is defined as a collection of one or more surfaces (i.e. frames/buffers) of physical (system or video) memory used to store compositions of visuals or graphical drawings, or both. One of the surfaces of the surface list may be set as a current back buffer where drawing and/or compositing is done, and one of the surfaces of the surface list is set as a current primary, or front buffer, which is used to composite onto another render target.

[0060] Surfaces may be used in a number of ways. By way of example, FIG. 9A shows compositing to a surface. In FIG. 9A, a surface visual manager object 900 connects a surface list 902 as a render target for a visual tree 904. During each compositing cycle, the visuals are composited into the surface of the surface list that is currently serving as the active back buffer for the surface list. The surface being composited to can include a surface owned by the client/high level compositing engine 214 (FIG. 2) for in-process compositing scenarios, a surface owned by the low-level compositing engine 218 for scenarios where the client does not need the bits but the low-level compositing engine 218 needs them to composite the surface onto another render target, or a cross-process surface, for scenarios where the client needs access to the surface bits, but the low-level compositing engine 218 also needs the surface for other compositing work.

[0061] The compositing is controlled by a timing service that is attached to the Visual Manager. One example of a timing service, is a manual mode that might be used as in the example below:

```
// create a manual timing service and attach a visual manager
TimingService timingService = new ManualTimingService(visualManager);

// composite the visual tree to the current back buffer of the surface
visualManager.Render();

foreach (Tick tick in timingService)
```

```
{
      // advance the back buffer to the next frame of the surface
      surfaceList.NextFrame();

      // advance the time of the visual tree
      timingService.Tick(tick);

      // composite the visual tree to the current back buffer of surface
      visualManager.Render();
}
```

[0062] Another way to use a surface is with immediate-mode rendering to a surface, via a context. Attaching a surface list to a visual (a surface visual) enables immediate-mode rendering to the surface of the surface list that is currently serving as the active back buffer for the surface list. This rendering is done by obtaining a drawing context from the surface visual and executing drawing commands on that context, as described above. Note that obtaining a drawing context locks the surface so that other compositing operations cannot be done to it. Each drawing command is executed immediately, and vectors and other surfaces can be drawn (blended) onto the surface. However, other visuals cannot be drawn onto the surface, but instead can be composited into the surface by associating it with a visual manager, as previously described (e.g., in FIG. 9A).

```
// attach a surface list to a visual
SurfaceVisual surfaceVisual = new SurfaceVisual(surfaceList);

// enable immediate-mode rendering to (and lock) back buffer
surface
BaseDrawingContext dc = surfaceVisual.Open();

// draw a line (immediately) to the current back buffer of the
surface
dc.DrawLine (pen, startPoint, endPoint);
```

```
// unlock the surface - we're done with immediate-mode rendering
surfaceVisual.Close(dc);
```

[0063] Another use for surfaces is when compositing a surface onto another render target. To this end, once a surface list is attached to a surface visual, the surface can then be attached as a node in a visual tree, and the surface of the surface list that is currently serving as the primary or front buffer can be composited to another surface or to the desktop. This is illustrated in FIG. 9B and in the example below:

```
// attach a surface list to a visual
SurfaceVisual surfaceVisual = new SurfaceVisual(surfaceList);

// Add the surfaceVisual to a visual tree for compositing onto another
// render target
rootVisual.Add(surfaceVisual);
```

[0064] Live composition to/from a surface is represented in FIG. 9C, where the above-described capabilities are combined so that compositing to the back buffer surface of a surface list and compositing from the front buffer surface of a surface list (e.g. to the desktop) happen simultaneously. Note that to eliminate the undesirable video effect known as tearing, the surface list should have at least two surfaces, a front and a back buffer surface. A surface used as in FIG. 9C is likely owned by the low-level engine 218, or is a cross-process surface to make the composition in the low level engine 218 perform better.

[0065] Surfaces are constructed as independent objects, as set forth in the examples of constructors below:

```
public class Surface
{
      // create and allocate a blank surface without initial data
      public Surface(int width,
            int height,
            int dpi,
            PixelFormat pixelFormat,
            SurfaceFlags flags)

      // create a surface using the supplied memory
      public Surface(int width,
            int height,
            int dpi,
            PixelFormat pixelFormat,
            IntPtr pixels,  // managed memory for the surface
            Int stride)

      // create from a source (i.e. Clone)
      public Surface(Surface sourceSurface,
            SurfaceFlags flags)

      // Create from File or URL
      public Surface (String filename,
            SurfaceFlags flags)

      // Create from Stream
      public Surface (System.IO.Stream stream,
            SurfaceFlags flags)

      // Create from HBITMAP (which can't be selected into an HDC)
      public Surface (HBITMAP hbitmap, HPALETTE hPalette)

      // Create from HICON
      public Surface (HICON hicon)

      // read-only properties
      public Int Width {get; }

      public Int Height {get; }

      public Int Dpi {get;}

      public PixelFormat Format{get; }

      public int Stride{get; }

      public IntPtr Buffer {get;}

}
```

```
public class SurfaceList
{
      // Create a list of blank surfaces (without initial data).
      public SurfaceList (int width,
            int height,
            int dpi,
            PixelFormat pixelFormat,
            int numSurfaces,
            SurfaceFlags flags)

      // Create a SurfaceList that uses the specified surfaces
      // All the surfaces must have identical properties (w, h,
      // dpi, etc).
      public SurfaceList (Surface []surfaces)

      // change the front buffer to the first-in-line back buffer
      public Flip()

      // advance the back buffer to the next surface
      public Next()

      public int FrontBufferIndex {get; set;}

      public int BackBufferIndex {get; set;}

      public Surface GetFrontBuffer()
      public Surface GetBackBuffer()
      public Surface GetSurface(int surfaceIndex)
}
```

[0066] Once constructed, a surface and/or a surface list can be attached to a surface visual object or to a visual manager object.

```
// Create a surface visual
public SurfaceDrawingVisual(Surface surface)
public SurfaceDrawingVisual(SurfaceList surfaceList)

// Create a visual manager with a surface render target
public VisualManager(Surface surface)
public VisualManager(SurfaceList surfaceList)
```

[0067] Further, a surface can get data from a decoder, and/or send its data to an encoder for writing to a specific file format. Surfaces can also receive/send data from/to effect interfaces. A surface can be constructed for any pixel format from the full set of supported surface format types. However, some adjustments may be made to the specified pixel format, e.g., if the specified pixel format is less than 32 bits per pixel, then the format will be promoted to 32 bits per pixel. Whenever bits are requested from a surface in the original format, the surface will be copied to a buffer of the requested pixel format using a format conversion filter.

[0068] Returning to FIG. 5, yet another visual is an HwndVisual 505, which positions a Win32 child HWnd in the scene graph. More particularly, legacy programs will still operate via the WM_PAINT method (or the like) that draws to a child HWnd (or the like) based on prior graphics technology. To support such programs in the new graphics processing model, the HwndVisual allows the Hwnd to be contained in a scene graph and moved as the parent visual is repositioned, as represented in FIG. 10A. As a result of limitations with existing Hwnds, however, when rendered, a child Hwnd can only be on top of other windows, and cannot be rotated or scaled like other visuals described above. Some clipping is possible, as represented in FIG. 10B, where the dashed lines indicate the HWnd's displayed rectangle being clipped during relative movement with respect to its parent visual.

[0069] Other types of visuals 506 are also feasible, and the present object model is extensible to allow others to be developed. For example, as represented in FIG. 11, a layered visual 1100 enables an application developer to separately control the information in a visual via multiple data streams, providing a finer granularity of control relative to visuals having a single data stream. Note that similar granularity of control can be accomplished by having (e.g., three) separate child visuals under a single parent visual, however this requires that the program code work with multiple visuals, which is more complicated than working with a single layered visual having indexes to multiple layers.

[0070] By way of example, in FIG. 11, background data, content data and border data are contained in a single layered visual, but are separated from one another as indexed by a layer value, e.g., 0, 1 or 2, respectively. Layers can be inserted, including tacked onto either end, and/or deleted, with the layering order (e.g., left-to-right as shown) defining an implied Z-order for display. Note that for security, child content and other data in a layered visual cannot be enumerated.

[0071] Other types of visuals include container visuals, and redirected child HWnd visuals, in which content is drawn to a bitmap, and incorporated into a surface visual. Three-dimensional visuals enable a connection between two-dimensional and three dimensional worlds, e.g., a camera-like view is possible via a two-dimensional visual having a view into a three-dimensional world.

[0072] Many of the resource objects are immutable once created, that is, once they are created they cannot be changed for various reasons, including simplifying threading issues, preventing corruption by others, and simplifying the interaction with elements and APIs. Note that this generally simplifies the system. It should be noted, however, that it is feasible to have a system where such objects are mutable, but for example would require managing a dependency graph. For example, while it is possible to have a system where such objects are mutable, if program code changed the clip set on a Visual, the visual would need to be re-rendered, thus requiring a notification / registration mechanism, e.g., if a new clip is assigned to a visual, the visual registers itself with the clip for notifications (e.g., a clip changed notification). Thus, in one implementation, for simplification purposes, resource objects are immutable.

[0073] These resource objects can be defined with a constructor, which is a straightforward, generic way to create an object, or by using a companion builder object, as described below. For instance, to create a SolidColorBrush, (brush objects are described below), a constructor may be used:

```
Brush MyBrush = new SolidColorBrush(Colors.Red);
```

[0074] The user can also use the static members on the Brushes class to get a set of predefined colors.

[0075] Because immutable objects cannot be changed, to effectively change an object, the user needs to create a new object and replace the old one with it. To this end, many of the resource objects in the system may utilize the builder pattern, in which immutable objects are created with a builder class, which is a companion class that is mutable. The user creates an immutable object to mirror the parameters set on the builder, creates a new builder for that object, and initializes it from the immutable object. The user then changes the builder as necessary. Once done, the user can build a new object, by changing the builder and reusing it to create another immutable object. Note that having immutable objects with set properties is desirable, and that immutable objects cannot be changed, but only replaced by firing a property change event.

[0076] Thus, instead of using a constructor to create a SolidColorBrush as described above, a SolidColorBrushBuilder may be used:

```
SolidColorBrushBuilder MyBuilder = new
SolidColorBrushBuilder();
MyBuilder.Color = Colors.Red;
Brush MyBrush = MyBuilder.ToBrush();
```

[0077] Most objects that take static values can also take animation objects. For instance, on the DrawingContext there is an override on DrawCircle that takes a PointAnimationBase for the center of the circle. In this way, the user can specify rich animation information at the primitive level. For resource objects there exists an animation collection in addition to the base value. These are composited, whereby if the user wanted to animate the above example, the user could specify the following example line before the brush is built:

```
MyBuilder.ColorAnimations.Add(new ColorAnimation (...));
```

[0078] Note that an object with animation parameters is still immutable, because its animation parameters are static. However, when the scene graph is processed (e.g., traversed), the meaning of animation parameters changes over time, giving the appearance of animated, not static, data.

[0079] As described above, visuals can be drawn on by populating their drawing contexts with various drawing prim-

itives, including Geometry, ImageData and VideoData. Furthermore, there are a set of resources and classes that are shared through this entire stack. This includes Pens, Brushes, Geometry, Transforms and Effects. The IDrawingContext exposes a set of drawing operations that can be used to populate a DrawingVisual, ValidationVisual. ISurfaceDrawingContext, a base interface to IDrawing context, can be used to populate a SurfaceVisual. In other words, the drawing context exposes a set of drawing operations; for each drawing operation there are two methods, one that takes constants as arguments, and one that takes animators as arguments.

[0080] The DrawLine method draws a line with the specified pen from the start point to the end point.

```
public void DrawLine(Pen pen, Point start, Point end);
public void DrawLine(
      Pen pen,
      PointAnimationBase start,
      PointAnimationBase end);
```

[0081] The DrawRoundedRectangle method draws a rounded rectangle with the specified brush and pen; brush and pen can be null.

```
public void DrawRoundedRectangle(
      Brush brush,
      Pen pen,
      Point topLeft,
      Size size,
      float radius);
public void DrawRoundedRectangle(
      Brush brush,
      Pen pen,
      PointAnimationBase topLeft,
      SizeAnimationBase size,
      NumberAnimationBase radius);
public void DrawRoundedRectangle(
      Brush brush,
      Pen pen,
      Point topLeft,
      Point bottomRight,
      float rx,
      float ry);
public void DrawRoundedRectangle(
      Brush brush,
      Pen pen,
      PointAnimationBase topLeft,
      PointAnimationBase bottomRight,
      NumberAnimationBase radiusX,
      NumberAnimationBase radiusY);
```

[0082] The DrawGeometry method draws a path with the specified brush and pen; brush and pen can be null.

```
public void DrawGeometry(
      Brush brush,
```

```
        Pen pen,
        Geometry geometry);
```

[0083] The DrawRectangle method draws a rectangle with the specified brush and pen; brush and pen can be null.

```
    public void DrawRectangle(
        Brush brush,
        Pen pen,
        Point topLeft,
        Size size);
    public void DrawRectangle(
        Brush brush,
        Pen pen,
        PointAnimationBase topLeft,
        SizeAnimationBase size);
```

[0084] The DrawSurface method draws a surface.

```
    public void DrawSurface(
        Surface surface,
        Point topLeft,
        Size size,
        float opacity);
    public void DrawSurface(
        Surface image,
        PointAnimationBase topLeft,
        SizeAnimationBase size,
        NumberAnimationBase opacity);
```

[0085] Geometry is a type of class (FIG. 12) that defines a vector graphics skeleton, without stroke or fill. Each geometry object is a simple shape (LineGeometry, EllipseGeometry, RectangleGeometry), a complex single shape (PathGeometry) or a list of such shapes GeometryList with a combine operation (e.g., union, intersection, and so forth) specified. These objects form a class hierarchy as represented in FIG. 12.

[0086] As represented in FIG. 13, the PathGeometry is a collection of Figure objects. In turn, each of the Figure objects is composed of one or more Segment objects which actually define the figure's shape. A Figure is a sub-section of a Geometry that defines a segment collection. This segment collection is a single connected series of two-dimensional Segment objects. The Figure can be either a closed shape with a defined area, or just a connected series of Segments that define a curve, but no enclosed area.

[0087] The filled area of the PathGeometry is defined by taking the contained Figures that have their Filled property set to true, and applying a FillMode to determine the enclosed area. Note that the FillMode enumeration specifies how the intersecting areas of Figure objects contained in a Geometry are combined to form the resulting area of the Geometry. An "Alternate" rule determines whether a point is inside the canvas, by conceptually drawing a ray from that point to infinity in any direction, and then examining the places where a segment of the shape crosses the ray. By starting with a count of zero and adding one each time a Segment crosses the ray from left to right and subtracting one each time a path segment crosses the ray from right to left, after counting the crossings, if the result is zero then the point is outside the path. Otherwise, it is inside. A "winding" rule determines whether a point on the canvas is inside, and works by conceptually drawing a ray from that point to infinity in any direction and counting the number of path Segments from the given shape that the ray crosses. If this number is odd, the point is inside; if even, the point is outside.

[0088] As represented in FIG. 14, when geometry (e.g., a rectangle) is drawn, a brush or pen can be specified, as described below. Furthermore, the pen object also has a brush object. A brush object defines how to graphically fill a plane, and there is a class hierarchy of brush objects. This is represented in FIG. 14 by the filled rectangle 1402 that

results when the visual including the rectangle and brush instructions and parameters is processed.

[0089] As described below, some types of Brushes (such as gradients and nine grids) size themselves. When used, the size for these brushes is obtained from the bounding box, e.g., when the GradientUnits/DestinationUnits for the Brush is set to ObjectBoundingBox, the bounding box of the primitive that is being drawn is used. If those properties are set to UserSpaceOnUse, then the coordinate space is used.

[0090] A Pen object holds onto a Brush along with properties for Width, LineJoin, LineCap, MiterLimit, DashArray and DashOffset, as represented in the example below:

```
public enum System.Windows.Media.PenLineCap
{
    Butt, Round, Square
}
```

```
public enum System.Windows.Media.PenLineJoin
{
    Miter, Round, Bevel
}

public class System.Windows.Media.Pen
{
    // Constructors
    public Pen(Color color, float width);
    public Pen(Brush brush, float width);

    // Properties
    public float[] DashArray { get; }

    public float DashOffset { get; }
    public FloatAnimationCollection DashOffsetAnimations { get; }

    public PenLineCap LineCap { get; }
    public PenLineJoin LineJoin { get; }

    public float MiterLimit { get; }
    public FloatAnimationCollection MiterLimitAnimations { get; }

    public float Opacity { get; }
    public FloatAnimationCollection OpacityAnimations { get; }

    public Brush Brush { get; }

    public float Width { get; }
    public FloatAnimationCollection WidthAnimations { get; }
}

public sealed class System.Windows.Media.PenBuilder : Builder
{

    // Fields

    // Constructors
    public PenBuilder();
    public PenBuilder(Color color);
    public PenBuilder(Brush brush);
    public PenBuilder(Pen pen);

    // Properties
    public float[] DashArray { get; set; }

    public float DashOffset { get; set; }
    public FloatAnimationCollectionBuilder DashOffsetAnimations {
      get; }

    public PenLineCap LineCap { get; set; }
    public PenLineJoin LineJoin { get; set; }

    public float MiterLimit { get; set; }
```

```
    public FloatAnimationCollectionBuilder MiterLimitAnimations {
      get; }

    public float Opacity { get; set; }
    public FloatAnimationCollectionBuilder OpacityAnimations { get;
      }

    public Brush Brush { get; set; }

    public float Width { get; set; }
    public FloatAnimationCollectionBuilder WidthAnimations { get; }

    // Methods
    public Pen ToPen();
}
```

[0091] As mentioned above, the graphics object model of the present invention includes a Brush object model, which is generally directed towards the concept of covering a plane with pixels. Examples of types of brushes are represented in the hierarchy of FIG. 15, and, under a Brush base class, include SolidColorBrush, GradientBrush, ImageBrush, VisualBrush (which can reference a Visual) and NineGridBrush. GradientBrush includes LinearGradient and RadialGradient objects. As described above, Brush objects are immutable.

```
public abstract class System.Windows.Media.Brush
{
    float Opacity { get; }
    FloatAnimationCollection OpacityAnimations { get; }
}
```

[0092] The following sets forth an example BrushBuilder class:

```
public abstract class System.Windows.Media.BrushBuilder : Builder
{

    public virtual Brush ToBrush();
    public override sealed object CreateInstance();
    {
        return ToBrush();
    }
    float Opacity { get; set; }
    FloatAnimationCollectionBuilder OpacityAnimations { get; }
}
```

[0093] Note that Brush objects may recognize how they relate to the coordinate system when they are used, and/or how they relate to the bounding box of the shape on which they are used. In general, information such as size may be inferred from the object on which the brush is drawn. More particularly, many of the brush types use a coordinate system for specifying some of their parameters. This coordinate system can either be defined as relative to the simple bounding box of the shape to which the brush is applied, or it can be relative to the coordinate space that is active at the time that the brush is used. These are known, respectively, as ObjectBoundingBox mode and UserSpaceOnUse mode.

```
public enum System.Windows.Media.BrushMappingMode
{
    ObjectBoundingBox,
    UserSpaceOnUse,
}
```

[0094] A SolidColorBrush object fills the identified plane with a solid color. If there is an alpha component of the color, it is combined in a multiplicative way with the corresponding opacity attribute in the Brush base class. The following sets forth an example SolidColorBrush object:

```
public sealed class System.Windows.Media.SolidColorBrush : Brush
{

    // Constructors
    public SolidColorBrush(); // initialize to black
    public SolidColorBrush(Color color);
    public SolidColorBrush(System.Windows.Media.Animation.ColorComposer
      colorComposer);

    // Properties
    public Color Color { get; }
    public IEnumerator ColorAnimations { get; }
}

public class System.Windows.Media.SolidColorBrushBuilder : BrushBuilder
{
    // Constructors
    public SolidColorBrushBuilder();
    public SolidColorBrushBuilder(Color color);
    public SolidColorBrushBuilder(SolidColorBrush scp);

    // Properties
    public Color Color { get; set; }
    public AnimationList ColorAnimations { get; }

    // Methods
    public virtual Brush ToBrush();
}
```

[0095] The GradientBrush objects, or simply gradients, provide a gradient fill, and are drawn by specifying a set of gradient stops, which specify the colors along some sort of progression. The gradient is by drawn by performing linear interpolations between the gradient stops in a gamma 2.2 RGB color space; interpolation through other gammas or other color spaces (HSB, CMYK and so forth, is also a feasible alternative. Two types of gradient objects include linear and radial gradients.

[0096] In general, gradients are composed of a list of gradient stops. Each of these gradient stops contains a color (with the included alpha value) and an offset. If there are no gradient stops specified, the brush is drawn as a solid transparent black, as if there were no brush specified at all. If there is only one gradient stop specified, the brush is drawn as a solid color with the one color specified. Like other resource classes, the gradient stop class (example in the table below) is immutable.

```
public class System.Windows.Media.GradientStop
{
    public GradientStop(Color color, float offset);

    public Color Color { get; }
    public AnimationEnumerator ColorAnimations { get; }
    public float Offset { get; }
    public AnimationEnumerator OffsetAnimations { get; }
}

public class System.Windows.Media.GradientStopBuilder : Builder
{
    public GradientStopBuilder();
    public GradientStopBuilder(Color color, float offset);

    public Color Color { get; set; }
    public AnimationList ColorAnimations { get; }
    public float Offset { get; set; }
    public AnimationList OffsetAnimations { get; }
    public GradientStop ToGradientStop();
}
```

[0097] There is also a collection class, as set forth in the following example:

```
public class System.Windows.Media.GradientStopCollection : ICollection
{
    public GradientStopCollection(); // empty list
    public GradientStopCollection(GradientStop[] GradientStops);
    public GradientStopCollection(ICollection c);

    // IEnumerable
    public IEnumerator GetEnumerator();

    // ICollection
    public void CopyTo(Array array, int index);
    public bool ICollection.IsSynchronized { get { return false; } }
```

```
    public int Count { get; }
    public object ICollection.SyncRoot { get; }

    // Extra functions
    public GradientStop this[int index] { get; }
    public bool Contains(GradientStop value);
    public int IndexOf(GradientStop value); // returns first one
    public int IndexOf(GradientStop value, int startIndex);
    public int IndexOf(GradientStop value, int startIndex, int count);
    public int LastIndexOf(GradientStop value);
    public int LastIndexOf(GradientStop value, int startIndex);
    public int LastIndexOf(GradientStop value, int startIndex, int count);
    public GradientStopCollection GetRange(int index, int count);
}

public class System.Windows.Media.GradientStopCollectionBuilder : Builder,
      IList
{
    public GradientStopCollectionBuilder();
    public GradientStopCollectionBuilder(GradientStop [] GradientStops);
    public GradientStopCollectionBuilder(ICollection c);
    public GradientStopCollectionBuilder(GradientStopCollection
      GradientStops);

    // IEnumerable
    public IEnumerator GetEnumerator();

    // ICollection
    public void CopyTo(Array array, int index);
    public bool ICollection.IsSynchronized { get { return false; } }
    public int Count { get; }
    public object ICollection.SyncRoot { get; }

    // IList
    public bool IsFixedSize { get { return false; } }
    public bool IsReadOnly { get { return false; } }
    public object IList.this [int index] { get; set; }
    public int IList.Add(object value);
    public void Clear();
    public bool IList.Contains(object value);
    public int IList.IndexOf(object value); // returns first one
    public void IList.Insert(int index, object value);
    public void IList.Remove(object value); // removes first one
    public void RemoveAt(int index);

    // Extra functions
    public GradientStop this [int index] { get; set; }
    public int Add(GradientStop value);
    public bool Contains(GradientStop value);
    public int IndexOf(GradientStop value); // returns first one
    public int IndexOf(GradientStop value, int startIndex);
    public int IndexOf(GradientStop value, int startIndex, int count);
    public int LastIndexOf(GradientStop value);
    public int LastIndexOf(GradientStop value, int startIndex);
    public int LastIndexOf(GradientStop value, int startIndex, int count);
    public void Insert(int index, GradientStop value);
    public void Remove(GradientStop value); // removes first one
    public void AddRange(ICollection c);
```

```
    public void InsertRange(int index, ICollection c);
    public void RemoveRange(int index, int count);
    public void SetRange(int index, ICollection c);
    public GradientStopCollectionBuilder GetRange(int index, int count);

    // Capacity is a hint.  It will throw an exception if it is set less
      than Count.
    public int Capacity { get; set; }

    // Builder overloads
    public override object Build();
    public override void ResetBuilder();
    public override void SetBuilder(Object example);

    public GradientStopCollection ToGradientStopCollection();
}
```

[0098] As represented in the table below, the GradientSpreadMethod specifies how the gradient should be drawn outside of the specified vector or space. There are three values, including pad, in which the edge colors (first and last) are used to fill the remaining space, reflect, in which the stops are replayed in reverse order repeatedly to fill the space, and repeat, in which the stops are repeated in order until the space is filled:

```
public enum System.Windows.Media.GradientSpreadMethod
{
    Pad,
    Reflect,
    Repeat
}
```

[0099] FIG. 16 shows examples of the GradientSpreadMethod. Each shape has a linear gradient going from white to grey. The solid line represents the gradient vector.

[0100] The LinearGradient specifies a linear gradient brush along a vector. The individual stops specify colors stops along that vector. An example is shown in the table below:

```
public class System.Windows.Media.LinearGradient : GradientBrush
{
    // Sets up a gradient with two colors and a gradient vector
    // specified to fill the object the gradient is applied to.
    // This implies ObjectBoundingBox for the GradientUnits
    // property
    public LinearGradient(Color color1, Color color2, float
      angle);

    public BrushMappingMode GradientUnits { get; }
    public Transform GradientTransform { get; }
    public GradientSpreadMethod SpreadMethod { get; }

    // Gradient Vector
    public Point VectorStart { get; }
    public PointAnimationCollection VectorStartAnimations { get; }
    public Point VectorEnd { get; }
    public PointAnimationCollection VectorEndAnimations { get; }

    // Gradient Stops
    public GradientStopCollection GradientStops { get; }
}


public class System.Window.Media.LinearGradientBuilder :
     GradientBrushBuilder
{
    public LinearGradientBuilder();
    public LinearGradientBuilder(Color color1, Color color2, float
      angle);
    public LinearGradientBuilder(LinearGradient lg);

    // GradientUnits: Default is ObjectBoundingBox
    public BrushMappingMode GradientUnits { get; set; }
    // GradientTransform: Default is identity
    public Transform GradientTransform { get; set; }
    // SpreadMethod: Default is Pad
    public GradientSpreadMethod SpreadMethod { get; set; }

    // Gradient Vector
    // Default vector is (0,0) - (1,0)
    public Point VectorStart { get; set; }
    public PointAnimationCollectionBuilder VectorStartAnimations {
      get; set; }
    public Point VectorEnd { get; set; }
    public PointAnimationCollectionBuilder VectorEndAnimations { get; set;
      }
```

```
      // Gradient Stops
      public void AddStop(Color color, float offset);
      public GradientStopCollectionBuilder GradientStops { get;
set; }
```

```
}
```

[0101] The RadialGradient is similar in programming model to the linear gradient. However, whereas the linear gradient has a start and end point to define the gradient vector, the radial gradient has a circle along with a focal point to define the gradient behavior. The circle defines the end point of the gradient, that is, a gradient stop at 1.0 defines the color at the circle. The focal point defines center of the gradient. A gradient stop at 0.0 defines the color at the focal point.

[0102] FIG. 17 shows a radial gradient that from white to grey. The outside circle represents the gradient circle while the dot denotes the focal point. This example gradient has its SpreadMethod set to Pad:

```
public class System.Windows.Media.RadialGradient : GradientBrush
{
    // Sets up a gradient with two colors.
    // This implies ObjectBoundingBox for the GradientUnits
    // property along with a center at (0.5,0.5)
    // a radius of 0.5 and a focal point at (0.5,0.5)
    public RadialGradient(Color color1, Color color2);

    public BrushMappingMode GradientUnits { get; }
    public Transform GradientTransform { get; }
    public GradientSpreadMethod SpreadMethod { get; }

    // Gradient definition
    public Point CircleCenter { get; }
    public PointAnimationCollection CircleCenterAnimations { get; }
    public float CircleRadius { get; }
    public FloatAnimationCollection CircleRadiusAnimations { get; }
    public Point Focus { get; }
    public PointAnimationCollection FocusAnimations { get; }

    // Gradient Stops
    public GradientStopCollection GradientStops { get; }
}
```

```
public class System.Windows.Media.RadialGradientBuilder :
      GradientBrushBuilder
{
    public RadialGradientBuilder();
    public RadialGradient(Color color1, Color color2);
    public RadialGradientBuilder(RadialGradient rg);

    // GradientUnits: Default is ObjectBoundingBox
    public BrushMappingMode GradientUnits { get; set; }
    // GradientTransform: Default is identity
    public Transform GradientTransform { get; set; }
    // SpreadMethod: Default is Pad
    public GradientSpreadMethod SpreadMethod { get; set; }

    // Gradient definition
    public Point CircleCenter { get; set;}//Default: (0.5, 0.5)
    public PointAnimationCollectionBuilder CircleCenterAnimations { get;
      set;}
    public float CircleRadius { get;set; } // Default: 0.5
    public FloatAnimationCollectionBuilder CircleRadiusAnimations {
      get;set; }
    public Point Focus { get;set; } // Default: (0.5, 0.5)
    public PointAnimationCollectionBuilder FocusAnimations { get;set; }

    // Gradient Stops
    public void AddStop(Color color, float offset);
    public GradientStopCollectionBuilder GradientStops { get; set; }
}
```

[0103] Another brush object represented in FIG. 15 is a VisualBrush object. Conceptually, the VisualBrush provides a way to have a visual drawn in a repeated, tiled fashion as a fill. Visual paint objects also provide a mechanism for markup language to directly work with the API layer at a resource level, as described below. An example of such a fill is represented in FIG. 14 by the visual brush referencing a visual (and any child visuals) that specifies a single circular shape 1420, with that circular shape filling a rectangle 1422. Thus, the VisualBrush object may reference a visual to define how that brush is to be drawn, which introduces a type of multiple use for visuals. In this manner, a program may use an arbitrary graphics "metafile" to fill an area via a brush or pen. Since this is a compressed form for storing and using arbitrary graphics, it serves a graphics resource. The following sets forth an example VisualBrush object:

```
public class System.Windows.Media.VisualBrush : Brush
{
    public VisualBrush(Visual v);

    public BrushMappingMode DestinationUnits { get; }
    public BrushMappingMode ContentUnits { get; }
    public Transform Transform { get; }

    public Rect ViewBox { get; }
    public Stretch Stretch { get; }
    public HorizontalAlign HorizontalAlign { get; }
    public VerticalAlign VerticalAlign { get; }

    public Point Origin { get; }
    public PointAnimationCollection OriginAnimations { get; }
    public Size Size { get; }
    public SizeAnimationCollection SizeAnimations { get; }

    // Visual
    public Visual Visual { get; }
}

public class System.Windows.Media.VisualBrushBuilder : BrushBuilder
{
    public VisualBrushBuilder();
    public VisualBrushBuilder(Visual v);
    public VisualBrushBuilder(VisualBrush vb);

    // DestinationUnits: Default is ObjectBoundingBox
    public BrushMappingMode DestinationUnits { get; set; }
    // ContentUnits: Default is ObjectBoundingBox
    public BrushMappingMode ContentUnits { get; set; }
    // Transform: Default is Identity
    public Transform Transform { get; set; }
    // ViewBox: Default is (0,0,0,0) -- unset and ignored
    public Rect ViewBox { get; set; }
    // Stretch: Default is None -- and ignored
    //          because the ViewBox is not set
    public Stretch Stretch { get; set; }
    // HorizontalAlign: Default is Center and ignored
    public HorizontalAlign HorizontalAlign { get; set; }
    // VerticalAlign: Default is Center and ignored
    public VerticalAlign VerticalAlign { get; set; }

    // Origin: Default is (0,0)
    public Point Origin { get; set; }
    public PointAnimationCollectionBuilder OriginAnimations { get; set; }
    // Size: Default is (1,1)
    public Size Size { get; set; }
    public SizeAnimationCollectionBuilder SizeAnimations { get; set; }

    // Visual: Default is null -- nothing drawn
    public Visual Visual { get; set; }
}
```

[0104] A VisualBrush's contents have no intrinsic bounds, and effectively describe an infinite plane. These contents exist in their own coordinate space, and the space which is being filled by the VisualBrush is the local coordinate space at the time of application. The content space is mapped into the local space based on the ViewBox, ViewPort, Alignments and Stretch properties. The ViewBox is specified in content space, and this rectangle is mapped into the ViewPort (as specified via the Origin and Size properties) rectangle.

[0105] The ViewPort defines the location where the contents will eventually be drawn, creating the base tile for this Brush. If the value of DestinationUnits is UserSpaceOnUse, the Origin and Size properties are considered to be in local space at the time of application. If instead the value of DestinationUnits is ObjectBoundingBox, then an Origin and Size are considered to be in the coordinate space, where 0,0 is the top/left corner of the bounding box of the object being brushed, and 1,1 is the bottom/right corner of the same box. For example, consider a RectangleGeometry being filled which is drawn from 100,100 to 200,200. In such an example, if the DestinationUnits is UserSpaceOnUse, an Origin of 100,100 and a Size of 100,100 would describe the entire content area. If the DestinationUnits is ObjectBoundingBox, an Origin of 0,0 and a Size of 1,1 would describe the entire content area. If the Size is empty, this Brush renders nothing.

[0106] The ViewBox is specified in content space. This rectangle is transformed to fit within the ViewPort as determined by the Alignment properties and the Stretch property. If the Stretch is none, then no scaling is applied to the contents. If the Stretch is Fill, then the ViewBox is scaled independently in both X and Y to be the same size as the ViewPort. If the Stretch is Uniform or UniformToFill, the logic is similar but the X and Y dimensions are scaled uniformly, preserving the aspect ratio of the contents. If the Stretch is Uniform, the ViewBox is scaled to have the more constrained dimension equal to the ViewPort's size. If the Stretch is UniformToFill, the ViewBox is scaled to have the less constrained dimension equal to the ViewPort's size. In other words, both Uniform and UniformToFill preserve aspect ratio, but Uniform ensures that the entire ViewBox is within the ViewPort (potentially leaving portions of the ViewPort uncovered by the ViewBox), and UniformToFill ensures that the entire ViewPort is filled by the ViewBox (potentially causing portions of the ViewBox to be outside the ViewPort). If the ViewBox is empty, then no Stretch will apply. Note that alignment will still occur, and it will position the "point" ViewBox.

[0107] FIG. 18 provides representations of a single tile 1800 of graphics rendered with various stretch settings, including a tile 800 when stretch is set to "none." The tile 1802 is a representation of when the stretch is set to "Uniform," the tile 1804 when stretch is set to "UniformToFill," and the tile 1806 when stretch is set to "Fill."

[0108] Once the ViewPort is determined (based on DestinationUnits) and the ViewBox's size is determined (based on Stretch), the ViewBox needs to be positioned within the ViewPort. If the ViewBox is the same size as the ViewPort (if Stretch is Fill, or if it just happens to occur with one of the other three Stretch values), then the ViewBox is positioned at the Origin so as to be identical to the ViewPort. Otherwise, HorizontalAlignment and VerticalAlignment are considered. Based on these properties, the ViewBox is aligned in both X and Y dimensions. If the HorizontalAlignment is Left, then the left edge of the ViewBox will be positioned at the Left edge of the ViewPort. If it is Center, then the center of the ViewBox will be positioned at the center of the ViewPort, and if Right, then the right edges will meet. The process is repeated for the Y dimension.

[0109] If the ViewBox is (0,0,0,0), it is considered unset, whereby ContentUnits are considered. If the ContentUnits are UserSpaceOnUse, no scaling or offset occurs, and the contents are drawn into the ViewPort with no transform. If the ContentUnits are ObjectBoundingBox, then the content origin is aligned with the ViewPort Origin, and the contents are scale by the object's bounding box's width and height.

[0110] When filling a space with a VisualBrush, the contents are mapped into the ViewPort as above, and clipped to the ViewPort. This forms the base tile for the fill, and the remainder of the space is filled based on the Brush's TileMode. Finally, if set, the Brush's transform is applied - it occurs after all the other mapping, scaling, offsetting, etc.

[0111] The TileMode enumeration is used to describe if and how a space is filled by its Brush. A Brush which can be tiled has a tile rectangle defined, and this tile has a base location within the space being filled. The rest of the space is filled based on the TileMode value. FIG. 19 provides a representation of example graphics with various TileMode settings, including "None" 1900, "Tile" 1092, "FlipX" 1904, "FlipY" 1906 and "FlipXY" 1908. The top left-most tile in the various example graphics comprises the base tile.

[0112] FIG. 20 represents a process for generating the pixels for this brush. Note that the logic described in FIG. 20 is only one possible way to implement of the logic, and it should be understood that other ways, including more efficient ways, are feasible. For example, there are likely more efficient ways processing the data, e.g., such that the content is not drawn for each repetition, with the tile drawn and cached. However, FIG. 20 provides a straightforward description.

[0113] In general, each time the contents of the pattern are drawn, a new coordinate system is created. The origin and offset of each repetition is specified by the Origin and Size properties, as filtered through the DestinationUnits and Transform properties.

[0114] A coordinate frame is set up based on the DestinationUnits property. To this end, if at step 2000, the DestinationUnits property is UserSpaceOnUse, the current coordinate frame at the time the brush was used is the starting coordinate frame, via step 2002. If instead at step 2004 the property is ObjectBoundingBox, the bounding box of the geometry to which this brush is applied is used, as represented by step 2004, to set a new coordinate frame such that the upper left corner of the bounding box maps to (0,0) and the lower left corner of the bounding box maps to (1,1). In either case, at step 2006 the Transform property is applied to this coordinate frame, which essentially defines a grid.

[0115] FIG. 21 represents a VisualBrush Grid that is defined for the tiles in a VisualBrush. The first circle is a simple grid, and the second has a Transform with a Skew in the x direction of 47.

[0116] At step 2008, the visual is drawn into each cell of the grid, as represented in FIG. 22, where the visual draws the appropriate data. If at step 2010 there is a ViewBox specified, the Visual is fitted into the grid cell as specified by the ViewBox, Stretch, HorizontalAlign and VerticalAlign attributes, via step 2012. The DestinationUnits and Transform properties are used to apply the correct transform such that the visual lines up in the grid box.

[0117] If there is no ViewBox specified, then a new coordinate system is established for drawing the content at step 2014.

[0118] The coordinate frame is set such that its origin is at the Origin point for that particular grid cell being drawn.

[0119] A clip is applied at step 2018 based on the Size property such that this tile will not draw outside of the bounds of the cell. The Origin and Size are modified appropriately based on the DestinationUnits property.

[0120] The coordinate system is then modified, based on the SourceUnits property. To this end, if at step 2020 the SourceUnits property is ObjectBoundingBox, the appropriate scaling transform is applied at step 2026, otherwise it is UserSpaceOnUse, and no new transform is applied. The Transform property is applied at step 2024, and the content is drawn at step 2026.

[0121] Note that if any part of size is zero, nothing is drawn, and if Stretch is "None," the transform for the viewbox is set up such that one unit in the new coordinate frame is equal to one unit in the old coordinate frame. The transform essentially becomes an offset based on the align attributes and the size of the ViewBox. As described above at steps 2010 and 2012, Stretch and the alignment properties only apply when there is a ViewBox specified. The ViewBox specifies a new coordinate system for the contents, and Stretch helps to specify how those contents map into the ViewBox. The alignment options align the ViewBox, not the contents. Thus, for example, if the viewbox is set to "0 0 10 10" and something is drawn at -10,-10 and aligned to the upper left corner, that thing will be clipped out.

[0122] Returning to FIG. 15, image brush can be thought of as a special case of VisualBrush. Although a program can create a visual, put an image into it and attach it to VisualBrush, the API for doing so would be cumbersome. Since there is no necessary content coordinate frame, the ViewBox and ContentUnits property members no longer apply.

```
public class System.Windows.Media.ImageBrush : Brush
{
    public ImageBrush(ImageData image);

    public BrushMappingMode DestinationUnits { get; }
    public Transform Transform { get; }

    public Stretch Stretch { get; }
    public HorizontalAlign HorizontalAlign { get; }
    public VerticalAlign VerticalAlign { get; }

    public Point Origin { get; }
    public PointAnimationCollection OriginAnimations { get; }
    public Size Size { get; }
    public SizeAnimationCollection SizeAnimations { get; }

    public ImageData ImageData { get; }
}

public class System.Windows.Media.ImageBrushBuilder : BrushBuilder
{
    public ImageBrushBuilder();
    public ImageBrushBuilder(ImageData image);
    public ImageBrushBuilder(ImageBrush ib);
```

```
    // DestinationUnits: Default is ObjectBoundingBox
    public BrushMappingMode DestinationUnits { get; set; }
    // Transform: Default is identity
    public Transform Transform { get; set; }

    // Stretch: Default is None
    public Stretch Stretch { get; set; }
    // HorizontalAlign: Default is Center
    public HorizontalAlign HorizontalAlign { get; set; }
    // VerticalAlign: Default is Center
    public VerticalAlign VerticalAlign { get; set; }

    // Origin: Default is (0,0)
    public Point Origin { get; set; }
    public PointAnimationCollectionBuilder OriginAnimations { get; set; }

    // Size: Default is (1,1)
    public Size Size { get; set; }
    public SizeAnimationCollectionBuilder SizeAnimations { get; set; }

    // ImageData: Default is null -- nothing drawn
    public ImageData ImageData { get; set; }
}
```

[0123] NineGridBrush is very similar to ImageBrush except the image is warped based on the size. In essence, NineGridBrush may be thought of a custom type of Stretch, in which certain parts of the image stretch, while others (e.g., borders) do not. Thus, while the Size of the image in the ImageBrush will cause a simple scale, the NineGridBrush will produce a non-uniform scale up to the desired size. The units for the non-scaled areas are the user units when the brush is applied, which means that ContentUnits (if it existed for NineGridBrush) would be set to UserUnitsOnUse. The Transform property of the Brush can be used effectively. Note that the border members count in from the edge of the image.

[0124] By way of example, FIG. 23 represents a nine-grid image being enlarged from a first instance 2302 to a second instance 2304, with four types of areas. As represented in FIG. 23, to keep the border the same, the areas marked "a" expand horizontally, the areas marked "b" expand vertically, the areas marked "c" expand horizontally and vertically, and the areas marked "d" do not change in size.

```
public class System.Windows.Media.NineGridBrush : Brush
{
    public NineGridBrush(ImageData image,
            int LeftBorder, int RightBorder,
            int TopBorder, int BottomBorder);

    public BrushMappingMode DestinationUnits { get; }
    public Transform Transform { get; }

    public Point Origin { get; }
    public PointAnimationCollection OriginAnimations { get; }
    public Size Size { get; }
    public SizeAnimationCollection SizeAnimations { get; }

    public int LeftBorder { get; }
    public int RightBorder { get; }
    public int TopBorder { get; }
    public int BottomBorder { get; }

    public ImageData ImageData { get; }
}

public class System.Window.Media.NineGridBrushBuilder : BrushBuilder
{
    public NineGridBrushBuilder();
    public NineGridBrushBuilder (ImageData image,
            int LeftBorder, int RightBorder,
            int TopBorder, int BottomBorder);
    public NineGridBrushBuilder (NineGridBrush ngb);

    // DestinationUnits: Default is ObjectBoundingBox
    public BrushMappingMode DestinationUnits { get; set; }
    // Transform: Default is identity
    public Transform Transform { get; set; }

    // Origin: Default is (0,0)
    public Point Origin { get; set; }
    public PointAnimationCollectionBuilder OriginAnimations { get;
      set; }

    // Size: Default is (1,1)
    public Size Size { get; set; }
    public SizeAnimationCollectionBuilder SizeAnimations { get; set; }

    // *Border: default to 0
```

```
    public int LeftBorder { get; set; }
    public int RightBorder { get; set; }
    public int TopBorder { get; set; }
    public int BottomBorder { get; set; }

    // ImageData: Default is null -- nothing drawn
    public ImageData ImageData { get; set; }
}
```

[0125] As generally described above, the graphics object model of the present invention includes a Transform object

model, which includes the types of transforms represented in the hierarchy of FIG. 24, under a Transform base class. These different types of components that make up a transform may include TransformList, TranslateTransform, RotateTransform, ScaleTransform, SkewTransform, and MatrixTransform. Individual properties can be animated, e.g., a program developer can animate the Angle property of a RotateTransform.

[0126] Matrices for 2D computations are represented as a 3x3 matrix. For the needed transforms, only six values are needed instead of a full 3x3 matrix. These are named and defined as follows.

$$\begin{bmatrix} m00 & m01 & 0 \\ m10 & m11 & 0 \\ m20 & m21 & 1 \end{bmatrix}$$

[0127] When a matrix is multiplied with a point, it transforms that point from the new coordinate system to the previous coordinate system:

$$\begin{bmatrix} x_{newCoordSys} & y_{newCoordSys} & 1 \end{bmatrix} \bullet \begin{bmatrix} m00 & m01 & 0 \\ m10 & m11 & 0 \\ m20 & m21 & 1 \end{bmatrix} = \begin{bmatrix} x_{oldCoordSys} & y_{oldCoordSys} & 1 \end{bmatrix}$$

[0128] Transforms can be nested to any level. Whenever a new transform is applied it is the same as post-multiplying it onto the current transform matrix:

$$\begin{bmatrix} x_{newCoordSys} & y_{newCoordSys} & 1 \end{bmatrix} \bullet \begin{bmatrix} m00_2 & m01_2 & 0 \\ m10_2 & m11_2 & 0 \\ m20_2 & m21_2 & 1 \end{bmatrix} \bullet \begin{bmatrix} m00_1 & m01_1 & 0 \\ m10_1 & m11_1 & 0 \\ m20_1 & m21_1 & 1 \end{bmatrix} = \begin{bmatrix} x_{oldCoordSys} & y_{oldCoordSys} & 1 \end{bmatrix}$$

[0129] Most places in the API do not take a Matrix directly, but instead use the Transform class, which supports animation.

```
public struct System.Windows.Media.Matrix
{
    // Construction and setting
    public Matrix(); // defaults to identity

    public Matrix(
                double m00, double m01,
                double m10, double m11,
                double m20, double m21);

    // Identity
    public static readonly Matrix Identity;
    public void SetIdentity();
    public bool IsIdentity { get; }

    public static Matrix operator *(Matrix matrix1, Matrix
     matrix2);
    public static Point operator *(Matrix matrix, Point point);

    // These function reinitialize the current matrix with
    // the specified transform matrix.
    public void SetTranslation(double dx, double dy);
    public void SetTranslation(Size offset);
    public void SetRotation(double angle); // degrees
    public void SetRotation(double angle, Point center); // degrees
    public void SetRotationRadians(double angle);
    public void SetRotationRadians(double angle, Point center);
    public void SetScaling(double sx, double sy);
```

```
    public void SetScaling(double sx, double sy, Point center);
    public void SetSkewX(double angle); // degrees
    public void SetSkewY(double angle); // degrees
    public void SetSkewXRadians(double angle);
    public void SetSkewYRadians(double angle);

    // These function post-multiply the current matrix
    // with the specified transform
    public void ApplyTranslation(double dx, double dy);
    public void ApplyTranslation(Size offApply);
    public void ApplyRotation(double angle); // degrees
    public void ApplyRotation(double angle, Point center); //
      degrees
    public void ApplyRotationRadian(double angle);
    public void ApplyRotationRadian(double angle, Point center);
    public void ApplyScaling(double sx, double sy);
    public void ApplyScaling(double sx, double sy, Point center);
    public void ApplySkewX(double angle); // degrees
    public void ApplySkewY(double angle); // degrees
    public void ApplySkewXRadians(double angle);
    public void ApplySkewYRadians(double angle);
    public void ApplyMatrix(Matrix matrix);

    // Inversion stuff
    public double Determinant { get; }
    public bool IsInvertible { get; }
    public void Invert();  // Throws ArgumentException if
      !IsInvertable
    public static Matrix Invert(Matrix matrix);

    // Individual members
    public double M00 { get; set; }
    public double M01 { get; set; }
    public double M10 { get; set; }
    public double M11 { get; set; }
    public double M20 { get; set; }
    public double M21 { get; set; }
};
```

MARKUP LANGUAGE AND OBJECT MODEL FOR VECTOR GRAPHICS

[0130] In accordance with an aspect of the present invention, a markup language and element object model are provided to enable user programs and tools to interact with the scene graph data structure 216 without requiring a specific knowledge of the details of the API layer 212 (FIG. 2). In general, a vector graphics markup language is provided, which comprises an interchange format, along with a simple markup based authoring format for expressing vector graphics via the element object model. Via this language, markup (e.g., HTML or XML-type content) may be programmed. Then, to build the scene graph, the markup is parsed and translated into the appropriate visual API layer objects that were as described above. At this higher operating level, an element tree, the property system and the presenter system are provided to handle much of the complexity, making it straightforward for scene designers to design possibly complex scenes.

[0131] In general, the vector graphics system generally provides a set of shape and other elements, integration with a general property system, a grouping and compositing system, and a two-tiered (element level and resource level) approach so that the user can program in a way that matches flexibility and performance needs. In keeping with one aspect of the present invention, the element object model for dealing with vector graphics correlates with the scene graph object model. In other words, the vector graphics system and the Visual API layer share a set of resources at the element object model level, e.g., the Brush object is used when drawing at the Visual API and it is also the type of the fill property on Shape. Thus, in addition to having elements that correlate with the scene graph objects, the markup

language shares a number of primitive resources (e.g., brushes, transforms, and so forth) with the Visual API layer. The vector graphics system also exposes and extends the animation capabilities of the Visual API layer, which is largely shared between the levels.

[0132] Further, as described below, the vector graphics system can program to different profiles, or levels, including an element level and a resource level. In the element level, each of the drawing shapes is represented as an element at the same level as the rest of the programmable elements in a page/screen. This means that the shapes interact in a full way with the presenter system, events and properties. In the resource level, the vector graphics systems operates in a pure resource format, similar to a traditional graphics metafile. The resource level is efficient, but has somewhat limited support for cascaded properties, eventing and fine-grained programmability. The scene designer thus has the ability to balance efficiency with programmability as needed.

[0133] In keeping with one aspect of the present invention, the vector graphics system at the resource level also correlates to the visual API layer, in that the resource level markup, in one implementation, is expressed as a VisualBrush. When the resource markup is parsed, a visual object is created. The visual object is set into a VisualBrush which may be used by shapes, controls and other elements at the element level.

[0134] FIG. 25 is a representation of the element class hierarchy 2500. The classes of the markup language object model of the present invention are represented via shadowed boxes, and include a shape class 2502, an image class 2504, a video class 2506 and a canvas class 2508. Elements of the shape class include rectangle 2510, polyline 2512, polygon 2514, path 2516, line 2518 and ellipse 2520. Note that in some implementations, a circle element may not be present as indicated by the dashed box 2522 in FIG. 25, however for purposes of the various examples herein, the circle element 2522 will be described. Each element may include or be associated with fill (property) data, stroke data, clipping data, transform data, filter effect data and mask data.

[0135] As described below, shapes correspond to geometry that is drawn with inherited and cascaded presentation properties. The presentation properties are used to construct the pen and the brush needed to draw the shapes. In one implementation, shapes are full presenters, like other control elements. However, in other implementations, a canvas class 2508 may be provided as a container for shapes, and shapes can only be drawn when in a canvas element. For example, to keep shapes lightweight, shapes may not be allowed to have attached presenters. Instead, the canvas has an attached presenter and draws the shapes. Canvas elements are described in more detail below.

[0136] As also described below, the image class is more specific than a shape, and for example can include border data, which may be complex. For example, a border can be specified as one color on the top, a different color on the sides, with possibly various thicknesses specified and other properties set. Position, size rotation and scale may be set for an image or similar boxed element, such as text or video. Note that the image and video elements can exist and be shown outside of a canvas element, and also inherit from BoxedElement, e.g., to get the background, borders and padding support from that element.

[0137] The video element allows video (or similar multimedia) to be played within a displayed element. In this manner, the vector graphics system provides a markup interface to the API layer that is seamlessly consistent across multimedia, including text, 2D graphics, 3D graphics, animation, video, still images and audio. This allows designers to that learn to work with one media to easily integrate other media into applications and documents. The vector graphics system also enables multimedia to be animated in the same way as other elements, again allows designers the ability to use multimedia like other elements, yet without sacrificing the core intrinsic uniqueness of each individual media type. For example, a designer can use the same naming scheme for rotating, scaling, animating, drawing, compositing and other effects across different media types, whereby designers may easily create very rich applications, as well as allowing for a very efficient rendering and compositing implementation to be built underneath.

[0138] FIG. 26 represents one implementation in which the markup code 2602 is interpreted by a parser / translator 2604. In general, the parser / translator 2604 adds elements to an element tree / property system 208 (also represented in FIG. 2) and attaches presenters to those elements. The presenter system 210 then takes the element tree 210 with the attached presenters and translates the data to objects and calls to the visual API layer 212. Note that not all elements need to be translated, only those with attached presenters.

[0139] In general, an element is an object in the element layer that participates in the property system, eventing and layout/presentation system. The parser finds tags and decides if those tags help to define an element or a resource object. In the special case of a VisualBrush, the same tags may be interpreted as elements or also interpreted as resource objects, depending on the context of where those tags appear, e.g., depending on whether appearing in complex property syntax or not.

[0140] In accordance with one aspect of the present invention, the markup language provides distinct ways to describe a resource, including a simple string format or a complex object notation. For a simple string format, the parser / translator 2604 uses a type converter 2608 for converting a string to an appropriate visual API object. By way of example, in the following line of markup, the Fill property value can be converted to a brush object, via the type converter 2608:

```
<Circle CenterX="10" CenterY="10" Radius="5" Fill="Red" />
```

As can be readily appreciated, the conversion of such an inline line of tag-based markup with simple strings of parameters is to a brush object is straightforward, and provides a simple way for a scene designer to add a shape and its attributes to a scene.

[0141] However there are times when the fill attribute is too complex to fit into a single string. In such a situation, complex property syntax, which may be inline in the markup, is used to set this property. For example, the following complex property syntax fills a circle with a gradient rather than a solid color, specifying the colors at various gradient stops (which can range from 0 to 1):

```
<Circle CenterX="10" CenterY="10" Radius="5">
  <Circle.Fill>
    <LinearGradient>
      <GradientStop Color="Red" Offset="0"/>
      <GradientStop Color="Blue" Offset="0.33"/>
      <GradientStop Color="Green" Offset="0.66"/>
      <GradientStop Color="Red" Offset="1.0"/>
    </LinearGradient>
  </Circle.Fill>
```

```
</Circle>
```

[0142] In addition to being present inline in the markup, a resource instance may be located elsewhere (e.g., in the markup or in a file, which can be local or on a remote network and appropriately downloaded), and referenced by a name, (e.g., a text name, reference or other suitable identifier). In this manner, a scene designer can reuse an element in the element tree throughout a scene, including elements described by the complex property syntax.

[0143] The parser handles markup in the complex property syntax by accessing the type converter 2608 as necessary, and also matching specified parameters to the object properties, thereby handling the complexity for the scene designer. Thus, the parser does not just set up the objects, but also sets attributes on the objects. Note that the parser actually instantiates a builder to create the objects, since objects are immutable.

[0144] Because the same rendering model is shared between the element level and the API level, many of the objects are essentially the same. This makes parsing / translation highly efficient, and also allows different types of programming languages (e.g., C#-like languages) the ability to easily convert from the markup to its own syntax, and vice-versa. Note that as represented in FIG. 26, another such programming language 2610 can add elements to the element tree 208, or can directly interface with the visual API layer 212.

[0145] As also represented in FIG. 26 and in accordance with an aspect of the present invention, the same markup 2602 may be used to program at an element level and a resource level. As described above, the element level gives the scene designer full programmability, usage of the property system that provides inheritance (e.g., style-sheet like

features), and eventing (e.g., whereby an element may have attached code to change its appearance, position and so forth in response to a user input event). However, the present invention also provides a resource-level mechanism by which scene designers can essentially shortcut the element tree and presenter system and program directly to the visual API layer. For many types of static shapes, images and the like where element-level features are not needed, this provides a more efficient and lightweight way to output the appropriate object. To this end, the parser recognizes when a fill of type "visual brush" is present, and directly calls the API layer 212 with resource level data 2612 to create the object. In other words, as represented in FIG.22, element level vector graphics get parsed into created elements, which need later translation to the objects, while resource level vector graphics get parsed and directly stored in an efficient manner.

[0146] By way of example, the following markup is directly derived from the object model for the LinearGradient object, and fills an outer circle with a VisualBrush. The contents of that VisualBrush are defined by the inner markup. Note that this syntax is commonly used for expressing various brushes, transforms and animations:

```
<Circle CenterX="10" CenterY="10" Radius="5">
  <Circle.Fill>
    <VisualBrush xmlns="...">
      <Circle CenterX="0.5" CenterY="0.5" Radius="0.25" Fill="Blue"/>
      <Circle CenterX="0.6" CenterY="0.6" Radius="0.25" Fill="Green"/>
      <Circle CenterX="0.7" CenterY="0.7" Radius="0.25" Fill="Red"/>
      <Circle CenterX="0.8" CenterY="0.8" Radius="0.25" Fill="LemonChiffon"/>
    </VisualBrush>
  </Circle.Fill>
</Circle>
```

[0147] Note that while these visual brush-filled objects are efficiently stored, the resource level data (or the objects created thereby) can be referenced by elements and part of the element tree 208, as generally represented in FIG. 26. To this end, these visual brush resources may be named (e.g., with a name, reference or other suitable identifier) and referenced like other resources described via the complex property syntax.

[0148] Turning to an explanation of the canvas, as mentioned above in one alternative implementation, shapes may be kept lightweight and thus may be required to be contained in a canvas. In this alternative implementation, when content is rendered, it is rendered onto an infinite, device-independent canvas which has an associated coordinate system. The canvas element may thus position content according to absolute coordinates. The canvas element can optionally define a viewport, which specifies clipping, a transform, a preferred aspect ratio and a way of mapping the viewport into a parent space. If there is no viewport established, the canvas element only specifies a grouping of drawing primitives and can set up a transform, opacity and other compositing attributes.

[0149] The following is a markup example for a sample canvas:

```
<Canvas Background="black" Top="100" Left="100"Height="600" Width="800">
  <Rectangle Top="600" Left="100" Width="100" Height="50" Fill="red"
Stroke="blue" StrokeWidth="10"/>
  <Line x1="100" y1="300" x2="300" y2="100" Stroke="green" StrokeWidth="5"
/>
</Canvas>
```

[0150] Note that in one implementation, when coordinates are specified without units then they are considered as "logical pixels" of 96ths of an inch, and in the above example, the line will be 200 pixels long. In addition to coordinates, other properties include width, height horizontal and vertical alignment, and ViewBox (of type rect; default is unset or (0,0,0,0), meaning no adjustment is made, and the stretch and align properties get ignored). As generally described above with reference to FIGS. 18-20, other properties include stretch, which when not specified preserves original size, or can 1) specify a fill in which the aspect ratio is not preserved and the content is scaled to fill the bounds established by the top/left/width/height, 2) specify uniform, which scales size uniformly until the image fits the bounds established by the top/left/width/height, or 3) specify UniformToFill, which scales size uniformly to fill the bounds established by top/left/width/height, and clips as necessary.

[0151] To further correlate with the lower-level object model, the transform property establishes a new coordinate

frame for the children of the element, while the clip property restricts the region to which content can be drawn on the canvas, with the default clipping path defined as the bounding box. The ZIndex property can be used to specify rendering order for nested canvas elements within a panel.

[0152] The Viewbox specifies a new coordinate system for the contents, e.g., by redefining the extent and origin of the viewport. Stretch helps to specify how those contents map into the viewport. The value of the viewBox attribute is a list of four "unitless" numbers <min-x>, <min-y>, <width> and <height>, e.g., separated by whitespace and/or a comma, and is of type Rect. The Viewbox rect specifies the rectangle in user space that maps to the bounding box. It works the same as inserting a scaleX and scaleY. The stretch property (in case the option is other than none) provides additional control for preserving the aspect ratio of the graphics. An additional transformation is applied to descendants of the given element to achieve the specified effect.

[0153] In the example above, the effective result of the rectangle in the markup sample above under each stretch rule would be:

```
None - from (100,600) to (200,650)

Fill - from (100,100) to (900,700)

Uniform - from (100,?)  to (900,?)  - the new height will be
400, and it will centered based on HorizontalAlign and
VerticalAlign.

UniformToFill - from (?,100) to (?,700)  The new width is
1200, and will again be centered based on HorizontalAlign and
VerticalAlign.
```

[0154] If there is a transform on the canvas, it is essentially applied above (e.g., in the tree) the mapping to ViewBox. Note that this mapping will stretch any of the elements in a canvas, e.g., boxes, text, and so forth, not just shapes. Further, note that if a viewbox is specified, the canvas no longer sizes to its contents, but rather has a specified size. If y-width and y-height are also specified, then the stretch/align properties are used to fit the viewbox into the specified width and height.

[0155] The elements in the object model can each have a 'Clip' attribute applied. On some elements, notably shapes, this is exposed directly as a common language runtime property, while on others (e.g., most controls) this property is set via a DynamicProperty.

[0156] In general, the clipping path restricts the region to which content can be drawn, as generally represented in FIG. 27 wherein a button is shown in an unclipped form 2702 and a form 2704 in which a clipping path is specified (where the dashed line represents the clipping path). Conceptually, any parts of the drawing that lie outside of the region bounded by the currently active clipping path are not drawn. A clipping path can be thought of as a mask wherein those pixels outside the clipping path are black with an alpha value of zero and those pixels inside the clipping path are white with an alpha value of one (with the possible exception of anti-aliasing along the edge of the silhouette).

[0157] A clipping path is defined by a Geometry object, either inline or more typically in a resource section. A clipping path is used and/or referenced using the "Clip" property on an element, as shown in the following example:

```
<def:Resources>
    <Geometry def:ID="MyClip">
        <Path Data="..." />
        <Rectangle ...  />
      </Geometry>
</def:Resources>
     <Element Clip=""%resource; MyClip"  ... />
```

[0158] Note that animating a Clip is similar to animating transforms:

```
<Element>
    <Element.Clip>
        <Circle ..../>
        <Rectangle .... >
                <FloatAnimation ... />
        </Rectangle>
    </Element.Clip>
    ... children ...
</Element>
```

[0159] A path is drawn by specifying the 'Geometry' data and the rendering properties, such as Fill, Stroke, and StrokeWidth on the Path element. An example markup for a path is specified as follows:

```
<Path Data="M 100 100 L 300 100 L 200 300 z"
Fill="red" Stroke="blue" StrokeWidth="3" />
```

[0160] The path 'Data' string is of type Geometry. A more verbose and complete way to specify a drawn path is via the complex property syntax, as described above. The markup (such as in the following example) is fed directly into the Geometry builder classes described above:

```
  <Path>
    <Path.Data>
      <CircleGeometry ... />
      <RectangleGeometry ... />
      <PathGeometry ...  />
    </Path.Data>
    <Path.Fill value="red" />
    <Path.Stroke value="blue"/>
</Path>
```

[0161] The path data string is also described, using the following notation to describe the grammar for a path data string:

```
*: 0 or more
+: 1 or more
?: 0 or 1
(): grouping
|: separates alternatives
double quotes surround literals
```

[0162] The following shows the path data string information described with this notation (note that in one implementation, FillMode may be specified here, instead of a property at the element level):

```
wvg-path:
    wsp* moveto-drawto-command-groups? wsp*

moveto-drawto-command-groups:
    moveto-drawto-command-group
    | moveto-drawto-command-group wsp* moveto-drawto-command-
groups

moveto-drawto-command-group:
    moveto wsp* drawto-commands?

drawto-commands:
    drawto-command
    | drawto-command wsp* drawto-commands

drawto-command:
    closepath
    | lineto
    | horizontal-lineto
    | vertical-lineto
    | curveto
    | smooth-curveto
    | quadratic-bezier-curveto
```

```
    | smooth-quadratic-bezier-curveto
    | elliptical-arc

moveto:
    ( "M" | "m" ) wsp* moveto-argument-sequence

moveto-argument-sequence:
    coordinate-pair
    | coordinate-pair comma-wsp? lineto-argument-sequence

closepath:
    ("Z" | "z")

lineto:
    ( "L" | "l" ) wsp* lineto-argument-sequence

lineto-argument-sequence:
    coordinate-pair
    | coordinate-pair comma-wsp? lineto-argument-sequence

horizontal-lineto:
    ( "H" | "h" ) wsp* horizontal-lineto-argument-sequence

horizontal-lineto-argument-sequence:
    coordinate
    | coordinate comma-wsp? horizontal-lineto-argument-
sequence

vertical-lineto:
    ( "V" | "v" ) wsp* vertical-lineto-argument-sequence

vertical-lineto-argument-sequence:
    coordinate
    | coordinate comma-wsp? vertical-lineto-argument-sequence

curveto:
    ( "C" | "c" ) wsp* curveto-argument-sequence

curveto-argument-sequence:
    curveto-argument
    | curveto-argument comma-wsp? curveto-argument-sequence

curveto-argument:
    coordinate-pair comma-wsp? coordinate-pair comma-wsp?
coordinate-pair

smooth-curveto:
    ( "S" | "s" ) wsp* smooth-curveto-argument-sequence

smooth-curveto-argument-sequence:
```

```
    smooth-curveto-argument
    | smooth-curveto-argument comma-wsp? smooth-curveto-
argument-sequence

smooth-curveto-argument:
    coordinate-pair comma-wsp? coordinate-pair

quadratic-bezier-curveto:
    ( "Q" | "q" ) wsp* quadratic-bezier-curveto-argument-
sequence

quadratic-bezier-curveto-argument-sequence:
    quadratic-bezier-curveto-argument
    | quadratic-bezier-curveto-argument comma-wsp?
        quadratic-bezier-curveto-argument-sequence

quadratic-bezier-curveto-argument:
    coordinate-pair comma-wsp? coordinate-pair

smooth-quadratic-bezier-curveto:
    ( "T" | "t" ) wsp* smooth-quadratic-bezier-curveto-
argument-sequence

smooth-quadratic-bezier-curveto-argument-sequence:
    coordinate-pair
    | coordinate-pair comma-wsp? smooth-quadratic-bezier-
curveto-argument-sequence

elliptical-arc:
    ( "A" | "a" ) wsp* elliptical-arc-argument-sequence

elliptical-arc-argument-sequence:
    elliptical-arc-argument
    | elliptical-arc-argument comma-wsp? elliptical-arc-
argument-sequence

elliptical-arc-argument:
    nonnegative-number comma-wsp? nonnegative-number comma-
wsp?
        number comma-wsp flag comma-wsp flag comma-wsp
coordinate-pair

coordinate-pair:
    coordinate comma-wsp? coordinate

coordinate:
    number

nonnegative-number:
    integer-constant
```

```
    | floating-point-constant

number:
    sign? integer-constant
    | sign? floating-point-constant

flag:
    "0" | "1"

comma-wsp:
    (wsp+ comma? wsp*) | (comma wsp*)

comma:
    ","

integer-constant:
    digit-sequence

floating-point-constant:
    fractional-constant exponent?
    | digit-sequence exponent

fractional-constant:
    digit-sequence? "." digit-sequence
    | digit-sequence "."

exponent:
    ( "e" | "E" ) sign? digit-sequence

sign:
    "+" | "-"

digit-sequence:
    digit
    | digit digit-sequence

digit:
    "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"

wsp:
    (#x20 | #x9 | #xD | #xA)
```

[0163] The image element (FIG. 25) indicates that the contents of a complete file are to be rendered into a given rectangle within the current user coordinate system. The image (indicated by the image tag) can refer to raster image files such as PNG or JPEG, or to files with MIME type of "image/wvg", as set forth in the following example:

```
<Image Top="200" Left="200" Width="100px" Height="100px"
Source ="myimage.png">
</Image>
```

[0164] The following table provides information on some example properties for images:

Name	Type	R/RW	Default Value	Description
Top	BoxUnit			Coordinate for the top side of the Image
Left	BoxUnit			Coordinate for the left side of the Image
Width	BoxUnit			Width of the Image
Height	BoxUnit			Height of the Image
Source	ImageData			Source of the Image
Dpi	Float		96(?)	Target DPI to use for sizing
HorizontalAlign	enum { Left (?), Center (?), Right(?) }		Center	
VerticalAlign	enum { Top (?), Middle (?), Bottom(?) }		Middle	
Stretch	enum Stretch { None, Fill, Uniform, UniformToFill }		None	**None**: Preserve original size **Fill**: Aspect ratio is not preserved and the content is scaled to fill the bounds established by tlbh **Uniform** Scale size uniformly until the image fits the bounds established by the tlwh. **UniformToFill**: Scale size uniformly to fill the bounds established by tlbh, and clipped.
ReadyState	enum { MetaDataReady, Loading, Loaded LoadError }			
LoadCounter	Int	Read	Null	Counter that increments when ReadyState is Loading
Name	String			Alternate text for the Image.

[0165] As described above, shapes correspond to geometry drawn with inherited and cascaded presentation properties. The following tables set forth example shape properties for the basic shape elements described above (Rectangle, Ellipse, Line, Polyline, Polygon). Note that these basic shapes may have stroke properties, fill properties, and used as clip paths, have inheritance characteristics, and apply to both the element and Resource levels:

Name	Type	R/RW	Default Value	Description
Fill	Brush	RW	null	Coordinate for the top side of the rect
FillOpacity	Float	RW	1.0	Coordinate for the left side of the rect
Stroke	Brush	RW	null	Width of the rect
StrokeOpacity	Float	RW	1.0	Height of the rect
StrokeWidth	BoxUnit	RW	1px	Width of the stroke. 1px = 1/96 of an inch
FillRule	enum { EvenOdd, NonZero }	RW	EvenOdd	FillRule indicates the algorithm which is to be used to determine what parts of the canvas are included inside the shape.
StrokeLineCap	enum { Butt, Round, Square, Diamond }	RW	Butt	StrokeLineCap specifies the shape to be used at the end of open subpaths when they are stroked.
StrokeLineJoi nt	enum { Miter, Round, Bevel }	RW	Miter	StrokeLineJoin specifies the shape to be used at the corners of paths (or other vector shapes) that are stroked when they are stroked.
StrokeMiterLi mit	Float	RW	4.0	The limit on the ratio of the MiterLength to the StrokeWidth. Value to be >= 1
StrokeDashArr ay	PointLis t	RW	null	StrokeDashArray controls the pattern of dashes and gaps used to stroke paths. <dasharray> contains a list of space- or comma-separated <number>s that specify the lengths of alternating dashes and gaps in user units. If an odd number of values is provided, then the list of values is repeated to yield an even number of values. Thus, stroke-dasharray: 5 3 2 is equivalent to stroke-dasharray: 5 3 2 5 3 2.
StrokeDashOff set	Point	RW		StrokeDashoffset specifies the distance into the dash pattern to start the dash.
Transform	Transfer m	RW	null	Transform establishes a new coordinate frame for the children of the element

(continued)

Name	Type	R/RW	Default Value	Description
Clip	Geometry	RW	null	Clip restricts the region to which paint can be applied on the canvas. The default clipping path is defined as the bounding box.

[0166] The following is an example markup syntax for a rectangle:

```
<Rectangle Top="600" Left="100" Width="100" Height="50"
Fill="red" Stroke="blue" StrokeWidth="10"/>
```

[0167] A rectangle has the following properties in the object model (note that rectangles are read/write, have default values equal to zero, support inheritance and apply to both the element and Resource levels):

Name	Type	Description
Top	BoxUnit	Coordinate for the top side of the rect
Left	BoxUnit	Coordinate for the left side of the rect
Width	BoxUnit	Width of the rect
Height	BoxUnit	Height of the rect
RadiusX	BoxUnit	For rounded rectangles, the X-axis radius of the ellipse used to round off the corners of the rectangle. If a negative X-axis radius is specified, the absolute value of the radius will be used.
RadiusY	BoxUnit	For rounded rectangles, the Y-axis radius of the ellipse used to round off the corners of the rectangle. If a negative X-axis radius is specified, the absolute value of the radius will be used.

[0168] The following is an example markup syntax for a circle:

```
<Circle CenterX="600" CenterY="100" Fill="red"
Stroke="blue" StrokeWidth="10"/>
```

A circle has the following properties in the object model (note that circles are read/write, have default values equal to zero, support inheritance and apply to both the element and Resource levels):

Name	Type	Description
CenterX	BoxUnit	X coordinate of the center of the circle
CenterY	BoxUnit	X coordinate of the center of the circle
Radius	BoxUnit	Radius of the circle

[0169] The following is an example markup syntax for an ellipse:

```
<Ellipse CenterX="600" CenterY="100" Fill="red"
Stroke="blue" StrokeWidth="10"/>
```

An ellipse has the following properties in the object model (note that ellipses are read/write, have default values equal to zero, support inheritance and apply to both the element and Resource levels):

Name	Type	Description
CenterX	Coordinate	X coordinate of the center of the ellipse
CenterY	Coordinate	X coordinate of the center of the ellipse
RadiusX	Length	The X-axis radius of the ellipse. If a negative X-axis radius is specified, the absolute value of the radius will be used.
RadiusY	Length	The Y-axis radius of the ellipse. If a negative Y-axis radius is specified, the absolute value of the radius will be used.

[0170] The following is an example markup syntax for a line:

```
<Line x1="100" y1="300" x2="300" y2="100"
StrokeWidth="5" />
```

A line has the following properties in the object model (note that lines are read/write, have default values equal to zero, support inheritance and apply to both the element and Resource levels):

Name	**Type**	**Description**
X1	BoxUnit	The X-axis coordinate of the start of the line. The default value is "0".
Y1	BoxUnit	The Y-axis coordinate of the start of the line. The default value is "0".
X2	BoxUnit	The X-axis coordinate of the end of the line. The default value is "0".
Y2	BoxUnit	The Y-axis coordinate of the end of the line. The default value is "0".

[0171] The 'Polyline' defines a set of connected straight line segments. Typically, a 'Polyline' defines an open shape.

[0172] The following is an example markup syntax for a polyline:

```
<Polyline Fill="None" Stroke="Blue" StrokeWidth="10cm"
Points="50,375
150,375 150,325 250,325 250,375
350,375 350,250 450,250 450,375
550,375 550,175 650,175 650,375
750,375 750,100 850,100 850,375
950,375 950,25 1050,25 1050,375
1150,375" />
```

A polyline has the following properties in the object model (note that lines are read/write, have default values equal to null, support inheritance and apply to both the element and Resource levels):

Name	Type	Description
Points	PointCollection	The points that make up the Polyline. Coordinate values are in the user coordinate system.

[0173] The Polygon element defines a closed shape comprising a set of connected straight line segments. The following is an example markup syntax for a polygon:

```
<Polygon Fill="red" Stroke="blue" StrokeWidth="10"
     points="350,75 379,161 469,161 397,215
     423,301 350,250 277,301 303,215
     231,161 321,161" />
```

A polygon has the following properties in the object model (note that lines are read/write, have default values equal to null, support inheritance and apply to both the element and Resource levels):

Name	Type	Description
Points	PointCollection	The points that make up the Polygon. Coordinate values are in the user coordinate system. If an odd number of coordinates are provided, then the element is in error.

[0174] The grammar for points specifications in 'polyline' and 'polygon' elements is described with the following notation:

```
*: 0 or more
+: 1 or more
?: 0 or 1
(): grouping
|: separates alternatives
double quotes surround literals
```

[0175] The following describes the points specifications in 'Polyline' and 'Polygon' elements using the above notation:

```
list-of-points:
    wsp* coordinate-pairs? wsp*

coordinate-pairs:
    coordinate-pair
    | coordinate-pair comma-wsp coordinate-pairs

coordinate-pair:
    coordinate comma-wsp coordinate

coordinate:
    number

number:
    sign? integer-constant
    | sign? floating-point-constant

comma-wsp:
    (wsp+ comma? wsp*) | (comma wsp*)

comma:
    ","

integer-constant:
    digit-sequence

floating-point-constant:
    fractional-constant exponent?
    | digit-sequence exponent

fractional-constant:
    digit-sequence? "." digit-sequence
```

```
    | digit-sequence "."

exponent:
    ( "e" | "E" ) sign? digit-sequence

sign:
    "+" | "-"

digit-sequence:
    digit
    | digit digit-sequence

digit:
    "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"

wsp:
    (#x20 | #x9 | #xD | #xA)+
```

CONCLUSION

[0176] As can be seen from the foregoing detailed description, there is provided a system, method and element / object model that provide program code various mechanisms to interface with a scene graph. The system, method

and object model are straightforward to use, yet powerful, flexible and extensible.

[0177] While the invention is susceptible to various modifications and alternative constructions, certain illustrated embodiments thereof are shown in the drawings and have been described above in detail. It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention.

Claims

1. In a computing environment, a system comprising:

   a mechanism that interprets markup to construct an element tree of elements, at least some of the elements in the element tree having associated property data and corresponding to an element object model;
   a scene graph interface layer, comprising a set of at least one interface that populates a scene graph with objects in response to requests to create the objects, the objects corresponding to a scene graph object model; and
   a translator that translates at least some of the elements and property data in the element tree into requests to the scene graph interface layer to create objects in the scene graph.

2. The system of claim 1 wherein the elements of the element object model substantially correlate with the objects of the scene graph object model.

3. The system of claim 1 wherein the markup includes inline text including a string that defines an element property, and the translator communicates with a type converter to convert the string to an object property.

4. The system of claim 1 wherein the markup includes inline text comprising complex property syntax.

5. The system of claim 4 wherein the inline text is identified with a reference that is referred to at another location in the markup.

6. The system of claim 4 wherein the inline text is identified with a reference that refers to a file.

7. The system of claim 4 wherein the inline text is identified with a reference that corresponds to a file that may be downloaded from a remote location in a network.

8. The system of claim 1 wherein the markup includes inline text comprising complex property syntax corresponding to a graphical resource.

9. The system of claim 8 wherein the graphical resource describes a visual brush object, the translator providing resource level data for directly communicating with the scene graph interface layer to create a visual paint object corresponding to the element described by the complex property syntax.

10. The system of claim 9 wherein the resource level data is identified with a reference that is referred to at another location in the markup.

11. The system of claim 9 wherein the resource level data is identified with a reference that refers to a file.

12. The system of claim 9 wherein the resource level data is identified with a reference that refers to a file that may be downloaded from a remote location in a network.

13. The system of claim 1 wherein one of the elements of the element object model comprises an image element.

14. The system of claim 1 wherein one of the elements of the element object model comprises a video element.

15. The system of claim 1 wherein one of the elements of the element object model comprises a canvas element that contains a shape element.

16. The system of claim 1 wherein one of the elements of the element object model comprises a shape element.

17. The system of claim 16 wherein the shape element comprises a rectangle element.

18. The system of claim 16 wherein the shape element comprises a polyline element.

19. The system of claim 16 wherein the shape element comprises a polygon element.

20. The system of claim 16 wherein the shape element comprises a path element.

21. The system of claim 16 wherein the shape element comprises a line element.

22. The system of claim 16 wherein the shape element comprises an ellipse element.

23. The system of claim 16 wherein the shape element comprises a circle element.

24. The system of claim 16 wherein the shape element includes fill property data.

25. The system of claim 16 wherein the shape element includes stroke property data.

26. The system of claim 16 wherein the shape element includes clipping property data.

27. The system of claim 16 wherein the shape element includes transform property data.

28. The system of claim 16 wherein the shape element includes effect data.

29. The system of claim 16 wherein the shape element includes opacity data.

30. The system of claim 16 wherein the shape element includes blend mode data.

31. The system of claim 1 further comprising an engine that processes the scene graph data structure and provides commands to at least one lower level graphics component.

32. The system of claim 31 wherein the engine traverses the scene graph data structure.

33. The system of claim 31 wherein the engine transmits the scene graph data structure.

34. The system of claim 1 wherein the translator requests instantiation of at least one builder to create the objects.

35. A computer-implemented method, comprising:

parsing markup, the markup including tags and associated property data according to an object model;
interpreting a tag in the markup to determine whether the tag is directed to an element level or to a resource level;
and

a) if the tag is directed to the element level, creating an element based on the tag and property data associated with the tag and adding the element to an element tree for later translation into a scene graph object in a scene graph data structure; and
b) if the tag is directed to the resource level, providing data to directly create a scene graph object in the scene graph data structure via an interface to the scene graph data structure.

36. The method of claim 35 wherein objects of the element object model substantially correlate with objects in the scene graph data structure.

37. The method of claim 35 wherein the markup includes inline text for a tag property value and further comprising, communicating with a type converter to convert the inline text to an object property.

38. The method of claim 35 wherein the markup includes inline text for a tag property value having a reference to other text in the markup, and wherein interpreting the tag property value comprises interpreting the other text.

39. The method of claim 35 wherein the markup includes tags comprising complex property syntax for an element, and wherein interpreting the tags comprises interpreting the complex property syntax to determine that the tags are directed to the element level.

40. The method of claim 35 wherein the markup includes tags specifying complex property syntax for an element, and wherein interpreting the tags comprises interpreting the complex property syntax to determine that the element is directed to the resource level.

41. The method of claim 40 wherein interpreting the complex property syntax comprises detecting that the complex property syntax describes a property corresponding to a visual brush object.

42. The method of claim 40 wherein tags defining a visual brush object are referenced by an element in the element tree.

43. A computer-readable medium having computer-executable instructions for performing the method of claim 35.

44. A computer-readable medium having stored thereon a data structure, comprising:

a first set of data comprising a first set of tags and property data, in which the context in which the first set of tags is interpreted indicates that the first set of tags is directed to an element level;
a second set of data comprising a second set of tags and second property data, in which the context in which the second set of tags is interpreted corresponds to complex property syntax and indicates that the second set of tags is directed to a resource level; and
when the data structure is interpreted, the first set of data results in data corresponding to the first set of tags being created and inserted into an element-level tree based on the first information in the first set of text, and the second set of data results in data corresponding to the second set of tags being provided to directly create a scene graph object in a scene graph data structure at the resource level via an interface to the scene graph data structure, based on the second information in the second set of text.

45. The data structure of claim 44 further comprising a third set of data comprising a string corresponding to a property value.

46. The data structure of claim 44 wherein the first set of tags specify an identifier, and further comprising a third set of data that references the identifier.

47. The data structure of claim 46 wherein when interpreted, the third set of data results in data corresponding to the first set of tags being added to the element-level tree in a tree location for the third set of data.

48. The data structure of claim 44 wherein the second set of tags includes an identifier, and further comprising a third set of data that references the identifier.

49. The data structure of claim 44 wherein the second set of tags includes data formatted in a complex property syntax inline in markup.

50. The data structure of claim 49 wherein the complex property syntax describes a resource level element having a fill property corresponding to a visual paint object.

51. The data structure of claim 49 wherein the complex property syntax describes properties of an image element.

52. The data structure of claim 49 wherein the complex property syntax describes properties of a video element.

53. The data structure of claim 44 wherein the first set of tags describes properties of a shape element.

54. The data structure of claim 53 further comprising data in the data structure that describes a canvas element that contains the shape element.

55. The data structure of claim 53 wherein the properties of the shape element comprise fill property data.

56. The data structure of claim 53 wherein the properties of the shape element comprise stroke property data.

57. The data structure of claim 44 wherein the properties of the first element include clipping data.

58. The data structure of claim 44 wherein the properties of the first element include transform data

59. The data structure of claim 44 wherein the properties of the first element include opacity data.

60. The data structure of claim 44 wherein the properties of the first element include blend mode data.

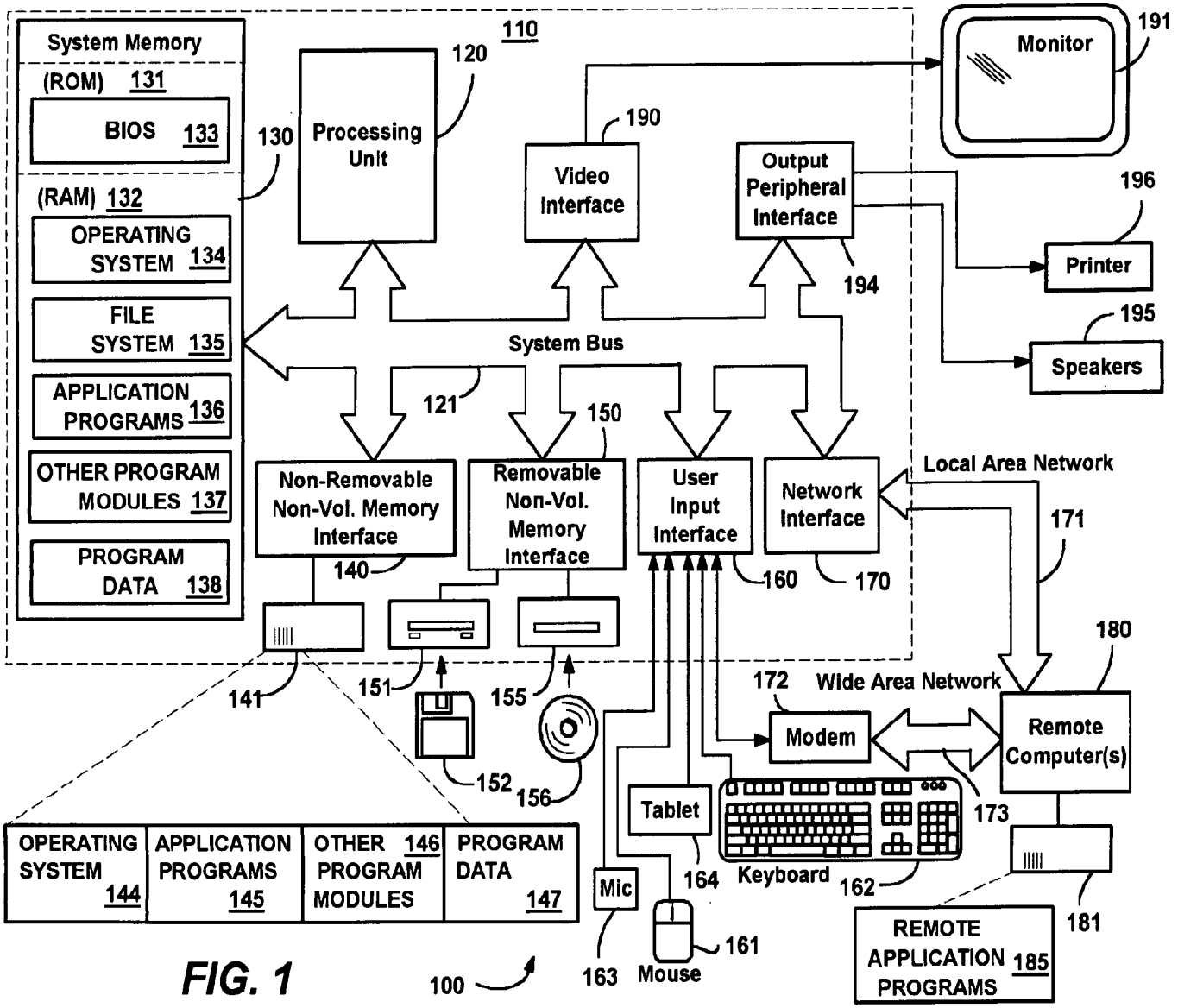

System Memory
(ROM) 131
BIOS 133
(RAM) 132
OPERATING SYSTEM 134
FILE SYSTEM 135
APPLICATION PROGRAMS 136
OTHER PROGRAM MODULES 137
PROGRAM DATA 138
110
120
130
Processing Unit
190
Video Interface
Output Peripheral Interface
194
Monitor
191
196
Printer
195
Speakers
System Bus
121
150
Non-Removable Non-Vol. Memory Interface
Removable Non-Vol. Memory Interface
User Input Interface
Network Interface
160
170
Local Area Network
171
140
141
151
155
152
156
172
Wide Area Network
Modem
180
Remote Computer(s)
173
Tablet
164
Keyboard
162
Mic
163
Mouse
161
181
REMOTE APPLICATION PROGRAMS 185
OPERATING SYSTEM 144
APPLICATION PROGRAMS 145
OTHER PROGRAM MODULES 146
PROGRAM DATA 147
100

FIG. 1

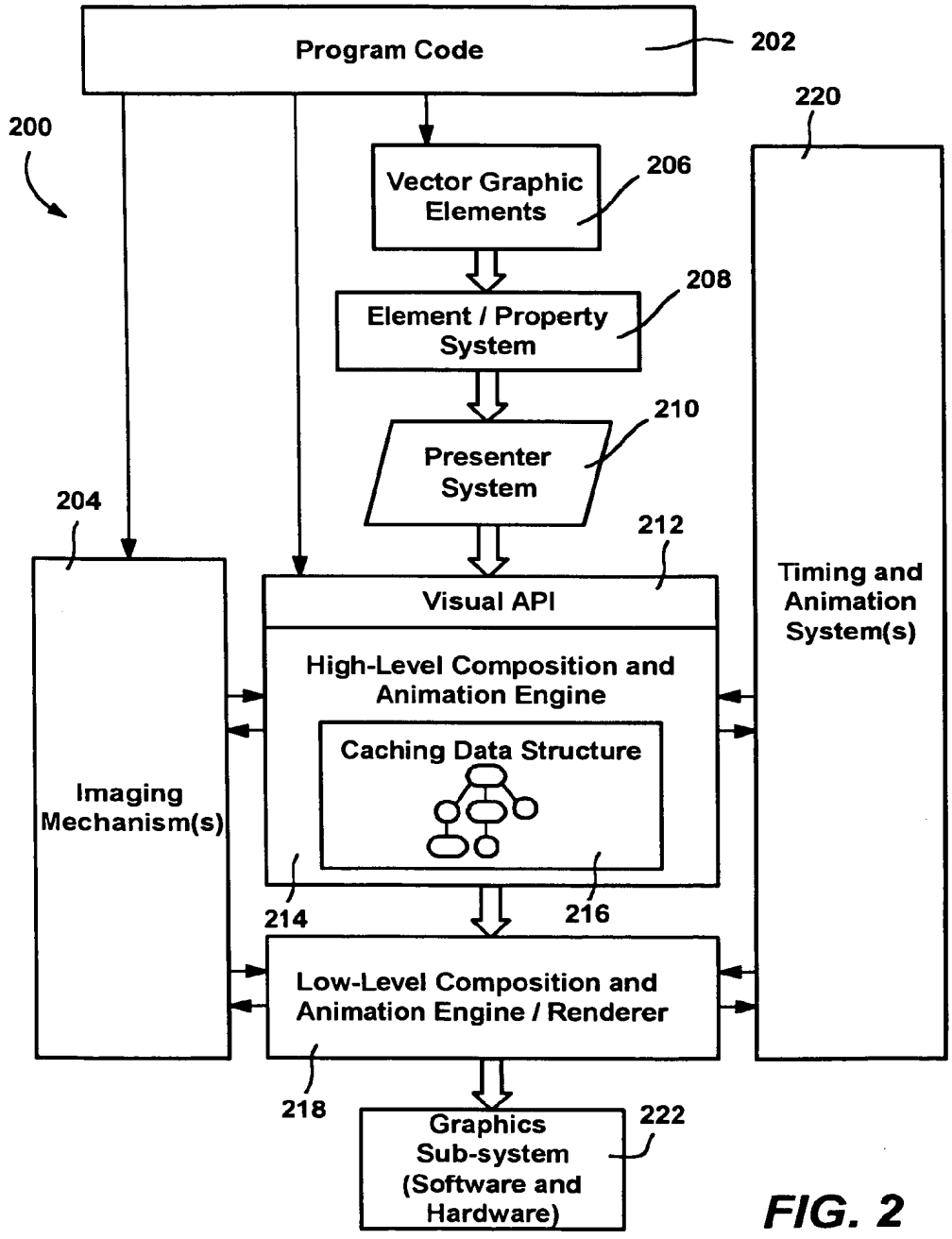

Program Code
202
200
220
Vector Graphic Elements
206
Element / Property System
208
Presenter System
210
204
212
Visual API
Timing and Animation System(s)
High-Level Composition and Animation Engine
Caching Data Structure
Imaging Mechanism(s)
214
216
Low-Level Composition and Animation Engine / Renderer
218
Graphics Sub-system (Software and Hardware)
222

FIG. 2

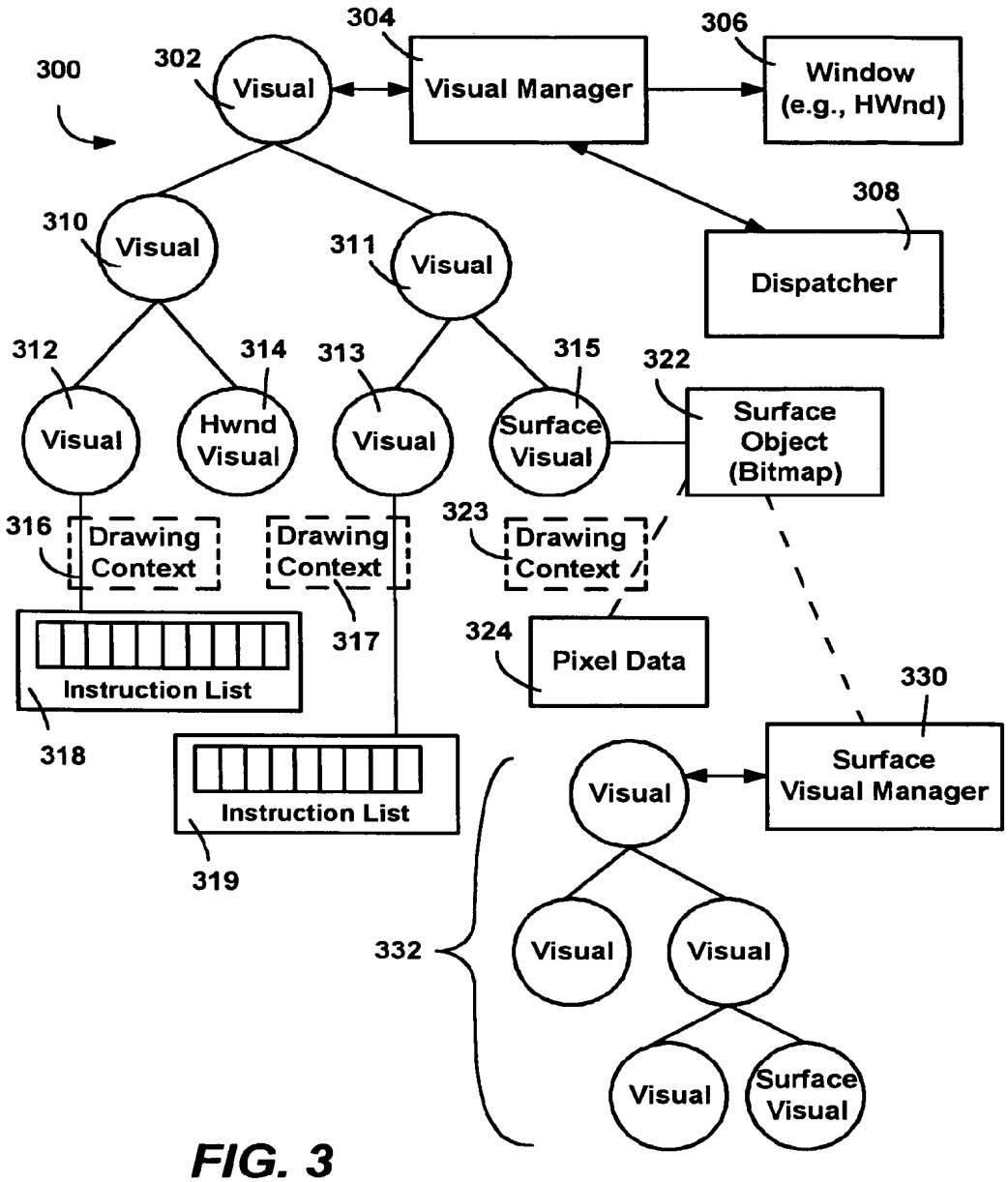

300
302
Visual
304
Visual Manager
306
Window
(e.g., HWnd)
308
Dispatcher
310
Visual
311
Visual
312
Visual
314
Hwnd
Visual
313
Visual
315
Surface
Visual
322
Surface
Object
(Bitmap)
316
Drawing
Context
Drawing
Context
317
323
Drawing
Context
324
Pixel Data
Instruction List
318
Instruction List
319
330
Surface
Visual Manager
332
Visual
Visual
Visual
Visual
Surface
Visual

FIG. 3

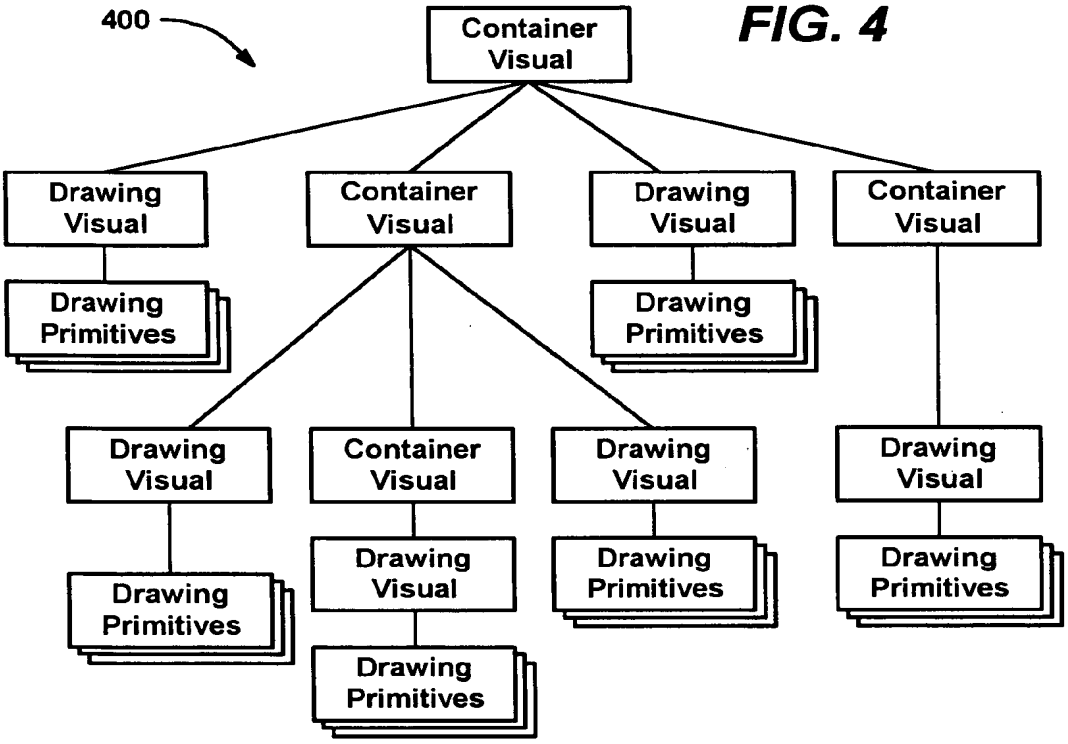

400
Container Visual
Drawing Visual
Container Visual
Drawing Visual
Container Visual
Drawing Primitives
Drawing Primitives
Drawing Visual
Container Visual
Drawing Visual
Drawing Visual
Drawing Primitives
Drawing Visual
Drawing Primitives
Drawing Primitives
Drawing Primitives

FIG. 4

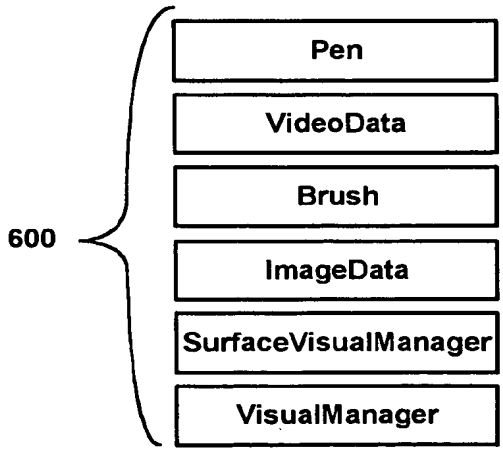

600
Pen
VideoData
Brush
ImageData
SurfaceVisualManager
VisualManager

FIG. 6

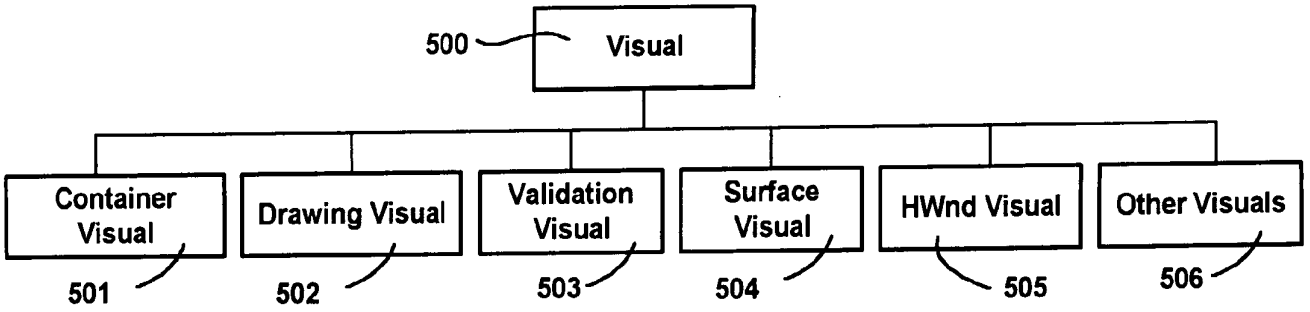

500
Visual
Container Visual
Drawing Visual
Validation Visual
Surface Visual
HWnd Visual
Other Visuals
501
502
503
504
505
506

FIG. 5

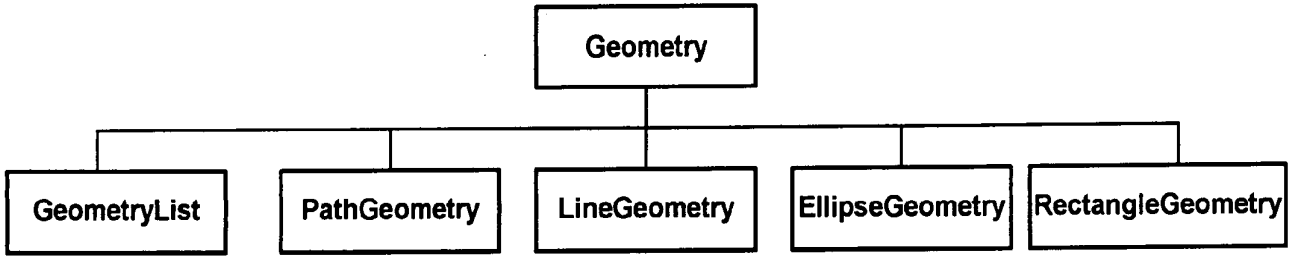

Geometry
GeometryList
PathGeometry
LineGeometry
EllipseGeometry
RectangleGeometry

FIG. 12

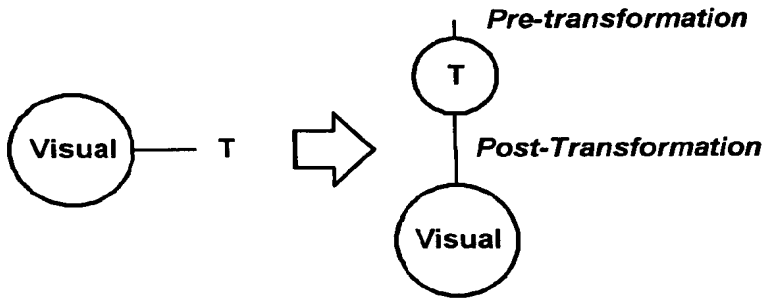

Pre-transformation
T
Visual
T
Post-Transformation
Visual

FIG. 7

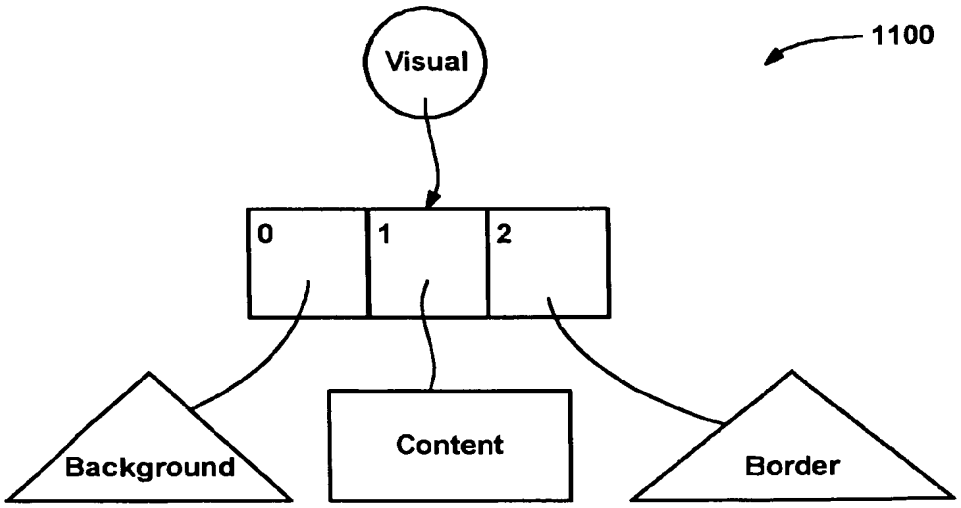

Visual
1100
0
1
2
Background
Content
Border

FIG. 11

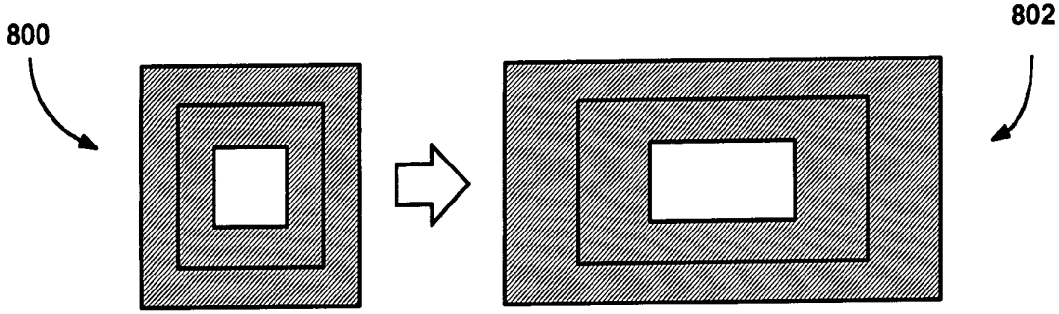


FIG. 8A

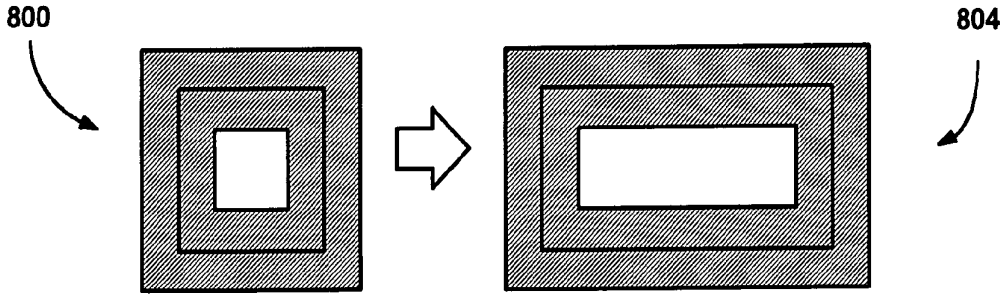


FIG. 8B

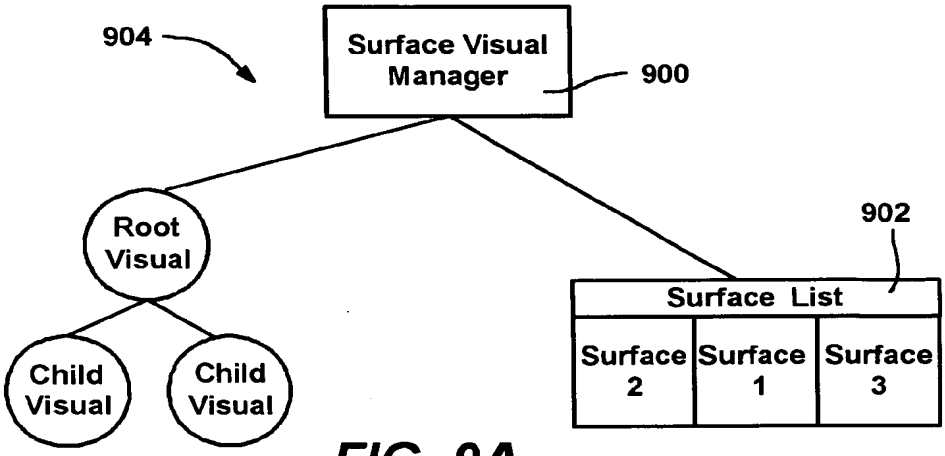

904
Surface Visual Manager
900
Root Visual
902
Surface List
Surface 2
Surface 1
Surface 3
Child Visual
Child Visual

FIG. 9A

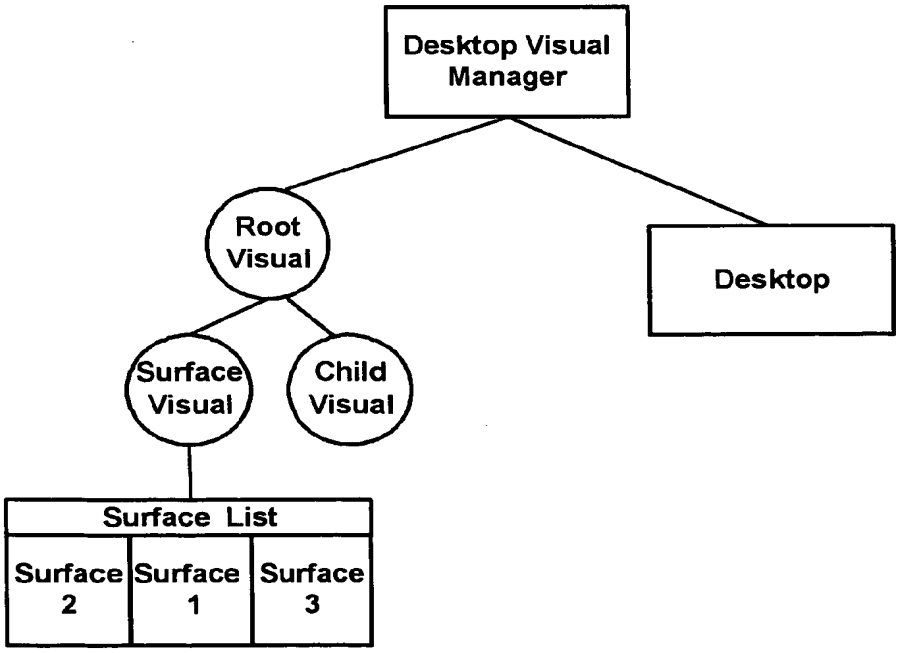

Desktop Visual Manager
Root Visual
Desktop
Surface Visual
Child Visual
Surface List
Surface 2
Surface 1
Surface 3

FIG. 9B

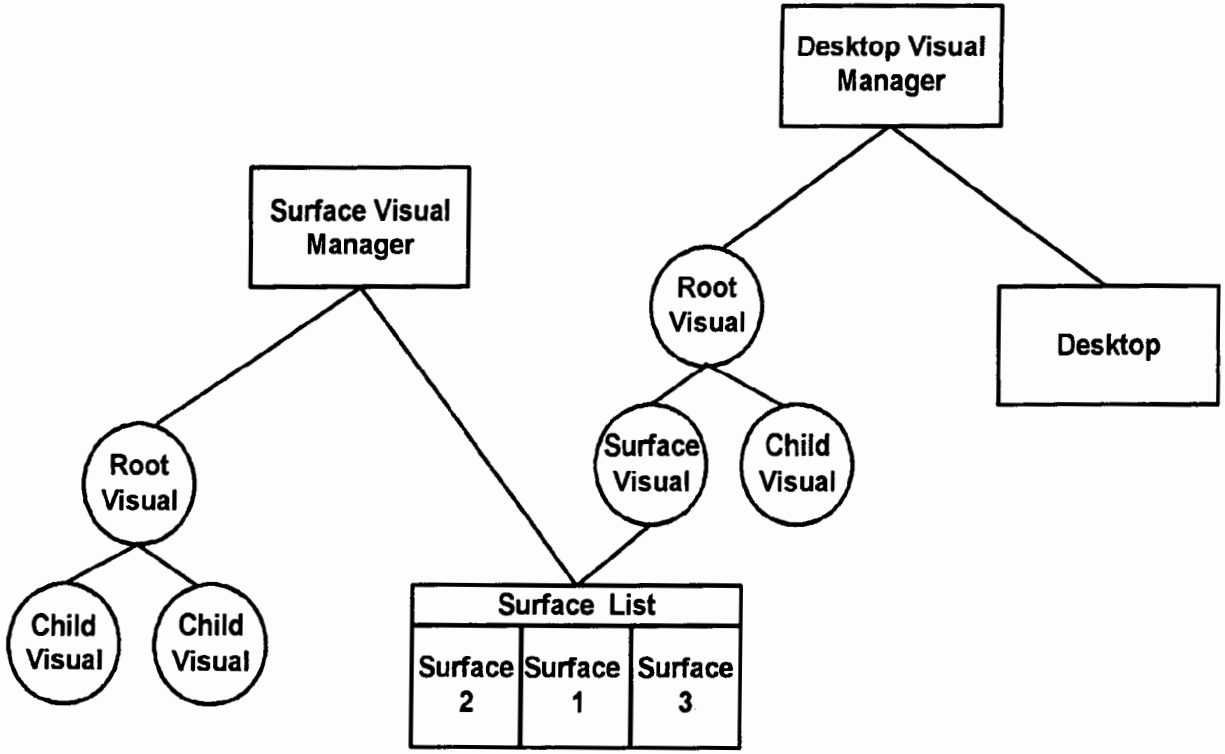

Desktop Visual Manager
Surface Visual Manager
Root Visual
Desktop
Root Visual
Surface Visual
Child Visual
Child Visual
Child Visual
Surface List
Surface 2
Surface 1
Surface 3

FIG. 9C

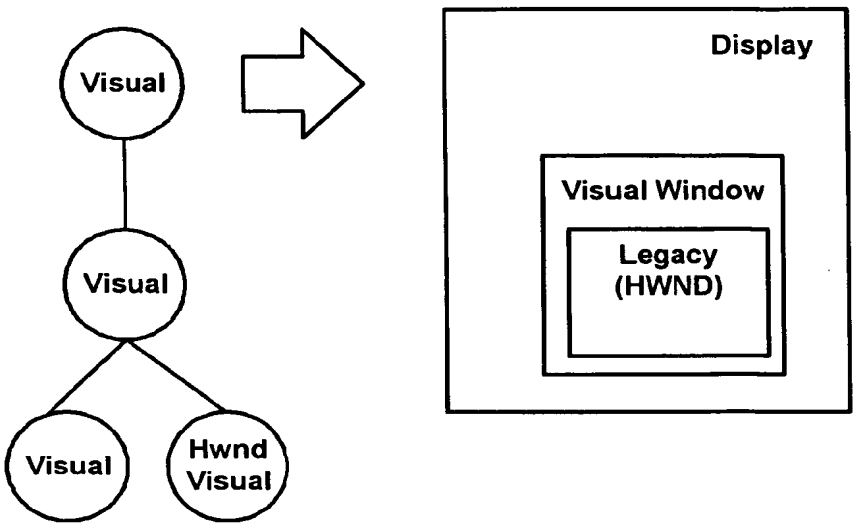


FIG. 10A

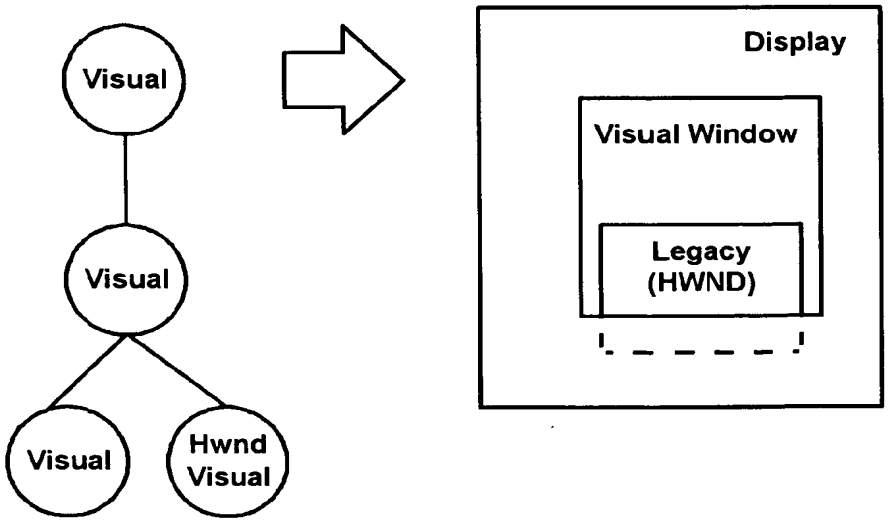


FIG. 10B

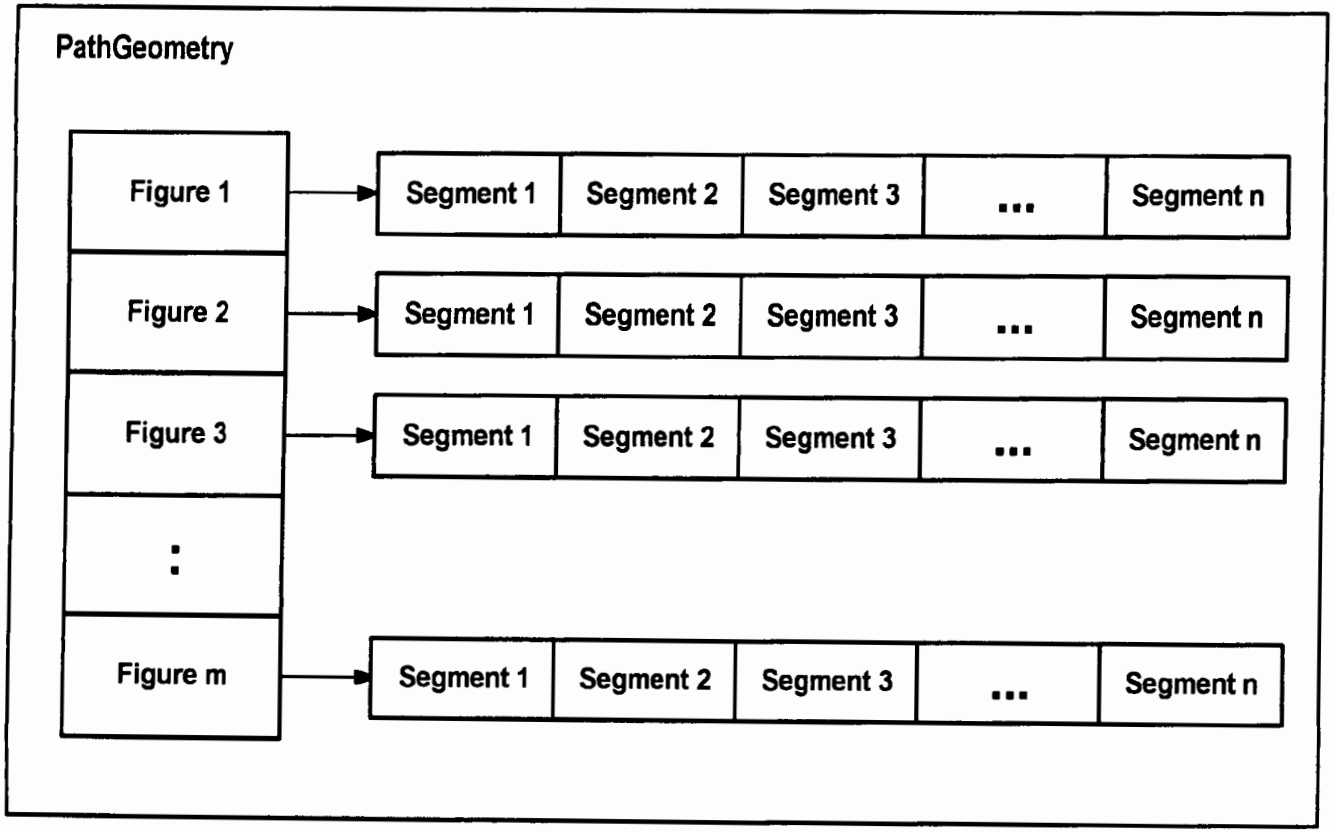

PathGeometry
Figure 1
Figure 2
Figure 3
Figure m
Segment 1
Segment 2
Segment 3
...
Segment n

FIG. 13

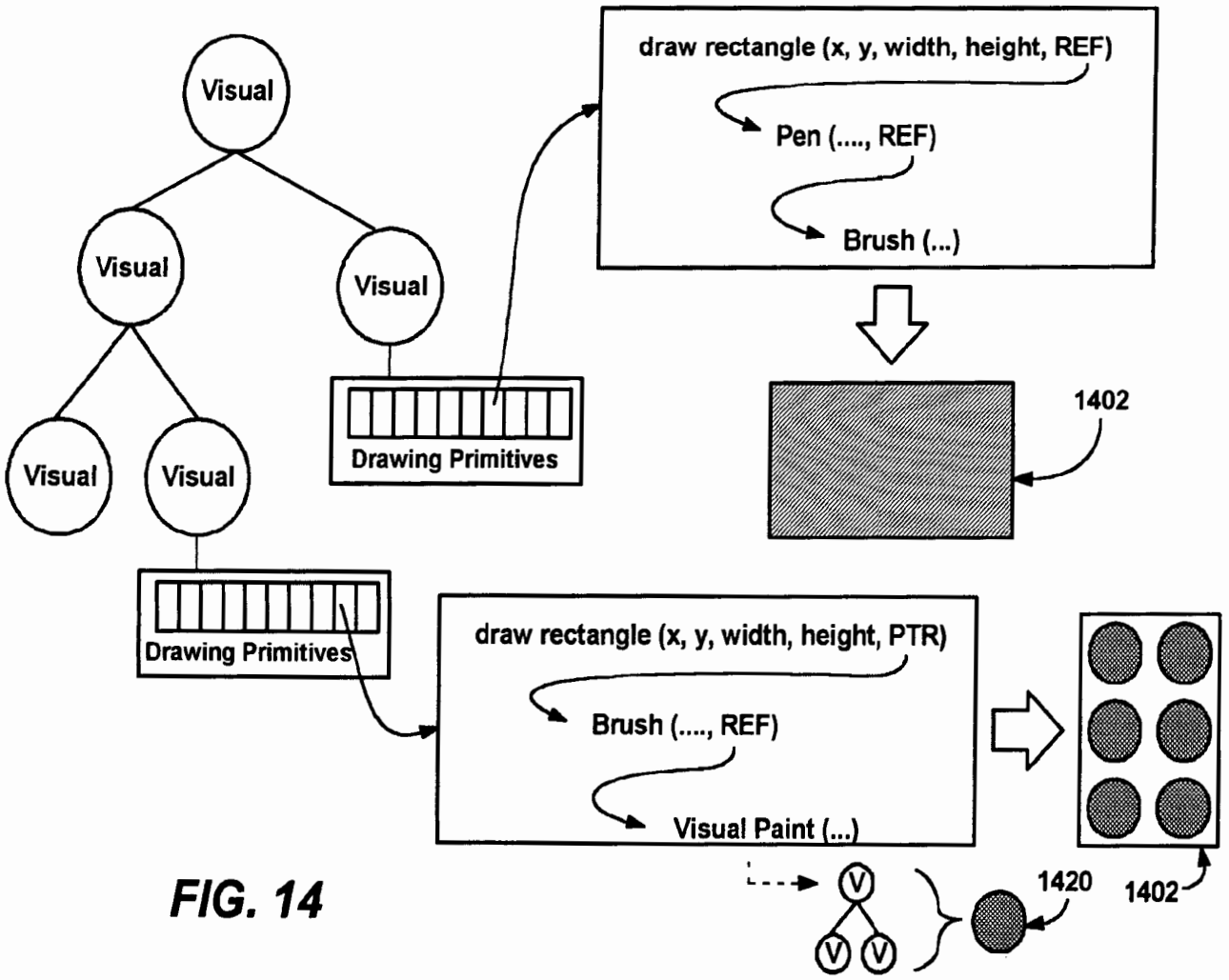

Visual
Visual
Visual
Visual
Visual
Drawing Primitives
Drawing Primitives
draw rectangle (x, y, width, height, REF)
Pen (...., REF)
Brush (...)
1402
draw rectangle (x, y, width, height, PTR)
Brush (...., REF)
Visual Paint (...)
V
V
V
1420
1402

FIG. 14

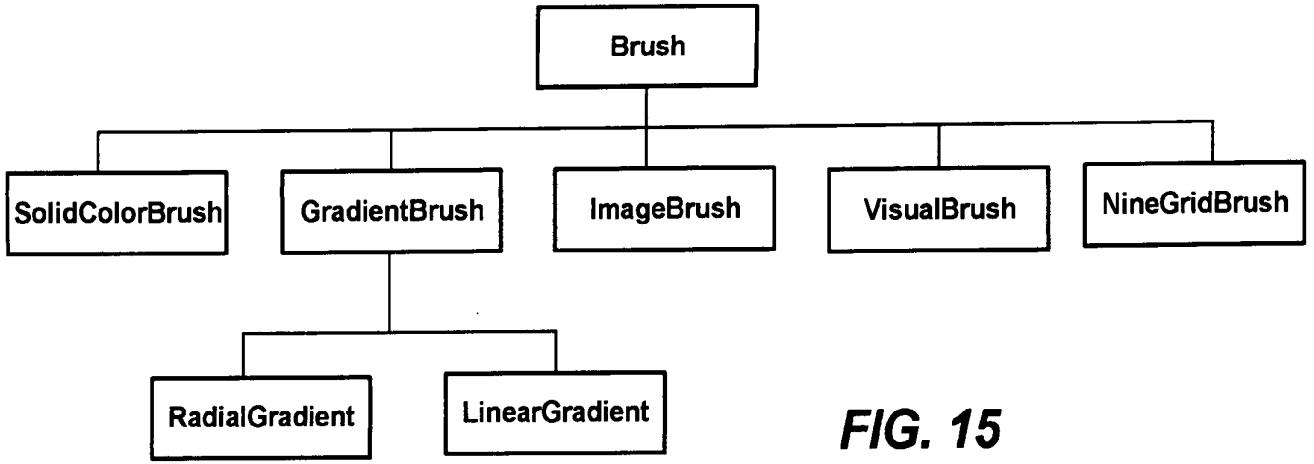

Brush
SolidColorBrush
GradientBrush
ImageBrush
VisualBrush
NineGridBrush
RadialGradient
LinearGradient

FIG. 15

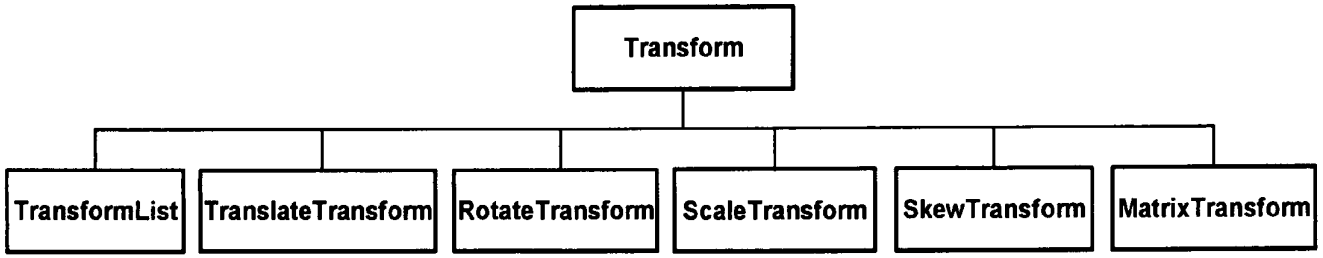

Transform
TransformList
TranslateTransform
RotateTransform
ScaleTransform
SkewTransform
MatrixTransform

FIG. 24

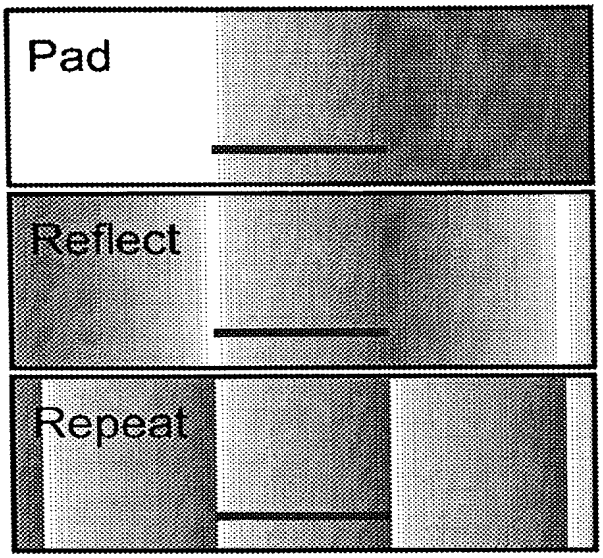


FIG. 16

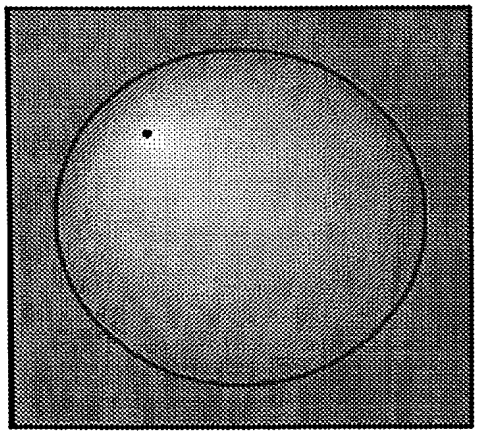


FIG. 17

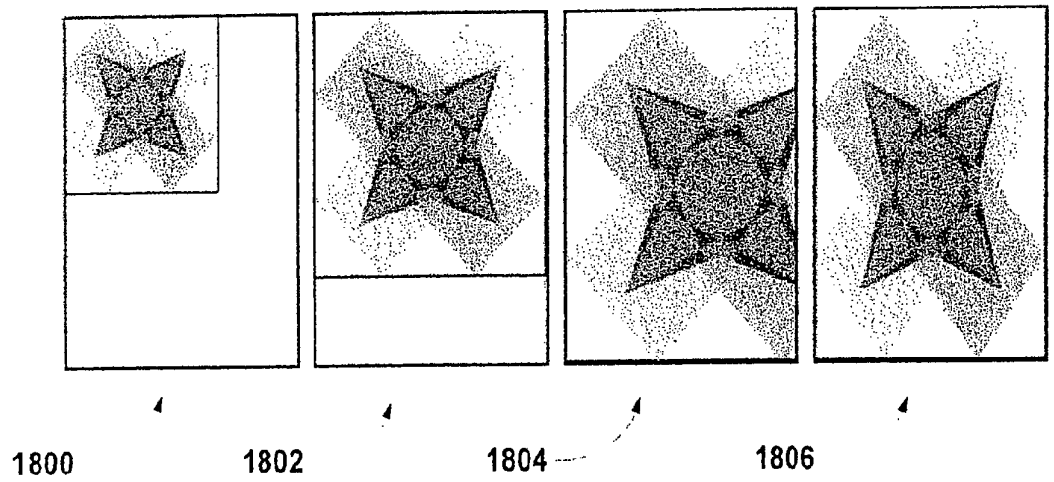


FIG. 18

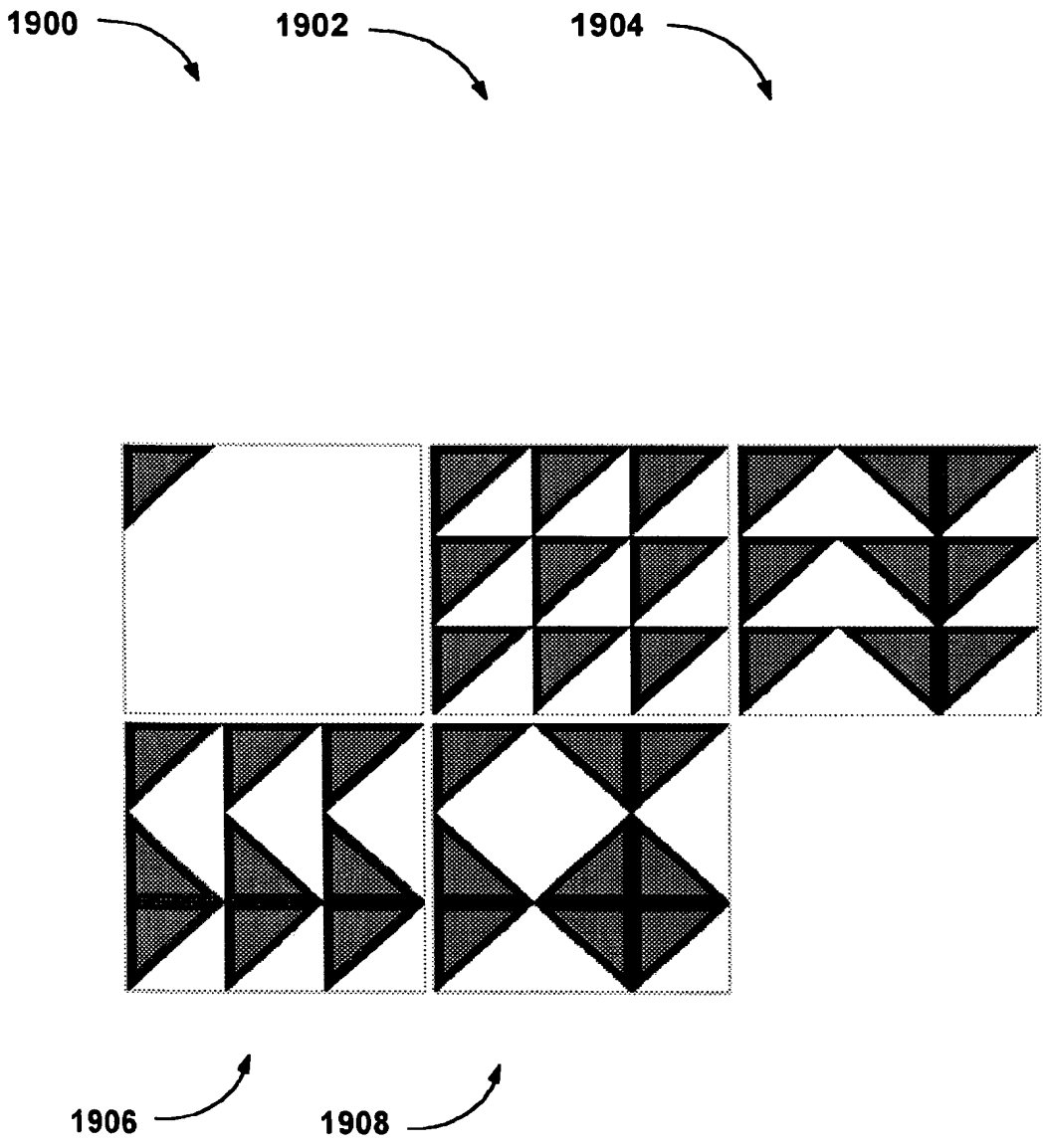


FIG. 19

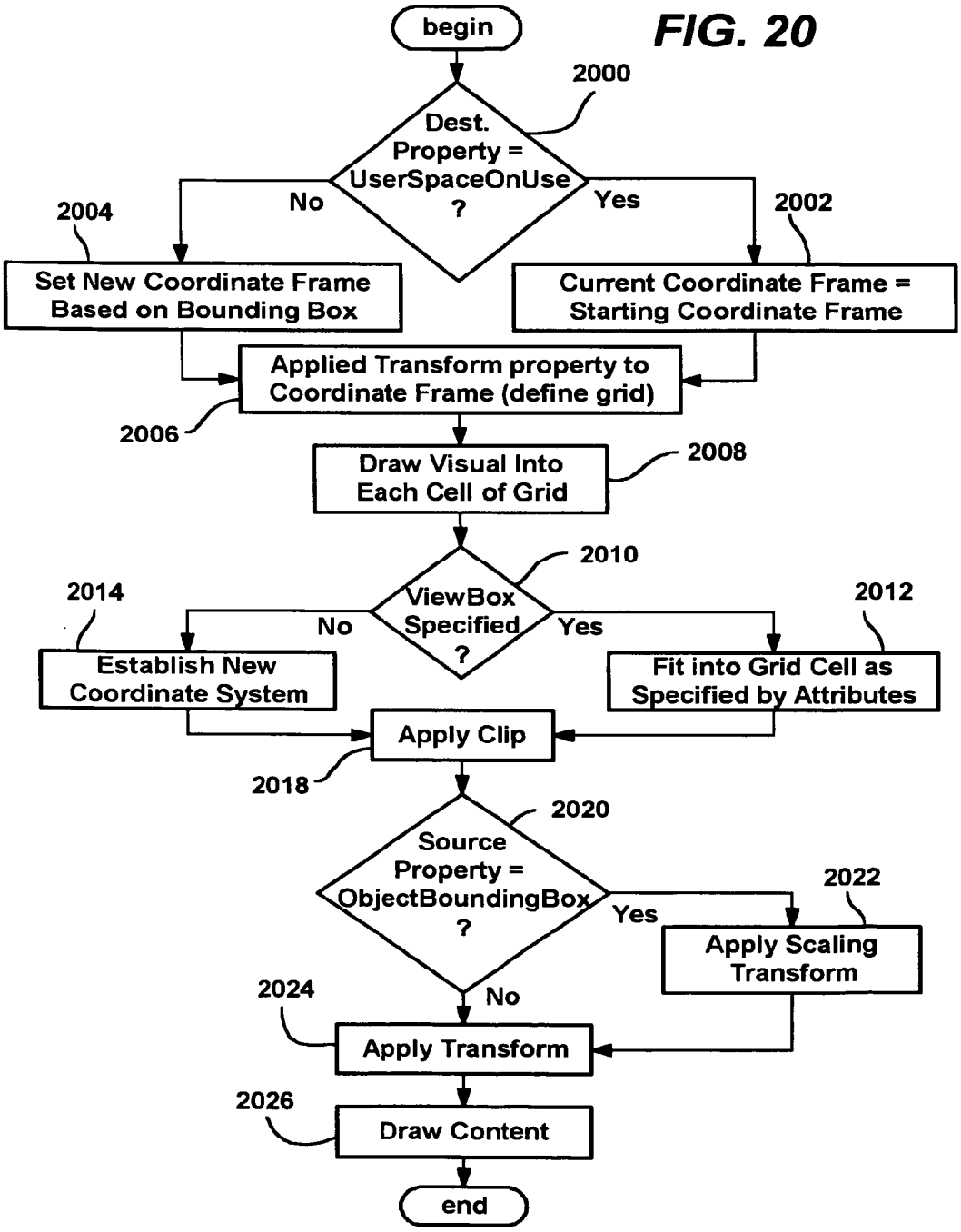

begin
2000
Dest. Property = UserSpaceOnUse ?
No
Yes
2004
2002
Set New Coordinate Frame Based on Bounding Box
Current Coordinate Frame = Starting Coordinate Frame
Applied Transform property to Coordinate Frame (define grid)
2006
Draw Visual Into Each Cell of Grid
2008
2010
ViewBox Specified ?
2014
2012
No
Yes
Establish New Coordinate System
Fit into Grid Cell as Specified by Attributes
Apply Clip
2018
2020
Source Property = ObjectBoundingBox ?
2022
Yes
Apply Scaling Transform
2024
No
Apply Transform
2026
Draw Content
end

FIG. 20

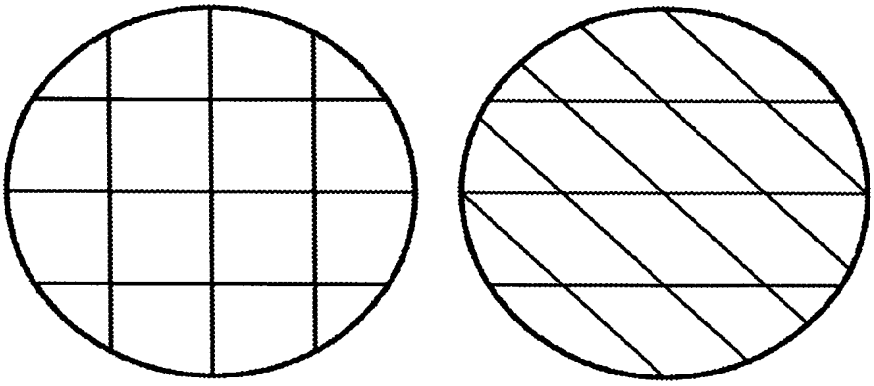


FIG. 21

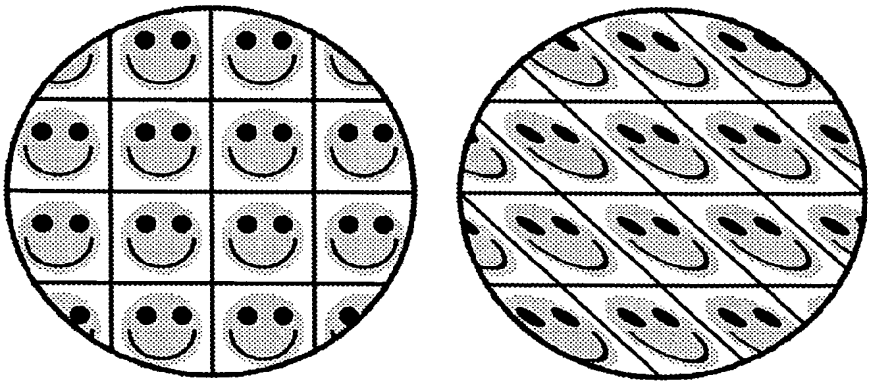


FIG. 22

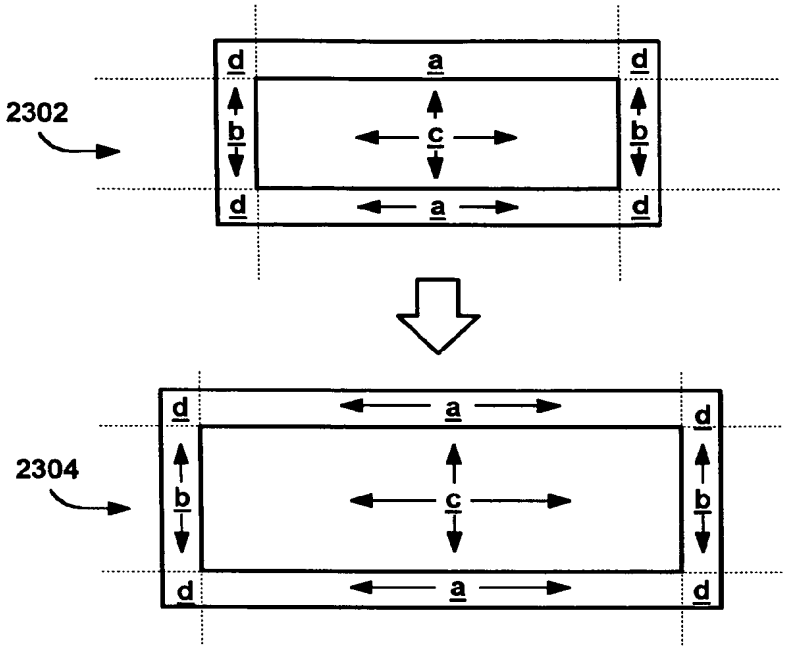

2302
d
a
d
b
c
b
d
a
d
2304
d
a
d
b
c
b
d
a
d

FIG. 23

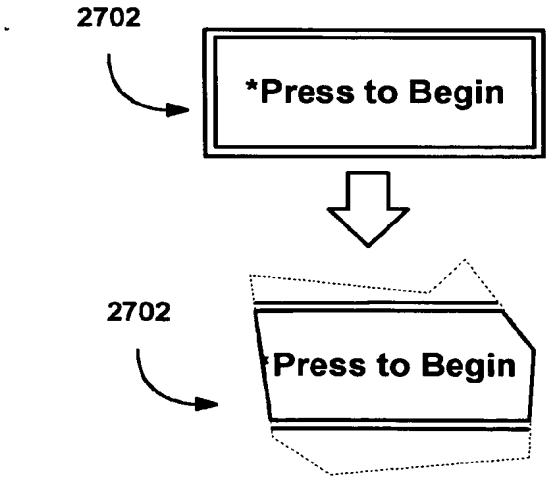

2702
*Press to Begin
2702
*Press to Begin

FIG. 27

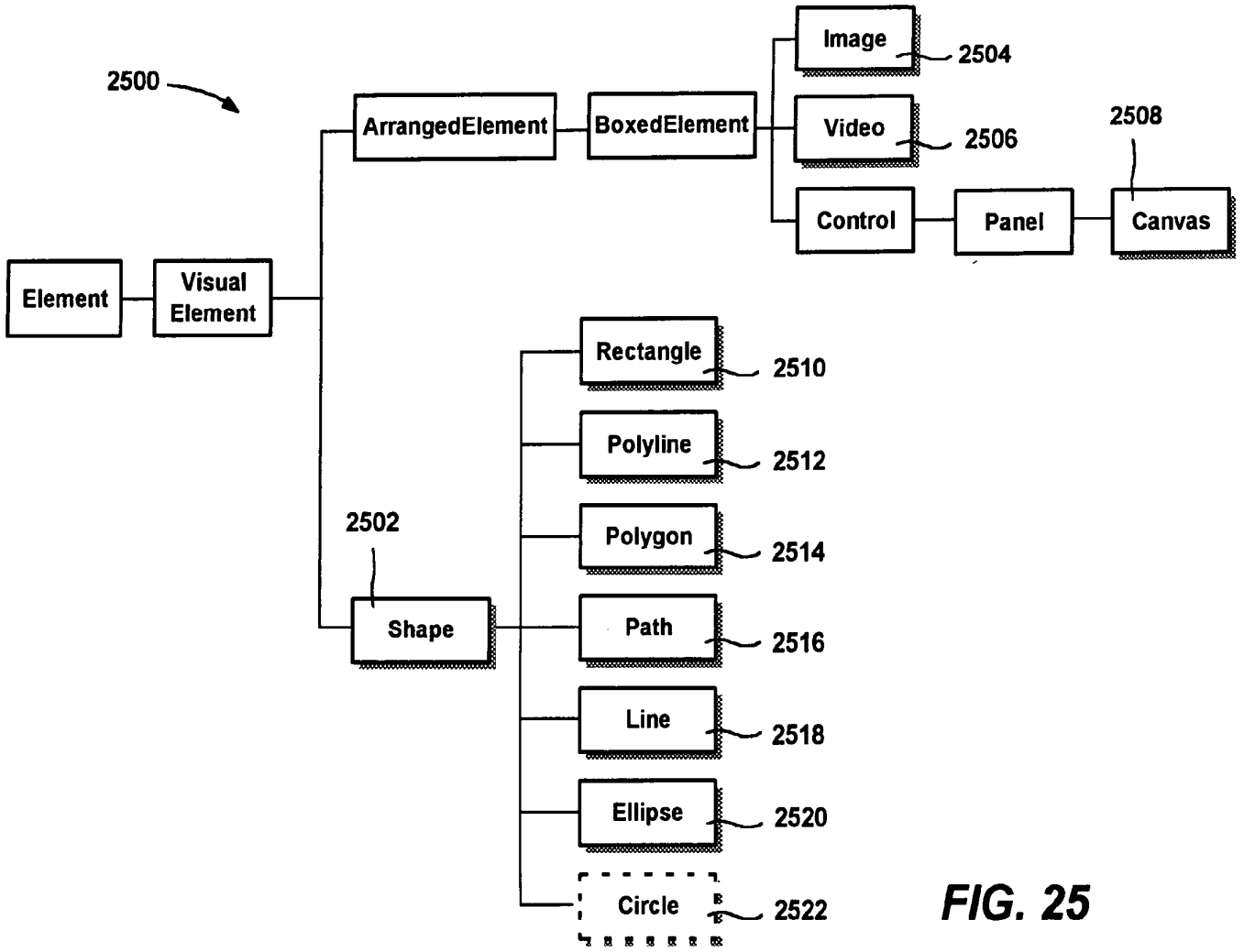

2500
Element
Visual Element
ArrangedElement
BoxedElement
Image
2504
Video
2506
Control
Panel
Canvas
2508
2502
Shape
Rectangle
2510
Polyline
2512
Polygon
2514
Path
2516
Line
2518
Ellipse
2520
Circle
2522

FIG. 25

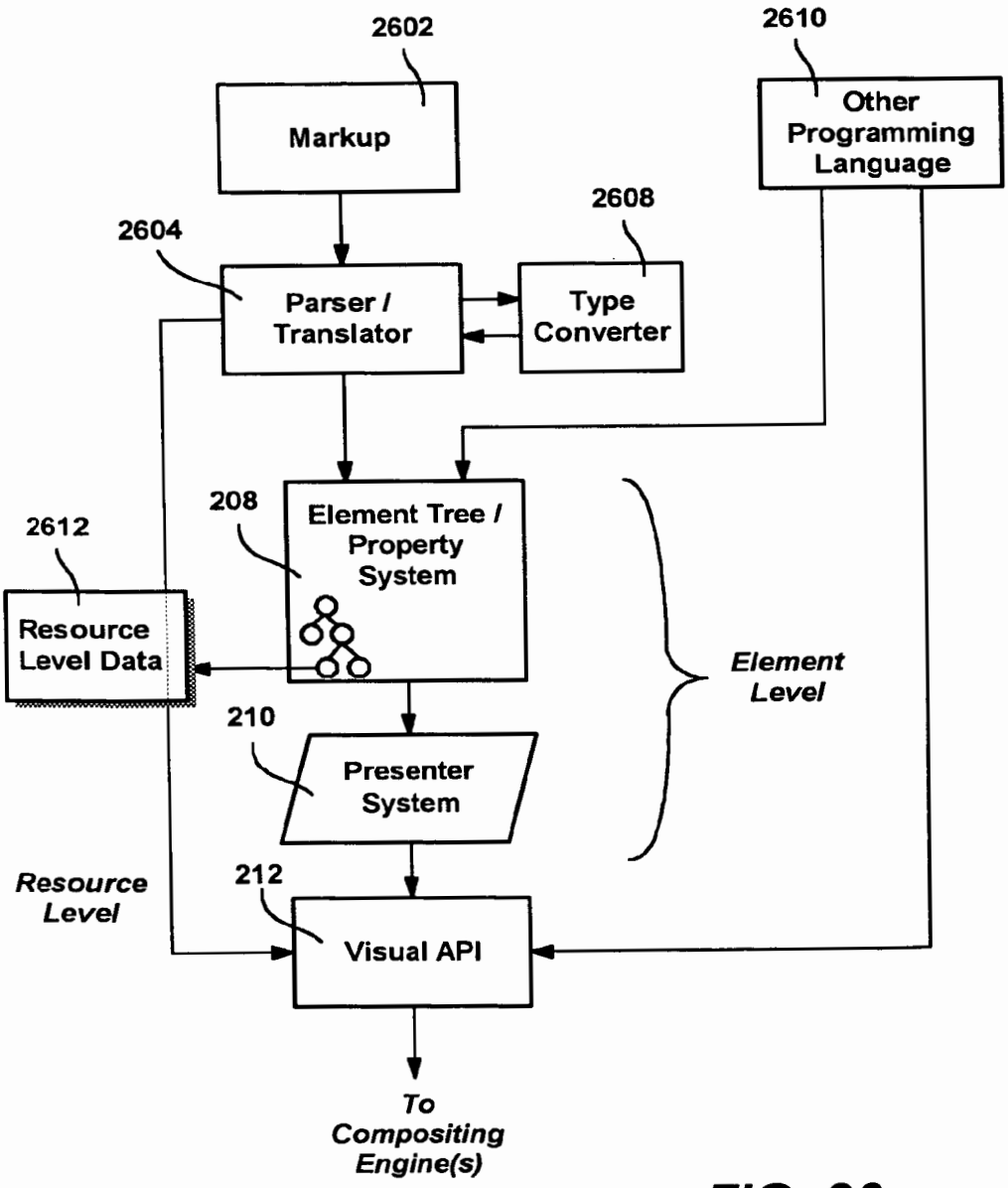

2602
Markup
2610
Other Programming Language
2608
2604
Parser / Translator
Type Converter
208
Element Tree / Property System
2612
Resource Level Data
Element Level
210
Presenter System
Resource Level
212
Visual API
To Compositing Engine(s)

FIG. 26

PTO/SB/08a (02-18)
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(Not for submission under 37 CFR 1.99)

Application Number	16990215
Filing Date	2020-08-11
First Named Inventor	Koen Simon Herman BEEL
Art Unit	3600
Examiner Name	TBD
Attorney Docket Number	BEEL3001C4/TL

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	2	20110078716		2011-03-31	MacWan	

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	1							

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	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	3600
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Non-Final Office Action in related U.S. application 16/812,755 dated February 19, 2021.	

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	3600
	Examiner Name	TBD
	Attorney Docket Number	BEEL3001C4/TL

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas Lee/	Date (YYYY-MM-DD)	2021-03-16
Name/Print	THOMAS LEE	Registration Number	66396

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

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EFS ID:	42194653
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Shelly Darrenkamp
Filer Authorized By:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TL
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Application Type:	Utility under 35 USC 111(a)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_IDS_SB08_16MAR21.pdf	1034333 d6879cfb6c76aa204169ec0bde2fd15cf144e0f5	no	4

Warnings:

Information:					
2	Non Patent Literature	OA1_19Feb2021.pdf	2904271 e528350d43ee0051813ebbd9ab986aca2fdfadbd	no	71
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(Not for submission under 37 CFR 1.99)

Application Number	16990215
Filing Date	2020-08-11
First Named Inventor	Koen Simon Herman BEEL
Art Unit	3600
Examiner Name	TDB
Attorney Docket Number	BEEL3001C4/TL

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	3600
	Examiner Name	TDB
	Attorney Docket Number	BEEL3001C4/TL

	1	Chinese Office Action in corresponding Chinese Application No. 201810229467.1, dated January 8, 2021.	☒
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	Application Number	16990215
	Filing Date	2020-08-11
	First Named Inventor	Koen Simon Herman BEEL
	Art Unit	3600
	Examiner Name	TDB
	Attorney Docket Number	BEEL3001C4/TL

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Signature	/Thomas Lee/	Date (YYYY-MM-DD)	2021-01-29
Name/Print	THOMAS LEE	Registration Number	66396

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Electronic Acknowledgement Receipt

EFS ID:	41780131
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Shelly Darrenkamp
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Attorney Docket Number:	BEEL3001C4/TL
Receipt Date:	29-JAN-2021
Filing Date:	11-AUG-2020
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Application Type:	Utility under 35 USC 111(a)

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	BEEL3004C_OA1_14Jan2021.pdf	1319663 2237894d9672626e3affe8d4c178a8904ef6c821	no	16

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Information:					
3	Foreign Reference	CN101566940_with_translation.pdf	2695116 1acddc2e0ff49a28ae482e8ae117c76432753505	no	30
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4	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_IDS.pdf	1034474 dd215e2ded4794854a190ebc2932f43e3a98e892	no	4
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DESCRIPTION CN101566940A

10 Method and device for realizing universal serial bus audio transmission of wireless data terminal

[0001]

14 Technical field

[0002]

18 The invention relates to audio data transmission technology, in particular to a method and device for realizing universal serial bus audio transmission of a wireless data terminal.

[0003]

23 Background technique

[0004]

27 At present, Time Division-Synchronous Code Division Multiple Access (TD-SCDMA, Time Division-Synchronous Code Division Multiple Access) technology, as the third-generation mobile communication standard proposed by China, has matured day by day. With the support of TD-SCDMA technology, it can download data and The speed of uploading data to the network has been greatly improved, and the increase in speed will inevitably promote the increase of users' demand for audio services and video services.

[0005]

35 In the prior art, when processing audio data, the wireless data terminal directly sends the analog audio signal received from the air interface to the corresponding radio frequency, codec and other hardware devices for demodulation and decoding, and finally it is played by the speaker; The collected analog audio signal that

needs to be sent is encoded and modulated by the corresponding codec, radio frequency and other hardware devices and then sent out.

40 The disadvantage of this way of processing audio data is that, due to the need to encode and decode audio data, the wireless data terminal must be equipped with a corresponding codec, which increases hardware costs.

[0006]

45 To overcome the shortcomings of the aforementioned audio data processing methods, a currently popular implementation method is Universal Serial Bus Audio Transmission (VOUSB, Voice Over USB). The implementation of this method is briefly described with a widely used PC as a terminal device.

48 The wireless data terminal transmits the demodulated audio data to the PC through the USB interface for decoding and other processing; similarly, the audio data processed in the PC is transmitted to the wireless data terminal through the USB interface.

51 In this way, the wireless data terminal no longer needs a codec on the hardware, reducing the hardware cost. Moreover, compared to wireless data terminals, PCs have stronger computing power and more memory resources, so they have more powerful processing capabilities for audio data and can perform richer processing, such as: denoising, retouching, Mixing and other processing.

[0007]

58 Figure 1 is a schematic diagram of the implementation method of VOUSB in the prior art. The air interface of the wireless data terminal receives the analog audio signal sent by the remote device via the wireless communication network and transmits it to the radio frequency for demodulation. After that, the baseband processing module decodes it. The tuned audio data is amplified and digitally filtered to obtain a pulse code modulation (PCM, Pulse Code Modulation) code stream, and then transmit the PCM code stream to the USB driver on the wireless data terminal side, and the USB driver on the wireless data terminal side converts the PCM The code stream is transmitted to the USB endpoint of the wireless data terminal. Finally, in accordance with the batch transmission method of the USB standard, the PCM code stream is transmitted to the USB endpoint of the terminal device via the USB endpoint of the wireless data terminal.

67 Here, the role of the USB driver on the wireless data terminal side is to receive audio data from the baseband processing module and transmit it to the USB endpoint of the wireless data terminal, or read audio data from the USB endpoint of the wireless data terminal and transmit it to the baseband processing module. The characteristic of the USB standard batch transmission method is to support a large amount of data transmission within an uncertain time, which can guarantee that the data can be transmitted, but the transmission bandwidth and delay are not guaranteed, so the real-time performance of data transmission is not good; In addition, for the audio data transmitted in the USB standard batch transmission mode, the terminal device does not have a standard driver to process it. To process the audio data, it needs to be implemented with the help of a user interface (UI, User Interface). The process is as follows:

[0008]

79 For the PCM code stream sent by the wireless data terminal to the USB endpoint of the terminal device, the

terminal device side USB driver reads it, and the terminal device UI reads and releases it from the terminal device side USB driver. After that, the PCM code stream Transfer to a physical sound card.

82 The physical sound card decodes the transmitted PCM code stream, then obtains the analog audio signal through A/D conversion and other processing, and finally sends the analog audio signal to the speaker for playback. The physical sound card may be a sound card with a PCI interface or a USB sound card. Here, the role of the USB driver on the terminal device side is to read audio data from the USB endpoint of the terminal device and transmit it to the UI, or obtain audio data from the UI and transmit it to the USB endpoint of the terminal device.

[0009]

91 However, in the current implementation method based on VOUSB, the USB audio data transmission channel between the wireless data terminal and the terminal device is only used as the data transmission channel. The problem that this brings is that there is no special optimization for the characteristics of audio data transmission. In terms of real-time performance, it has affected the practical application of VOUSB.

[0010]

98 Summary of the invention

[0011]

102 In view of this, the main purpose of the present invention is to provide a method and device for realizing universal serial bus audio transmission of a wireless data terminal, making full use of the powerful ability of the terminal device to process audio data and enhancing the practical application effect of VOUSB.

[0012]

108 In order to achieve the above objective, the technical scheme of the present invention is achieved as follows:

[0013]

112 The invention discloses a method for realizing universal serial bus audio transmission of a wireless data terminal. The USB audio data transmission channel between the wireless data terminal and the terminal device is enumerated as a USB sound card device. The key is that the method includes the following steps:

[0014]

118 The wireless data terminal sends audio data to the terminal device through the USB sound card device, and the terminal device accesses the USB sound card device through its own audio device driver to obtain audio data; the terminal device sends audio to the USB sound card device through its own audio device driver Data, the wireless data terminal receives the audio data through the USB sound card device.

[0015]

125 The enumerating the USB audio data transmission channel between the wireless data terminal and the terminal device as a USB sound card device includes: the wireless data terminal defines the wireless data terminal USB endpoint that transmits audio data as a sound card, and sets the wireless data terminal USB The endpoint is connected to the USB endpoint of the terminal device through a USB data cable; the terminal device requests the wireless data terminal to obtain the device descriptor, configuration descriptor, and descriptor set of the connected sound card. After the wireless data terminal receives the request, it sends the device description to the terminal device According to the acquired device descriptor, configuration descriptor, and descriptor set, the terminal device determines the driver that can provide USB, loads the corresponding audio device driver that conforms to the USB specification, and the audio device driver performs the operation on the sound card Configure to get a USB sound card device.

[0016]

138 The terminal device includes an audio device driver, a user interface UI, and a physical sound card. The terminal device accesses the USB sound card device to obtain audio data through its own audio device driver, including: the audio device driver accesses the USB sound card device interface The USB sound card device reads and releases the pulse code modulation PCM code stream transmitted to the USB sound card device; the UI accesses the audio device driver through the audio device interface, and transmits the PCM code stream to the physical sound card.

[0017]

147 The terminal device includes an audio device driver, a user interface UI, and a physical sound card. The terminal device sends audio data to the USB sound card device through its own audio device driver, including: the physical sound card obtains a PCM code stream from an analog audio signal; UI Obtain the PCM code stream from the physical sound card, and transmit the PCM code stream to the audio device driver through the audio device interface of the audio device driver, and the audio device driver sends the PCM code stream to the USB sound card device.

[0018]

156 The invention also discloses a device for realizing universal serial bus audio transmission of a wireless data terminal. The device includes: a wireless data terminal, a USB sound card device and a terminal device,

[0019]

161 The wireless data terminal is used to send audio data to the terminal device through a USB sound card device, and to receive audio data from the terminal device through the USB sound card device.

[0020]

166 USB sound card device, used to transmit audio data between the wireless data terminal and the terminal device;

[0021]

171 The terminal device is used to access the USB sound card device through its own audio device driver to obtain audio data from the wireless data terminal, and send audio data to the USB sound card device through its own audio device driver.

[0022]

177 The USB sound card device includes: a wireless data terminal-side USB driver, a wireless data terminal USB endpoint, and a terminal device USB endpoint, wherein the wireless data terminal-side USB driver is connected to the baseband processing module of the wireless data terminal; the wireless data terminal The USB endpoint is connected with the USB endpoint of the terminal device through a USB data line; the USB endpoint of the terminal device is connected with the audio device driver of the terminal device.

[0023]

185 The terminal device includes an audio device driver, a user interface UI, and a physical sound card. The audio device driver is used to access the USB endpoint of the terminal device by accessing the USB sound card device interface, and the PCM code stream transmitted to the USB endpoint of the terminal device Read and release; UI is used to access the audio device driver through the audio device interface, and transmit the PCM code stream to the physical sound card; the physical sound card is used to obtain the analog audio signal from the PCM code stream.

[0024]

194 The terminal device includes an audio device driver, a user interface UI, and a physical sound card. The physical sound card is used to obtain the PCM code stream from the analog audio signal; the UI is used to obtain the PCM code stream from the physical sound card and drive the audio through the audio device. The device interface transmits the PCM code stream to the audio device driver; the audio device driver is used to send the PCM code stream to the USB endpoint of the terminal device.

[0025]

202 It can be seen that, compared with the prior art, the method and device for realizing universal serial bus audio transmission of a wireless data terminal provided by the present invention has the following characteristics and advantages:

[0026]

First, the USB audio data transmission channel between the wireless data terminal and the terminal device is enumerated into a USB sound card device to transmit audio data using the standard USB AUDIO CLASS defined by the USB specification, and the operating system on the widely used terminal device Both provide the implementation of audio device drivers conforming to the USB specification by default. Therefore, the audio device driver accesses the USB endpoint of the terminal device by accessing the USB sound card device interface; the audio device driver reads the audio data read from the USB endpoint And release.

[0027]

Secondly, using the USB standard synchronous transmission method to transmit audio data has good real-time performance, and the terminal device has a standard driver for the synchronous transmission method, that is, the audio device driver, which reads and releases the audio data of the terminal device USB endpoint. It is done in the audio device driver, and its processing priority is higher than that in the application UI. Therefore, when the terminal device system is heavily loaded, the audio data processing still has good real-time performance.

[0028]

Finally, the UI accesses the audio device driver through the audio device interface, and transmits the released audio data to the physical sound card.

Since the UI accesses the audio device driver through the audio device interface, it reduces the UI's dependence on the audio device driver; the audio device interface is a standard interface, and there is no need to pay attention to the details of the underlying audio device driver implementation, and the operating system has good portability, allowing the UI It is simpler and more reliable to implement.

[0029]

According to the characteristics of audio data transmission, the USB audio data transmission channel is abstracted and optimized, and the powerful ability of terminal equipment to process audio data is fully utilized to enhance the practical application effect of VOUSB.

[0030]

Description of the drawings

[0031]

Figure 1 is a schematic diagram of a method for implementing VOUSB in the prior art;

[0032]

249 Fig. 2 is a schematic diagram of abstracting the USB audio data transmission channel into a USB sound card device in the present invention;

[0033]

254 Fig. 3 is a transmission flow chart of the wireless data terminal as the audio data receiver in the present invention;

[0034]

259 Figure 4 is a transmission flow chart of the wireless data terminal as the audio data sender in the present invention;

[0035]

264 Fig. 5 is a schematic diagram of the device structure for realizing universal serial bus audio transmission of a wireless data terminal in the present invention.

[0036]

269 Detailed ways

[0037]

273 The present invention will be further described in detail below in conjunction with the drawings and specific embodiments.

[0038]

278 Figure 2 is a schematic diagram of abstracting the USB audio data transmission channel into a USB sound card device in the present invention.

280 Compared with Figure 1, in the present invention, the USB sound card application method in the USB specification is used to abstract the USB audio data transmission channel between the wireless data terminal and the terminal device into a USB sound card device.

283 The USB audio data transmission channel refers to the audio data transmission channel including the USB driver on the wireless data terminal side, the USB endpoint of the wireless data terminal, the USB endpoint of the terminal device, and the USB data line between two USB endpoints.

286 The key to abstract the USB audio data transmission channel into a USB sound card device is to enumerate the USB audio data transmission channel into a USB sound card device using the standard USB AUDIO CLASS defined by the USB specification.

289 The enumeration is achieved through the following steps: first, the wireless data terminal side defines the

wireless data terminal USB endpoint that transmits audio data as a sound card, and connects the wireless data terminal USB endpoint to the terminal device USB endpoint through a USB data cable; After that, the terminal device sends a request to the wireless data terminal to request information such as the device descriptor, configuration descriptor, descriptor set, etc. of the connected sound card; after receiving the request, the wireless data terminal sends the requested device descriptor to the terminal device , Configuration descriptors, descriptor sets and other information; then, after the terminal device obtains this information and determines the driver that can provide USB based on this information, it loads the corresponding audio device driver that conforms to the USB specification; finally, the terminal device gets various descriptions After the symbol, it is considered that the information of the connected sound card is complete, and the sound card is configured by the audio device driver. If the configuration is successful, the audio data transmission between the wireless data terminal and the terminal device can be realized.

301 At this point, the enumeration process ends, and the USB audio data transmission channel is enumerated into a USB sound card device.

303 The wireless data terminal is connected with the USB driver of the wireless data terminal side of the USB sound card device; the terminal device is connected with the USB end point of the terminal device of the USB sound card device.

[0039]

309 Different from the audio data processing capabilities of physical sound cards such as ordinary USB sound cards, and can directly send the processed audio data to the speakers for playback, the USB sound card device is characterized by the same access interface and use method as the physical sound card. To the user, it seems to be an actual physical sound card, but in fact, this USB sound card device only has the function of audio data transmission, and does not have the real audio data processing capability. If you want to process the received audio data, Need to rely on the physical sound card on the terminal device to achieve.

315 For the audio data sent by the terminal device to the wireless data terminal, the wireless data terminal will transmit to the remote device through the wireless communication network.

317 The remote device may be a wireless data terminal or terminal device.

318 If the remote device needs to process the received audio data, if the remote device is a terminal device, directly use the physical sound card on the terminal device to process the audio data and play it; if the remote device is a wireless data terminal , The received audio data is transmitted to the terminal device connected to the wireless data terminal through the USB sound card device, and the audio data is processed by the physical sound card on the terminal device and played.

[0040]

326 Since the USB audio data transmission channel between the wireless data terminal and the terminal device is enumerated into a USB sound card device using the standard USB AUDIO CLASS defined by the USB specification, the audio data transmission is realized, and the operating system on the widely used terminal device Both provide the implementation of audio device drivers that comply with the USB specification by default. Therefore, for the audio data sent by the wireless data terminal to the USB endpoint of the USB sound card device, the audio device driver accesses the terminal by accessing the USB sound card device

interface. Device USB endpoint; when accessing the terminal device USB endpoint, the audio device driver reads and releases the audio data sent to the terminal device USB endpoint. Compared with the existing audio data read and released by the application UI, The audio device driver has a higher priority for reading and releasing. Therefore, even when the terminal device system is heavily loaded, the audio data processing still has good real-time performance; in addition to the audio device driver downward access to the terminal device USB endpoint, The audio device interface can also be provided upwards. The audio device interface is a standard interface. When the UI accesses the audio device interface, there is no need to pay attention to the details of the low-level audio device driver implementation, and the operating system is portable. The UI can be accessed through the audio device interface The audio device drives and transfers the audio data to the physical sound card, which reduces the UI's dependence on the audio device drive, and makes the UI simpler and more reliable.

[0041]

346 Specifically, the process of using a USB sound card device to implement audio data transmission is shown in Figure 3 and Figure 4.

[0042]

351 Figure 3 is a transmission flow chart of a wireless data terminal as a receiver of audio data. The transmission of audio data includes the following steps:

[0043]

356 Step 301: The air interface of the wireless data terminal receives the analog audio signal sent by the remote device via the wireless communication network, and transmits it to the radio frequency and other hardware for demodulation. After that, the baseband processing module amplifies the demodulated audio data. Digital filter processing, get PCM code stream.

[0044]

363 Step 302: The PCM code stream obtained after processing is transmitted by the baseband processing module of the wireless data terminal to the USB driver of the wireless data terminal side of the USB sound card device; after that, according to the synchronous transmission mode of the USB standard, the PCM code stream passes through the USB endpoint of the wireless data terminal And the USB data line is transferred to the USB endpoint of the terminal device of the USB sound card device.

[0045]

371 Step 303: After the PCM code stream is transmitted to the terminal device USB endpoint, the audio device driver of the terminal device accesses the terminal device USB endpoint by accessing the USB sound card device interface, and reads the PCM code stream transmitted to the terminal device USB endpoint After

fetching and releasing, the UI accesses the audio device driver through the audio device interface, and transmits the PCM code stream to the physical sound card.

[0046]

379 Step 304: The physical sound card decodes the transmitted PCM code stream and processes the D/A conversion to obtain an analog audio signal. Finally, the analog audio signal is transmitted to the speaker for playback.

[0047]

385 Figure 4 is a transmission flow chart of a wireless data terminal as a sender of audio data. The transmission of audio data includes the following steps:

[0048]

390 Step 401: The microphone of the terminal device transmits the collected analog audio signal to the physical sound card, and the physical sound card performs A/D conversion, encoding and other processing on it to obtain a digital audio signal in the form of a PCM code stream.

[0049]

396 Step 402: The UI of the terminal device obtains the PCM code stream from the physical sound card, and transmits the PCM code stream to the audio device driver through the audio device interface driven by the audio device. The audio device driver compresses the PCM code stream, and then the audio device driver Return the PCM code stream to the terminal device USB endpoint of the USB sound card device by accessing the USB sound card device interface.

[0050]

404 Step 403: After the PCM code stream is transmitted to the USB endpoint of the terminal device of the USB sound card device, according to the synchronous transmission mode of the USB standard, the PCM code stream is transmitted to the wireless data terminal USB endpoint of the USB sound card device through the USB data line.

[0051]

411 Step 404: The baseband processing module of the wireless data terminal obtains the PCM code stream transmitted to the USB endpoint of the wireless data terminal through the USB driver on the wireless data terminal side, performs amplification and digital filtering, and modulates by radio frequency to obtain an analog audio signal. Finally, The air interface is sent to the remote device via the wireless communication network.

[0052]

In order to realize the above method, the present invention also provides a device for realizing universal serial bus audio transmission of a wireless data terminal. As shown in FIG. 5, the device is mainly composed of a wireless data terminal, a USB sound card device, and a terminal device.

[0053]

Among them, the wireless data terminal is used to send audio data to the terminal device through a USB sound card device; to receive audio data from the terminal device through the USB sound card device.

[0054]

USB sound card device, used to transmit audio data between the wireless data terminal and the terminal device.

[0055]

The terminal device is used to access the USB sound card device through its own audio device driver to obtain audio data from the wireless data terminal, and send audio data to the USB sound card device through its own audio device driver.

[0056]

Specifically, the audio device driver of the terminal device accesses the USB endpoint of the terminal device by accessing the USB sound card device interface, reads and releases the audio data transmitted to the USB endpoint of the terminal device, and then further transmits the audio data to The physical sound card is decoded, D/A converted, and finally played by the speaker; the audio data collected by the microphone, and further A/D converted and encoded by the physical sound card, is transmitted by the UI to the audio device driver for compression, and then the audio device The driver returns to the terminal device USB endpoint by accessing the USB sound card device interface.

[0057]

The foregoing descriptions are only preferred embodiments of the present invention, and are not used to limit the protection scope of the present invention.

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CLAIMS CN101566940A

1.

13 1、A method for realizing universal serial bus audio transmission of a wireless data terminal is characterized in that the USB audio data transmission channel between the wireless data terminal and the terminal device is enumerated as a USB sound card device, and the method includes the following steps:

16 The wireless data terminal sends audio data to the terminal device through the USB sound card device, and the terminal device accesses the USB sound card device through its own audio device driver to obtain the audio data;

19 The terminal device sends audio data to the USB sound card device through its own audio device driver, and the wireless data terminal receives the audio data through the USB sound card device.

2.

24 2、The method according to claim 1, wherein the enumerating USB audio data transmission channels between the wireless data terminal and the terminal device as a USB sound card device comprises:

26 The wireless data terminal defines the wireless data terminal USB endpoint that transmits audio data as a sound card, and connects the wireless data terminal USB endpoint to the terminal device USB endpoint through a USB data cable;

29 The terminal device requests the wireless data terminal to obtain the device descriptor, configuration descriptor, and descriptor set of the connected sound card. After receiving the request, the wireless data terminal sends the device descriptor, configuration descriptor, and descriptor set to the terminal device;

32 The terminal device determines the driver that can provide USB according to the acquired device descriptor, configuration descriptor, and descriptor set, loads the corresponding audio device driver that conforms to the USB specification, and configures the sound card by the audio device driver to obtain the USB sound card device.

3.

39 3、 The method according to claim 1, wherein the terminal device includes an audio device driver, a user interface UI and a physical sound card,

41 The terminal device accesses the USB sound card device through its own audio device driver to obtain audio data, including: the audio device driver accesses the USB sound card device by accessing the USB sound card device interface, and modulates the PCM code transmitted to the USB sound card device by pulse code The stream is read and released; the UI accesses the audio device driver through the audio device interface, and transmits the PCM code stream to the physical sound card.

4.

49 4、 The method according to claim 1, wherein the terminal device includes an audio device driver, a user interface UI and a physical sound card,

51 The terminal device sends audio data to the USB sound card device through its own audio device driver, including: the physical sound card obtains the PCM code stream from the analog audio signal; the UI obtains the PCM code stream from the physical sound card and uses the audio device interface driven by the audio device The PCM code stream is transmitted to the audio device driver, and the audio device driver sends the PCM code stream to the USB sound card device.

5.

59 5、 A device for realizing universal serial bus audio transmission of a wireless data terminal, characterized in that the device includes: a wireless data terminal, a USB sound card device and a terminal device,

61 The wireless data terminal is used to send audio data to the terminal device through a USB sound card device, and to receive audio data from the terminal device through the USB sound card device.

63 USB sound card device, used to transmit audio data between the wireless data terminal and the terminal device;

64 The terminal device is used to access the USB sound card device through its own audio device driver to obtain audio data from the wireless data terminal, and send audio data to the USB sound card device through its own audio device driver.

6.

70 6、 The device according to claim 5, wherein the USB sound card device comprises: a USB driver on the side of a wireless data terminal, a USB endpoint of a wireless data terminal, and a USB endpoint of a terminal device,

73 The USB driver on the side of the wireless data terminal is connected to the baseband processing module of the wireless data terminal;

75 The USB endpoint of the wireless data terminal is connected to the USB endpoint of the terminal device through a USB data cable;

77 The USB endpoint of the terminal device is connected with the audio device driver of the terminal device.

7.

81 7、The apparatus according to claim 6, wherein the terminal device comprises an audio device driver, a user interface UI and a physical sound card,

83 The audio device driver is used to access the USB endpoint of the terminal device by accessing the USB sound card device interface, and read and release the PCM code stream transmitted to the USB endpoint of the terminal device;

86 UI is used to access the audio device driver through the audio device interface, and transmit the PCM code stream to the physical sound card;

88 The physical sound card is used to obtain the analog audio signal from the PCM code stream.

8.

92 8、The method according to claim 6, wherein the terminal device includes an audio device driver, a user interface UI and a physical sound card,

94 The physical sound card is used to obtain the PCM code stream from the analog audio signal;

95 The UI is used to obtain the PCM code stream from the physical sound card, and transmit the PCM code stream to the audio device driver through the audio device interface of the audio device driver;

97 The audio device driver is used to send a PCM code stream to the USB endpoint of the terminal device.

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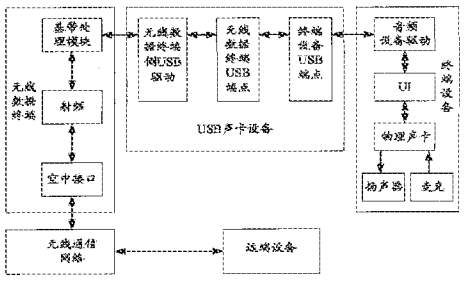
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[54] 发明名称

实现无线数据终端通用串行总线音频传输的方法及装置

[57] 摘要

本发明公开了一种实现无线数据终端通用串行总线音频传输的方法及装置。其方法为将无线数据终端与终端设备之间的 USB 音频数据传输通道，采用 USB 规范定义的标准的 USB AUDIO CLASS 枚举成一个 USB 声卡设备，传输音频数据；该装置包括无线数据终端、USB 声卡设备、终端设备。所述 USB 声卡设备仅传输音频数据，而不对音频数据进行处理；终端设备的音频设备驱动以访问 USB 声卡设备接口的方式访问终端设备 USB 端点，并对音频数据 PCM 码流进行读取和释放，或者，压缩和回传；终端设备的物理声卡对音频数据 PCM 码流进行编解码及 D/A 或 A/D 转换。采用本发明的方法及装置，对 USB 音频数据传输通道进行专门优化，充分利用终端设备处理音频数据的强大能力，增强了 VOUSB 的实际应用效果。



1、一种实现无线数据终端通用串行总线音频传输的方法，其特征在于，将无线数据终端和终端设备之间的USB音频数据传输通道枚举为USB声卡设备，该方法包括以下步骤：

无线数据终端通过所述USB声卡设备向终端设备发送音频数据，终端设备通过自身的音频设备驱动访问所述USB声卡设备获取音频数据；

终端设备通过自身的音频设备驱动向所述USB声卡设备发送音频数据，无线数据终端通过所述USB声卡设备接收该音频数据。

2、根据权利要求1所述的方法，其特征在于，所述将无线数据终端和终端设备之间的USB音频数据传输通道枚举为USB声卡设备，包括：

无线数据终端将传输音频数据的无线数据终端USB端点定义为声卡，并将该无线数据终端USB端点通过USB数据线连接到终端设备USB端点；

终端设备向无线数据终端请求获取所连接声卡的设备描述符、配置描述符、描述符集合，无线数据终端收到请求后，向终端设备发送设备描述符、配置描述符、描述符集合；

终端设备根据获取的设备描述符、配置描述符、描述符集合确定能够提供USB的驱动，加载相应符合USB规范的音频设备驱动，由音频设备驱动对声卡进行配置，得到USB声卡设备。

3、根据权利要求1所述的方法，其特征在于，所述终端设备包括音频设备驱动、用户界面UI和物理声卡，

所述终端设备通过自身的音频设备驱动访问USB声卡设备获取音频数据，包括：音频设备驱动以访问USB声卡设备接口的方式访问所述USB声卡设备，对传输到USB声卡设备的脉冲编码调制PCM码流进行读取和释放；UI通过音频设备接口访问音频设备驱动，将PCM码流传输到物理声卡。

4、根据权利要求1所述的方法，其特征在于，所述终端设备包括音频设备驱动、用户界面UI和物理声卡，

所述终端设备通过自身的音频设备驱动向 USB 声卡设备发送音频数据，包括：物理声卡由模拟音频信号得到 PCM 码流；UI 从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动，音频设备驱动向 USB 声卡设备发送 PCM 码流。

5、一种实现无线数据终端通用串行总线音频传输的装置，其特征在于，该装置包括：无线数据终端、USB 声卡设备和终端设备，

无线数据终端，用于通过 USB 声卡设备向终端设备发送音频数据，通过 USB 声卡设备接收来自终端设备的音频数据。

USB 声卡设备，用于在无线数据终端和终端设备之间传输音频数据；

终端设备，用于通过自身的音频设备驱动访问 USB 声卡设备获取来自无线数据终端的音频数据，通过自身的音频设备驱动向 USB 声卡设备发送音频数据。

6、根据权利要求 5 所述的装置，其特征在于，所述 USB 声卡设备包括：无线数据终端侧 USB 驱动、无线数据终端 USB 端点和终端设备 USB 端点，

所述无线数据终端侧 USB 驱动与无线数据终端的基带处理模块相连；

所述无线数据终端 USB 端点通过 USB 数据线与终端设备 USB 端点相连；

所述终端设备 USB 端点与终端设备的音频设备驱动相连。

7、根据权利要求 6 所述的装置，其特征在于，所述终端设备包括音频设备驱动、用户界面 UI 和物理声卡，

音频设备驱动用于以访问 USB 声卡设备接口的方式访问所述终端设备 USB 端点，对传输到终端设备 USB 端点的 PCM 码流进行读取和释放；

UI 用于通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡；

物理声卡用于由 PCM 码流得到模拟音频信号。

8、根据权利要求 6 所述的方法，其特征在于，所述终端设备包括音频设备驱动、用户界面 UI 和物理声卡，

物理声卡用于由模拟音频信号得到 PCM 码流；

UI 用于从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动；

音频设备驱动用于向所述终端设备 USB 端点发送 PCM 码流。

实现无线数据终端通用串行总线音频传输的方法及装置

技术领域

本发明涉及音频数据传输技术，具体涉及一种实现无线数据终端通用串行总线音频传输的方法及装置。

背景技术

目前，时分同步的码分多址（TD-SCDMA，Time Division-Synchronous Code Division Multiple Access）技术作为中国提出的第三代移动通信标准已经日趋成熟，在 TD-SCDMA 技术支持下，从网络下载数据和向网络上传数据的速度都得到了极大的提高，而速度的提高又必然会促进用户对音频业务和视频业务需求的增加。

现有技术中，无线数据终端在处理音频数据时，对从空口接收到的模拟音频信号，直接送到相应的射频、编解码器等硬件设备进行解调、解码，最后由扬声器播放；对麦克采集的需要发送的模拟音频信号，在相应的编解码器、射频等硬件设备进行编码、调制后发送出去。这种处理音频数据的方式存在的缺陷在于，由于需要对音频数据进行编码和解码，无线数据终端就必须配有相应的编解码器，增加了硬件成本。

为克服上述音频数据处理方式存在的缺陷，目前比较流行的实现方法是通用串行总线音频传输（VOUSB，Voice Over USB），以广泛应用的 PC 作为终端设备对该方法的实现作简单说明。无线数据终端将解调后的音频数据通过 USB 接口传输到 PC 进行解码等处理；类似的，将在 PC 中完成编码等处理的音频数据通过 USB 接口传输到无线数据终端。这样无线数据终端在硬件上就不再需要编解码器，降低了硬件成本。而且，相比于无线数据终端，PC 具有更强的计算能力和更多的内存资源，因此对音频数据具有更强大的处理能力，能够进行更

加丰富的处理，如：可进行去噪、润饰、混音等处理。

图 1 为现有技术中 VOUSB 的实现方法示意图，无线数据终端的空中接口接收远端设备经无线通信网络发来的模拟音频信号，并传输到射频进行解调，之后，由基带处理模块对解调后的音频数据进行放大和数字滤波处理，得到脉冲编码调制（PCM，Pulse Code Modulation） 码流，再将 PCM 码流传输到无线数据终端侧 USB 驱动，由该无线数据终端侧 USB 驱动将 PCM 码流传输到无线数据终端的 USB 端点，最后，按照 USB 标准的批量传输方式，PCM 码流经无线数据终端的 USB 端点传输到终端设备的 USB 端点。这里，无线数据终端侧 USB 驱动的作用是从基带处理模块接收音频数据并传输到无线数据终端的 USB 端点，或从无线数据终端的 USB 端点读出音频数据并传输到基带处理模块。所述 USB 标准的批量传输方式的特点是支持在不确定的时间内进行大量的数据传输，能保证数据一定可以传输，但不保证传输的带宽和延时，因此数据传输的实时性不好；另外，对于以 USB 标准的批量传输方式传输的音频数据，终端设备没有标准驱动对其进行处理，若要对该音频数据进行处理，需要借助于用户界面（UI，User Interface）来实现，其实现过程如下：

对无线数据终端发送到终端设备的 USB 端点的 PCM 码流，终端设备侧 USB 驱动将其读出，并进一步由终端设备的 UI 从终端设备侧 USB 驱动读取并释放，之后，将 PCM 码流传输到物理声卡。物理声卡对传输来的 PCM 码流进行解码，再经 A/D 转换等处理得到模拟音频信号，最后将模拟音频信号送扬声器播放。所述物理声卡可以为 PCI 接口的声卡或 USB 声卡等。这里，终端设备侧 USB 驱动的作用是从终端设备 USB 端点读出音频数据传输到 UI，或从 UI 获取音频数据传输到终端设备的 USB 端点。

但目前基于 VOUSB 的实现方法中，对无线数据终端和终端设备之间的 USB 音频数据传输通道仅仅是作为数据的传输通道，这样带来的问题是没有针对音频数据传输的特点做专门的优化，在实时性等方面影响了 VOUSB 的实际应用效果。

发明内容

有鉴于此，本发明的主要目的在于提供一种实现无线数据终端通用串行总线音频传输的方法及装置，充分利用终端设备处理音频数据的强大能力，增强VOUSB的实际应用效果。

为达到上述目的，本发明的技术方案是这样实现的：

本发明公开了一种实现无线数据终端通用串行总线音频传输的方法，将无线数据终端和终端设备之间的USB音频数据传输通道枚举为USB声卡设备，关键是该方法包括以下步骤：

无线数据终端通过所述USB声卡设备向终端设备发送音频数据，终端设备通过自身的音频设备驱动访问所述USB声卡设备获取音频数据；终端设备通过自身的音频设备驱动向所述USB声卡设备发送音频数据，无线数据终端通过所述USB声卡设备接收该音频数据。

所述将无线数据终端和终端设备之间的USB音频数据传输通道枚举为USB声卡设备，包括：无线数据终端将传输音频数据的无线数据终端USB端点定义为声卡，并将该无线数据终端USB端点通过USB数据线连接到终端设备USB端点；终端设备向无线数据终端请求获取所连接声卡的设备描述符、配置描述符、描述符集合，无线数据终端收到请求后，向终端设备发送设备描述符、配置描述符、描述符集合；终端设备根据获取的设备描述符、配置描述符、描述符集合确定能够提供USB的驱动，加载相应符合USB规范的音频设备驱动，由音频设备驱动对声卡进行配置，得到USB声卡设备。

所述终端设备包括音频设备驱动、用户界面UI和物理声卡，其中，所述终端设备通过自身的音频设备驱动访问USB声卡设备获取音频数据，包括：音频设备驱动以访问USB声卡设备接口的方式访问所述USB声卡设备，对传输到USB声卡设备的脉冲编码调制PCM码流进行读取和释放；UI通过音频设备接口访问音频设备驱动，将PCM码流传输到物理声卡。

所述终端设备包括音频设备驱动、用户界面UI和物理声卡，其中，所述终

端设备通过自身的音频设备驱动向 USB 声卡设备发送音频数据，包括：物理声卡由模拟音频信号得到 PCM 码流；UI 从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动，音频设备驱动向 USB 声卡设备发送 PCM 码流。

本发明还公开了一种实现无线数据终端通用串行总线音频传输的装置，该装置包括：无线数据终端、USB 声卡设备和终端设备，

无线数据终端，用于通过 USB 声卡设备向终端设备发送音频数据，通过 USB 声卡设备接收来自终端设备的音频数据。

USB 声卡设备，用于在无线数据终端和终端设备之间传输音频数据；

终端设备，用于通过自身的音频设备驱动访问 USB 声卡设备获取来自无线数据终端的音频数据，通过自身的音频设备驱动向 USB 声卡设备发送音频数据。

所述 USB 声卡设备包括：无线数据终端侧 USB 驱动、无线数据终端 USB 端点和终端设备 USB 端点，其中，所述无线数据终端侧 USB 驱动与无线数据终端的基带处理模块相连；所述无线数据终端 USB 端点通过 USB 数据线与终端设备 USB 端点相连；所述终端设备 USB 端点与终端设备的音频设备驱动相连。

所述终端设备包括音频设备驱动、用户界面 UI 和物理声卡，其中，音频设备驱动用于以访问 USB 声卡设备接口的方式访问所述终端设备 USB 端点，对传输到终端设备 USB 端点的 PCM 码流进行读取和释放；UI 用于通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡；物理声卡用于由 PCM 码流得到模拟音频信号。

所述终端设备包括音频设备驱动、用户界面 UI 和物理声卡，其中，物理声卡用于由模拟音频信号得到 PCM 码流；UI 用于从物理声卡获取该 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动；音频设备驱动用于向所述终端设备 USB 端点发送 PCM 码流。

由此可见，相比现有技术而言，本发明所提供的一种实现无线数据终端通

用串行总线音频传输的方法及装置具有下述特点和优点：

首先，将无线数据终端和终端设备之间的 USB 音频数据传输通道，采用 USB 规范定义的标准的 USB AUDIO CLASS 枚举成一个 USB 声卡设备来传输音频数据，而广泛使用的终端设备上的操作系统都默认的提供了符合 USB 规范的音频设备驱动的实现，因此，音频设备驱动以访问 USB 声卡设备接口的方式访问终端设备的 USB 端点；音频设备驱动对从 USB 端点读取的音频数据进行读取和释放。

其次，采用 USB 标准的同步传输方式传输音频数据具有好的实时性，且终端设备具有针对该同步传输方式的标准驱动，即音频设备驱动，对终端设备 USB 端点的音频数据的读取和释放都是在音频设备驱动中完成，其处理优先级高于在应用程序 UI 中处理，因此，在终端设备系统负载很重的时候，音频数据的处理依然有很好的实时性。

最后，UI 通过音频设备接口来访问音频设备驱动，将完成释放的音频数据传输到物理声卡。由于 UI 是通过音频设备接口来访问音频设备驱动，减少了 UI 对音频设备驱动的依赖；音频设备接口是标准接口，不用关注底层音频设备驱动实现的细节，且操作系统可移植性好，让 UI 实现起来更加简单、可靠。

针对音频数据传输的特点，对 USB 音频数据传输通道进行抽象和优化，充分利用终端设备处理音频数据的强大能力，增强 VOUSB 的实际应用效果。

附图说明

图 1 为现有技术中 VOUSB 的实现方法示意图；

图 2 为本发明中将 USB 音频数据传输通道抽象成 USB 声卡设备的示意图；

图 3 为本发明中无线数据终端作为音频数据接收方的传输流程图；

图 4 为本发明中无线数据终端作为音频数据发送方的传输流程图；

图 5 为本发明中实现无线数据终端通用串行总线音频传输的装置结构示意图。

具体实施方式

下面结合附图及具体实施例对本发明再作进一步详细的说明。

图 2 为本发明中将 USB 音频数据传输通道抽象成 USB 声卡设备的示意图。对比图 1，本发明中，借用 USB 规范中 USB 声卡应用方法将无线数据终端与终端设备之间的 USB 音频数据传输通道抽象成一个 USB 声卡设备。所述 USB 音频数据传输通道指：无线数据终端侧 USB 驱动、无线数据终端的 USB 端点、终端设备的 USB 端点、以及两个 USB 端点之间的 USB 数据线在内的音频数据传输通道。实现 USB 音频数据传输通道抽象成一个 USB 声卡设备的关键在于，将 USB 音频数据传输通道，采用 USB 规范定义的标准的 USB AUDIO CLASS 枚举成一个 USB 声卡设备。所述枚举通过以下步骤来实现：首先，无线数据终端侧将传输音频数据的无线数据终端 USB 端点定义为一个声卡，并将该无线数据终端 USB 端点通过 USB 数据线连接到终端设备 USB 端点；之后，终端设备向无线数据终端发送请求，请求获取所连接声卡的设备描述符、配置描述符、描述符集合等信息；无线数据终端在收到请求后，向终端设备发送所请求的设备描述符、配置描述符、描述符集合等信息；然后，终端设备在获取这些信息并根据这些信息确定能够提供 USB 的驱动以后，加载相应符合 USB 规范的音频设备驱动；最后，终端设备在得到各种描述符之后，认为所连接的声卡的信息已经齐全，便由音频设备驱动对声卡进行配置，配置成功即可实现无线数据终端与终端设备之间的音频数据传输。至此，枚举过程结束，实现了将 USB 音频数据传输通道枚举成 USB 声卡设备。无线数据终端与 USB 声卡设备的无线数据终端侧 USB 驱动相连接；终端设备与 USB 声卡设备的终端设备 USB 端点相连接。

不同于通常的 USB 声卡等物理声卡所具有的音频数据处理能力，且可将处理后的音频数据直接送到扬声器播放，该 USB 声卡设备的特点是具有和物理声卡一样的访问接口和使用方法，对用户来说就好像是一个实际的物理声卡，但实际上，这个 USB 声卡设备只具有音频数据传输功能，而没有真实的音频数

据处理能力，如果还要对收到的音频数据进行处理，就需要借助于终端设备上的物理声卡来实现。对于终端设备发送到无线数据终端的音频数据，无线数据终端将通过无线通信网络传输到远端设备。所述远端设备可以为无线数据终端或终端设备。如果远端设备还要对收到的音频数据进行处理，对于远端设备是终端设备的情况，直接借助该终端设备上的物理声卡处理音频数据后播放；对于远端设备是无线数据终端的情况，将接收到的音频数据传输到和该无线数据终端通过 USB 声卡设备相连的终端设备，借助于该终端设备上的物理声卡处理音频数据后播放。

由于将无线数据终端和终端设备之间的 USB 音频数据传输通道，采用 USB 规范定义的标准的 USB AUDIO CLASS 枚举成一个 USB 声卡设备，实现音频数据传输，而广泛使用的终端设备上的操作系统都默认的提供了符合 USB 规范的音频设备驱动的实现，因此，对于由无线数据终端发送到 USB 声卡设备的终端设备 USB 端点的音频数据，音频设备驱动以访问 USB 声卡设备接口的方式访问该终端设备 USB 端点；音频设备驱动在访问终端设备 USB 端点时，对发送到该终端设备 USB 端点的音频数据进行读取和释放，相比于现有的由应用程序 UI 读取和释放音频数据，由音频设备驱动进行读取和释放优先级更高，因此，即使在终端设备系统负载很重的时候，音频数据的处理依然具有很好的实时性；音频设备驱动除了向下访问终端设备 USB 端点，向上还可提供音频设备接口，该音频设备接口是标准接口，UI 访问该音频设备接口时，不用关注低层的音频设备驱动实现的细节，且操作系统可移植性好，UI 可通过音频设备接口访问音频设备驱动并将音频数据传送到物理声卡，减少了 UI 对音频设备驱动的依赖，使 UI 实现起来更加简单、可靠。

具体的，利用 USB 声卡设备实现音频数据传输的过程如图 3、图 4 所示。

图 3 为无线数据终端作为音频数据接收方的传输流程图，音频数据的传输包括以下步骤：

步骤 301：无线数据终端的空中接口接收远端设备经无线通信网络发来的模拟音频信号，并传送到射频等硬件进行解调，之后，由基带处理模块对解调

后的音频数据进行放大和数字滤波处理，得到 PCM 码流。

步骤 302：处理后得到的 PCM 码流由无线数据终端的基带处理模块传输到 USB 声卡设备的无线数据终端侧 USB 驱动；之后，按照 USB 标准的同步传输方式，PCM 码流经无线数据终端 USB 端点和 USB 数据线被传输到 USB 声卡设备的终端设备 USB 端点。

步骤 303：在 PCM 码流传输到终端设备 USB 端点之后，终端设备的音频设备驱动以访问 USB 声卡设备接口的方式访问该终端设备 USB 端点，并对传输到终端设备 USB 端点的 PCM 码流进行读取和释放，之后，UI 通过音频设备接口访问音频设备驱动，将 PCM 码流传输到物理声卡。

步骤 304：物理声卡对传送来的 PCM 码流进行解码、D/A 转换等处理后得到模拟音频信号，最后，将该模拟音频信号传输到扬声器播放。

图 4 为无线数据终端作为音频数据发送方的传输流程图，音频数据的传输包括以下步骤：

步骤 401：终端设备的麦克将采集的模拟音频信号传送到物理声卡，由物理声卡对其进行 A/D 转换、编码等处理，得到 PCM 码流形式的数字音频信号。

步骤 402：终端设备的 UI 从物理声卡获取 PCM 码流，并通过音频设备驱动的音频设备接口将 PCM 码流传输到音频设备驱动，由音频设备驱动对 PCM 码流进行压缩，之后，音频设备驱动以访问 USB 声卡设备接口的方式将 PCM 码流回传到 USB 声卡设备的终端设备 USB 端点。

步骤 403：在 PCM 码流传输到 USB 声卡设备的终端设备 USB 端点之后，按照 USB 标准的同步传输方式，PCM 码流经 USB 数据线传输到 USB 声卡设备的无线数据终端 USB 端点。

步骤 404：无线数据终端的基带处理模块通过无线数据终端侧 USB 驱动获取传输到无线数据终端 USB 端点的 PCM 码流，进行放大和数字滤波处理，再经射频进行调制，得到模拟音频信号，最后，由空中接口经无线通信网络发送到远端设备。

为实现上述方法，本发明还提供一种实现无线数据终端通用串行总线音频

传输的装置，如图 5 所示，该装置主要由无线数据终端、USB 声卡设备、以及终端设备组成。

其中，无线数据终端，用于通过 USB 声卡设备向终端设备发送音频数据；通过 USB 声卡设备接收来自终端设备的音频数据。

USB 声卡设备，用于在无线数据终端和终端设备之间传输音频数据。

终端设备，用于通过自身的音频设备驱动访问 USB 声卡设备获取来自无线数据终端的音频数据，通过自身的音频设备驱动向 USB 声卡设备发送音频数据。

具体的，终端设备的音频设备驱动以访问 USB 声卡设备接口的方式访问终端设备 USB 端点，对传输到该终端设备 USB 端点的音频数据进行读取和释放，之后，进一步由 UI 将音频数据传输到物理声卡进行解码、D/A 转换，最后由扬声器播放；对麦克采集，并进一步由物理声卡进行 A/D 转换、编码的音频数据，由 UI 传输到音频设备驱动进行压缩，之后，由音频设备驱动以访问 USB 声卡设备接口的方式回传到终端设备 USB 端点。

以上所述，仅为本发明的较佳实施例而已，并非用于限定本发明的保护范围。

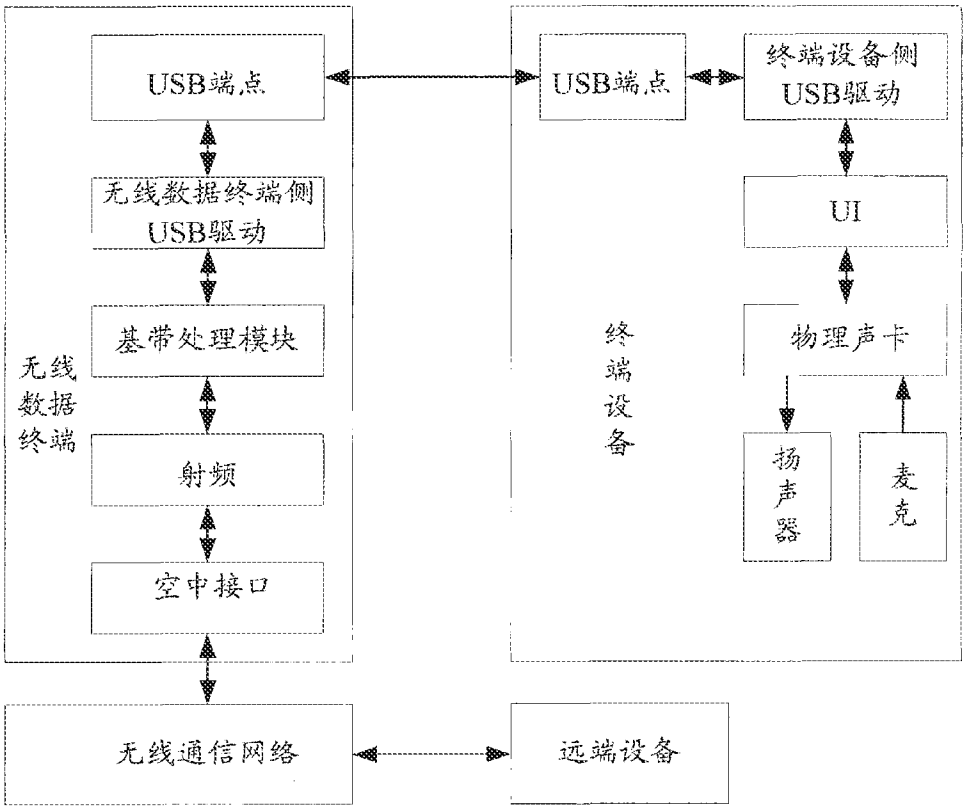

USB端点
无线数据终端侧USB驱动
基带处理模块
射频
空中接口
无线数据终端
USB端点
终端设备侧USB驱动
UI
物理声卡
扬声器
麦克
终端设备
无线通信网络
远端设备

图 1

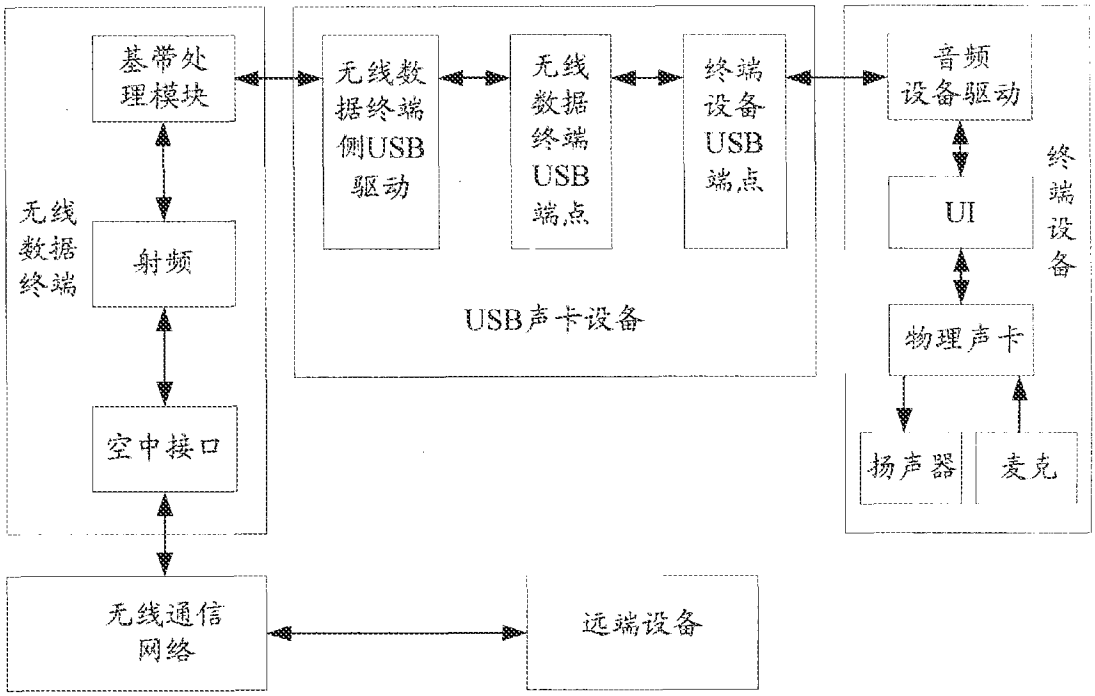

基带处理模块
射频
空中接口
无线数据终端
无线数据终端侧USB驱动
无线数据终端USB端点
终端设备USB端点
USB声卡设备
音频设备驱动
UI
物理声卡
扬声器
麦克
终端设备
无线通信网络
远端设备

图 2

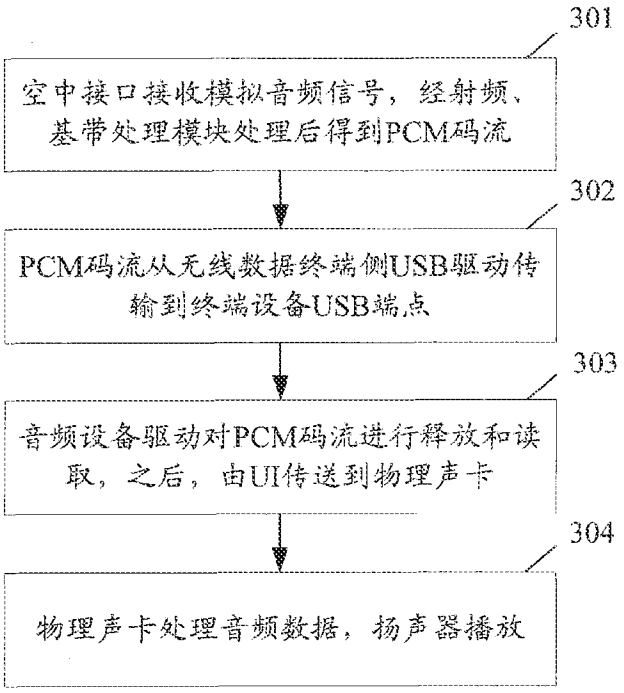

301
空中接口接收模拟音频信号，经射频、基带处理模块处理后得到PCM码流
302
PCM码流从无线数据终端侧USB驱动传输到终端设备USB端点
303
音频设备驱动对PCM码流进行释放和读取，之后，由UI传送到物理声卡
304
物理声卡处理音频数据，扬声器播放

图 3

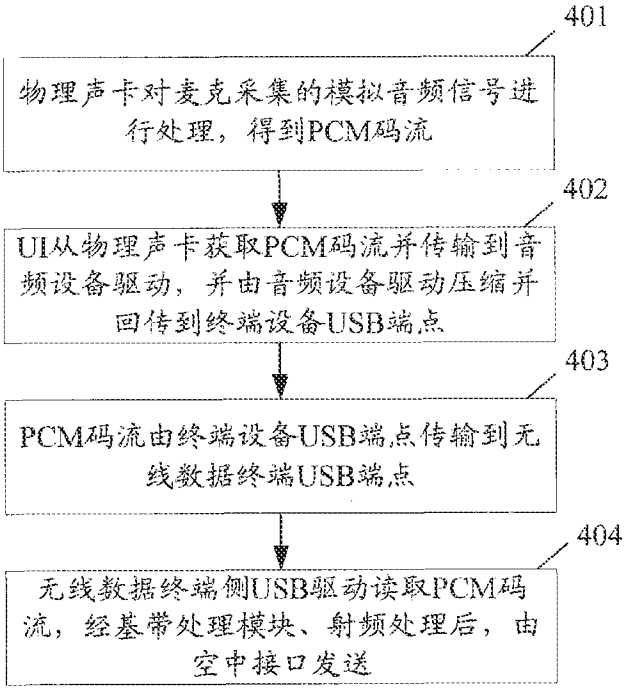

401
物理声卡对麦克采集的模拟音频信号进行处理，得到PCM码流
402
UI从物理声卡获取PCM码流并传输到音频设备驱动，并由音频设备驱动压缩并回传到终端设备USB端点
403
PCM码流由终端设备USB端点传输到无线数据终端USB端点
404
无线数据终端侧USB驱动读取PCM码流，经基带处理模块、射频处理后，由空中接口发送

图 4

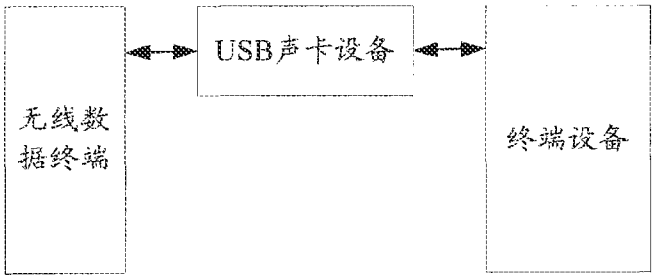


图 5

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16990215
Filing Date	2020-08-11
First Named Inventor	Koen Simon Herman BEEL
Art Unit	3600
Examiner Name	TDB
Attorney Docket Number	BEEL3001C4/TL

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	1	20060010116	A1	2006-01-12	Yaguchi et al.	
	2	20070168481	A1	2007-07-19	Lambert et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16990215
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	First Named Inventor	Koen Simon Herman BEEL
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	European Office Action in corresponding European Application No. 16207123.7, dated November 23, 2020.	
	2	U.S. Office Action in corresponding U.S. Application No. 16/852,790, dated October 08, 2020.	

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Thomas Lee/	Date (YYYY-MM-DD)	2020-12-09
Name/Print	THOMAS LEE	Registration Number	66396

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	41323937
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Shelly Darrenkamp
Filer Authorized By:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TL
Receipt Date:	09-DEC-2020
Filing Date:	11-AUG-2020
Time Stamp:	09:29:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	BEEL3001C4_IDS.pdf	1034540 1d32eaebacd2344d5b349be2ce3cac6ca5db1edc	no	4

Warnings:

Information:					
2	Non Patent Literature	EP_OA1_23Nov2020.pdf	165432 6239cd66902edc853324ab2f165eb137311b4451	no	5
Warnings:					
Information:					
3	Non Patent Literature	US_OA1_8Oct2020.pdf	4556095 502601b304969d88cc9c15193a454bfb92b06e13	no	118
Warnings:					
Information:					
			Total Files Size (in bytes):	5756067	

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/990,215	08/11/2020	Koen Simon Herman BEEL	BEEL3001C4/TL

CONFIRMATION NO. 5914

23364
BACON & THOMAS, PLLC
625 SLATERS LANE
FOURTH FLOOR
ALEXANDRIA, VA 22314-1176

PUBLICATION NOTICE

OC000000121621974

Title:ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS

Publication No.US-2020-0371967-A1
Publication Date:11/26/2020

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

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Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/990,215	08/11/2020		1720	BEEL3001C4/TL	20	2

CONFIRMATION NO. 5914

FILING RECEIPT

23364
BACON & THOMAS, PLLC
625 SLATERS LANE
FOURTH FLOOR
ALEXANDRIA, VA 22314-1176



Date Mailed: 08/18/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Koen Simon Herman BEEL, Eke, BELGIUM;
Yoav NIR, Komen, BELGIUM;
Filip Josephine Johan LOUWET, Knesselare, BELGIUM;
Guy COEN, Aalst, BELGIUM;

Applicant(s)

BARCO N.V., Kortrijk, BELGIUM;

Assignment For Published Patent Application

BARCO N.V., Kortrijk, BELGIUM

Power of Attorney: The patent practitioners associated with Customer Number 23364

Domestic Priority data as claimed by applicant

This application is a CON of 14/278,442 05/15/2014
which is a CON of 13/270,659 10/11/2011 PAT 8756348
which claims benefit of 61/534,592 09/14/2011

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 08/14/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/990,215**

Projected Publication Date: 11/26/2020

Non-Publication Request: No

Early Publication Request: No

Title

ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/990,215

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1720

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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This power revokes any previous powers of attorney given in the above-identified patent application.

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Customer Number: 23364

Please recognize or change the correspondence address for the above-identified application to the address associated with the above-mentioned Customer Number.

I (we) am/are the Applicant Assignee or Person to Whom the Inventor is Under an Obligation to Assign. This revocation and appointment to the above-identified Practitioners is to the exclusion of the inventor(s).

Signature of Applicant for Patent

Signature			
Name	Peter Gerets	Date	13/02/2017
Title and Company	BARCO NV, VP Technology		

Electronic tool and methods for meetings

Related Applications

This benefit of provisional patent application No. 61/534,592 filed September 14, 2011 is claimed and said application is incorporated herein by reference.

Field

The present invention relates to electronic tools for meetings including methods or devices for providing connection to a communications network, to networks or methods of operating the network, methods or devices for use in displaying media content as well as software for performing any of these methods.

Technical background

Tools for collaboration

Allowing *ad hoc* groups of persons to communicate with each other is one of the fundamental aspects of collaboration, problem solving, negotiation, teaching and education, etc. To assist in communication, there has been an explosion of electronic communication tools such as electronic conferencing tools, e.g. synchronous and asynchronous conferencing, online chat, Instant Messaging, audio conferencing, videoconferencing, data conferencing, application sharing, remote desktop sharing, electronic meeting systems, collaborative management (coordination) tools, project management systems, knowledge management systems, and social software systems.

One classic approach is the lecture or seminar often involving a presentation using presentation software. To a large extent the traditional single person presentation or lecture has been maintained with the audience being in a rather passive mode as far as determining, constructing, augmenting or modifying the information to be presented is concerned.

As with other business processes, meetings are going digital. Increasingly, people are using computer technology alone and in conjunction with broadband networks to support their meeting objectives prior to and during an actual meeting. For example, e-

mail is used to pass around files for people to read prior to a meeting.

Collaborative workspaces in corporate networks and on the Internet offer geographically distributed collaborators a virtual repository for documents related to a project or a meeting. Electronic meeting support systems, such as interactive network-connect white boards and videoconferencing appliances, are available for the benefit of those who share the same room as well as those who are in remote locations.

The AMIDA Final Public Report describes the overall methodology behind the development of meeting support technologies. It reports that numerous studies confirm that meetings dominate the way people work. Namely, according to a study conducted by MCI Worldcom in 2003 a business person participates in 60 meetings per month. People meet in groups for a multitude of reasons. They interact in numerous predictable and unpredictable ways and the results of their interactions are as varied as the people who participate and the projects on which they are collaborating or communicating. Studies of business processes also reveal that approximately 80% of the "workload" associated with a project or process happens in preparation for a meeting. In other words, many people view the "live" meeting as a milestone or deadline by which they can pace and measure their productivity and that of their colleagues. Unfortunately, for many information managers, being in perpetual meetings has reduced their ability to prepare adequately for the next meeting, perpetuating a vicious and negative cycle.

However, Marc Al-Hames et al. report in "Audio-Visual Processing in Meetings: Seven Questions and Current AMI Answers", that although large parts of working days are consumed by meetings and conferences, unfortunately a lot of them are neither efficient, nor especially successful. They report a study in which people were asked to select emotion terms that they thought would be frequently experienced in a meeting. The top answer – mentioned from more than two third of the participants – was "boring"; furthermore nearly one third mentioned "annoyed" as a frequently perceived emotion.

The conclusion is that despite the plethora of electronic aids to meetings, fundamental

problems in handling meetings have not been solved. In fact organising and conducting meetings in a business context involves a large number of factors.

Participation

A lack of efficiency of meetings is addressed in the article "Mood indicators on electronic meeting tools" IBM, IP.com number: IPCOM000011711D, Publication Date: March 12, 2003. This article addresses the issue that the lack of direct feedback makes meetings clumsy, inefficient and often unproductive. It proposes a "mood indicator" as well as an "I want to ask a question" indicator which allow the presenter to choose an appropriate moment to pause, change track or field a question. It is argued that interrupting a presenter in full flow can be awkward; however, sometimes it is difficult to get an opportunity to ask a question or make a comment when many different people are trying to make their voices heard. In a similar vein, US6966035 suggests displaying a "murmur frame" for a participant to express a view. To increase user participation, US 2010/0087139 discloses a system for sending a selection to another computer, and US 2006/0095376 discloses a system for secure voting. Commenting, voting or selecting requires that a central authority provides the information that is to be selected or commented or voted on. Hence, these proposals still leave a central figure such as the presenter in a dominating position and the other members of the meeting are largely an audience with limited selection or voting or participation rights.

A further problem with meetings is that someone is usually late or has to leave early. With the person arriving late one has to decide if the meeting is interrupted and a summary of the proceedings so far is given. For the person leaving early (often a senior person), subsequent discussions can go missing. If there is a notes taker, this provides a personal summary of the meeting – but not an objective one.

Presents systems do not provide an optimal solution.

Legal and security issues

A legal requirement of a meeting is that presentations, comments and submissions need to be completely reproducible – in some circumstances, e.g. in a share holders'

meeting, the events in the meeting should be subject to total recall. Computer-supported collaborative work technologies, particularly those which capture human verbal and non-verbal communications (audio and video interaction) in addition to text and graphics generated during a meeting, promise to have a long term impact on how people will prepare for and behave during and following meetings. In addition, connecting to a network brings the danger of virus, malware or spyware transfer in either direction, and there is danger of copying of confidential information.

Practical Difficulties

Scalability and ease of use

There are even more fundamental problems with using electronic tools in meetings. If two persons want to make two presentations then usually either both presentations must be placed on one machine or there is a need to swap between the presenters' machines. To bring the display content of a computer to a projector, the most common ways are to use a cable that connects the display adapter of the graphics card to the video input of the projector [method 1] or to use a software that captures the display contents and sends it over a wired or wireless network to a remote base unit connected to the projector [method 2]. This is often called "remote desktop" and is mostly used for remote administration or remote IT assistance purposes.

Less common but also practiced methods are to use a special device connected to the display adapter of the graphics card that captures, encodes and streams the display content over a wired or wireless network [method 3].

Method 1 has several practical problems and disadvantages. In meetings where people want to contribute content from their own computers, e.g. to project images on a display, typically a video cable such as a VGA cable is used to connect each PC one at a time to the projector. This is not only not scalable but also can be and often is quite a cumbersome process that typically wastes valuable meeting time and takes the dynamism out of the meeting. Connection can be made more difficult and time consuming for example if the computer has to be rebooted for it to detect the projector or when the format of the PC differs from the format of the projector. In addition changing format can leave the computer with a new format that is not compatible with

its own screen so that on reboot of the PC alone, nothing is displayed on the computer screen. Without a visible screen image the necessary re-configuration can be difficult. These issues are aggravated by a number of elements:

- The use of many different video adapters, such as VGA, DVI, DP, HDMI,...
- Reach depends on cable length: too long leaves a tangled cable "salad" in the meeting room, too short reduces flexibility, often necessitating people to move around in the meeting room when they want to present something.
- Cable connection is either point to point or requires tedious and extensive cabling and the use of complex and expensive video switches.
- It is often difficult and time consuming to find the right display resolution and refresh rate that both the computer and the display or projector support.

Method 2 also has many drawbacks. If the connection is made to a corporate LAN there is a danger of virus, malware or spyware transfer in either direction, there is danger of copying of confidential information, and there is the difficulty of making the connection, e.g. entry of a user code and password, as well the administration of such passwords and user codes.

The advantage of method 3 is that the computer does not need to use its own processing power to bring the display content in a form that is easily transported over a network. This advantage becomes less relevant as computers grow in processing power. A drawback of method 3 is that the same problems often encountered with method 1 of connecting to the display adapter remain. Another drawback is that the special device referred to requires significant processing power, which means that this device will consume much power, be relatively big and certainly be relatively expensive.

An alternative method in the making today is to use the well known USB interface of the computer for extracting the display content of the computer. US 2009/0198839 discloses such a pluggable cable arrangement. US 2011/0115689 discloses a similar USB solution for wireless connection to a projector. Accordingly connecting a projector to a computer using the standard USB port might become commonplace with

time. However, this usually requires special drivers and even special hardware. Connecting a projector to a computer using the standard USB port hence might become commonplace – but even when that happens there will be a mix of new and legacy machines for several years.

Firewalls

Additional problems can occur with firewalls. Typically a visitor to a meeting will bring a computer such as a laptop that is set up for a different corporate networking environment and hence has different or incompatible networking settings. The setting up of a firewall can be complicated and if this is not done correctly, telecommunication software that has to pass through a firewall may be blocked. In order to solve problems associated with firewalls it may be necessary to open ports or identify or even add programs in an exception list. If, besides a network (hardware) firewall and an operating system firewall, there is any software based third-party firewall like Zonealarm, Norton Systemworks, CA Internet Security Suite or McAfee Firewall, then it is necessary to follow that software developer's documentation to place programs on a safe list or adding exceptions to the firewall rules. Such activity is beyond the usual user. Fussing with computer settings, or having to call for IT support wastes valuable meeting time and takes the dynamism out of the meeting.

Conclusion

The following problems remain for holding a face-to-face meeting using advanced electronic tools at the present time:

- Complexity of the networking infrastructure.
- High demands on technical expertise of users in current systems that are supposed to be designed to support everyday use by the non-expert user.
- Barriers to the use of complicated technology in meetings.
- Great variety of possible collaborative software solutions – none of which seems to solve the fundamental problems of holding successful meetings.
- Meetings being boring or annoying for members of the meeting.
- Complexity of firewalls and other security measures employed in corporate networks.
- Lack of, or restriction of participation by members of a meeting.

- Time taken to prepare presentations for meetings.
- Need to record events in the proper time sequence at meetings without burdening a meeting more than necessary.

Although some tools solve some of these problems effectively, no electronic meeting tool solves all of them.

Summary of the invention

An object of the present invention is to provide network solutions including electronic tools for meetings including devices for providing connection to a communications network, to methods of operating the network, methods of displaying media content as well as software for performing any of these methods or for implementing such systems.

In an aspect the present invention provides an electronic meeting tool for communicating arbitrary media content from users at a meeting comprising:
a node configuration means adapted to operate a display node of a communications network, the display node being coupled to a first display, the node configuration means being adapted to receive user selected arbitrary media content and to control display of the user selected arbitrary media content on the first display; and
at least one peripheral device adapted to communicate the user selected arbitrary media content via the communications network, wherein the peripheral device is a connection unit comprising:

(a) a connector adapted to couple to a port of a processing device having a second display, a memory and an operating system; and
(b) a transmitter for communicating with the communications network,

a program adapted to be loaded onto the processing device and to run on the operating system of the processing device, said program being adapted to obtain user selected arbitrary media content, said program leaving a zero footprint on termination, and
an input device to allow the user to carry out a user action that triggers transfer of said user selected arbitrary media content to said transmitter through said port.

The program can be stored on the peripheral device. The transmitter can be a wireless transmitter or transceiver. The peripheral device can be a plug-and-play device. The program cane adapted to screen scrape content of the second display.

The input device can be physical actuator coupled to the peripheral device. The physical actuator preferably has a surface area of between 100 and 14,400 square mm. Alternatively, the input device can be a key displayed on the second display. The key displayed on the second display can be one not screen scraped by the program.

In another aspect the present invention provides a method for connecting a processing device to a communications network, the processing device having a memory, a display and an operating system with at least one pre-installed generic driver providing a generic communications protocol for communication between processing device and a standard class of peripheral devices, the method comprising the steps of:

a) coupling a peripheral device to the processing device, the peripheral device having a transceiver;

b) setting up, by means of the pre-installed generic driver of the operating system, a means for communication between the peripheral device and the processing device;

c) coupling the processing device to a communications network via the peripheral device;

d) routing screen scraped data between the processing device and the communication network via the means for communication, wherein the generic communication protocol is used for transferring the screen scraped data between the processing device and the peripheral device.

Step b) can comprise presenting the peripheral device to the processing device as a human interface device and wherein the pre-installed generic driver is a human interface device driver.

Alternatively step b) can comprise presenting the peripheral device to the processing device as a mass storage device and wherein the pre-installed generic driver is a mass storage device driver.

Alternatively, step b) comprises presenting the peripheral device to the processing device as a composite device and wherein pre-installed generic drivers drive different device interfaces independently.

A client application can be stored on the peripheral device which when run on the processing device obtains the screen scraped data. Such a client application can be a portable application.

In another aspect the present invention provides a peripheral device for providing communication connectivity to a processing device which is provided with memory, a display and an operating system with at least one pre-installed generic driver providing a generic communication protocol for communication between the processing device and a standard class of peripheral devices, the peripheral device comprising a memory in which executable software code is stored for execution on the processing device, said executable software code comprising:
a first software code portion for setting up, by means of the pre-installed generic driver of the operating system, a means for communication between the peripheral device and the processing device;
a second software code portion for connecting the processing device to a communications network via the peripheral device, the peripheral device having a transceiver;
a third software code portion for screen scraping data from the processing device; and
a fourth software code for routing screen scraped data between the processing device and the communications network over the means for communication; wherein the first software code portion is adapted to use the generic communication protocol for transferring the screen scraped data between the processing device and the peripheral device.

The first software code portion can be adapted to present the peripheral device to the processing device as a human interface device and wherein the pre-installed generic driver is a human interface device driver. The first software code portion can be adapted to present the peripheral device to the processing device as a mass storage

device and wherein the pre-installed generic driver is a mass storage device driver. The first software code portion can be adapted to present the peripheral device to the processing device as a composite device and wherein pre-installed generic drivers drive different device interfaces independently.

The executable software code can comprise fifth code for providing a means for connecting to the communications network including a base node. The executable software code can comprise sixth code for providing means for capturing video frame buffers of the processing device.

The executable software code can comprise seventh code for providing a means for encoding, compressing and optionally encrypting the screen scraped data and sending the screen scraped data the communication network. The executable software code can comprise eighth code for providing a means for handling the peripheral device. The executable software code can comprise ninth code for providing means for initiating connection to the base node. The executable software code can comprise tenth code for receiving inputs from an input device on the peripheral device. The executable software code can comprise eleventh code for providing a means for sending state changes to the visual indicator on the peripheral device. The executable software code can comprise twelfth code for providing a means for presenting to the user a GUI. The executable software code can comprise thirteenth code for presenting a GUI for administration of the said executable software code when executed as a portable application. The executable software code can comprise fourteenth code for providing a means for displaying and activating a key on the display of the client processing device for allowing a user to input the start the transfer of data from the processing device to the base node.

In another aspect the present invention provides a peripheral device for providing communication connectivity to a processing device which is provided with memory, a display and an operating system with at least one pre-installed generic driver providing a generic communication protocol for communication between the processing device and a standard class of peripheral devices, the peripheral device comprising a memory in which executable software code is stored for execution on the processing device,

said executable software code comprising:

a first software code portion for setting up, by means of the pre-installed generic driver of the operating system, a means for communication between the peripheral device and the processing device;

a second software code portion for connecting the processing device to a communications network via the peripheral device, the peripheral device having a transceiver; and

a third processing software code for routing data between the processing device and the communications network over the means for communication; wherein the first software code portion is adapted to use the generic communication protocol for transferring the data between the processing device and the peripheral device, and an input device coupled to the peripheral device, the input device being adapted to react to a user action to trigger the transfer of the data from the processing device to the peripheral device.

The first software code portion can be adapted to present the peripheral device to the processing device as a human interface device and wherein the pre-installed generic driver is a human interface device driver. The first software code portion can be adapted to present the peripheral device to the processing device as a mass storage device and wherein the pre-installed generic driver is a mass storage device driver. The first software code portion can be adapted to present the peripheral device to the processing device as a composite device and wherein pre-installed generic drivers drive different device interfaces independently.

The input device is preferably a physical actuator coupled to the peripheral device. The physical actuator preferably has a surface area of between 100 and 14,400 square mm. The input device can be for example a key for display on the display. The executable software code can comprise fourth code for providing a means for connecting to the communications network including a base node. The executable software code can comprise fifth code for providing a means for capturing video frame buffers of the processing device. The executable software code can comprise sixth code for providing a means for encoding, compressing and optionally encrypting the video frames and sending them over a secure link to the base node. The executable software code can comprise seventh code for providing a means for handling the

peripheral device. The executable software code can comprise eighth code for providing a means for initiating connection to the base node. The executable software code can comprises ninth code for receive inputs from an input device on the peripheral device. The executable software code can comprise tenth code for providing a means for sending state changes to the visual indicator on the peripheral device. The executable software code can comprise eleventh code for providing a means for presenting the user a GUI. The executable software code can comprise twelfth code for presenting GUI for administration of the executable software code when executed as a portable application. The executable software code can comprise thirteenth code for providing a means for displaying and activating a key on the display of the processing device for allowing a user input to start the transfer of data from the processing device to the base node.

In another aspect of the invention a peripheral device is provided for providing communication connectivity to a processing device which is provided with memory, a display and an operating system with at least one pre-installed generic driver providing a generic communication protocol for communication between the processing device and a standard class of peripheral devices, the peripheral device comprising a memory in which executable software code is stored for execution on the processing device, said executable software code comprising:

a first software code portion for setting up, by means of the pre-installed generic driver of the operating system, a means for communication between the peripheral device and the processing device;

a second software code portion for connecting the processing device to a communications network via the peripheral device, the peripheral device having a transceiver;

a third software code portion for receiving media content from the network and for displaying the media content on the display in accordance with a set of rules; wherein the first software code portion is adapted to use the generic communication protocol for transferring the media content between the peripheral device and the processing device.

The executable software code can comprise fourth code for providing a means for

correctly configuring a receiver as an access point. The executable software code can comprise fifth code for providing a means for listening for output of connection units trying to connect on a specific port. The executable software code can comprise sixth code for providing a means for a GUI for administration purposes. The executable software code can comprise seventh code for providing a means for publishing its presence over the network using the Zeroconf protocol. The executable software code can comprise eighth code for providing a means for accepting and installing software updates. The executable software code can comprise ninth code for providing a means for providing facilities for pairing of connection units to the processing device. The executable software code can comprise tenth code for providing a means for auto-composing of different incoming arbitrary media streams and rendering of composited image on display. The executable software code can comprise eleventh code for providing a means for receiving, decrypting and decoding incoming arbitrary media content. The executable software code can comprise twelfth code for scaling of incoming arbitrary media streams. The executable software code can comprise thirteenth code for providing a means for displaying incoming arbitrary media content in accordance with a set of rules.

The present invention also provides a method for communicating arbitrary media content from users at a meeting comprising:
operating a display node of a communications network, the display node being coupled to a first display, to receive user selected arbitrary media content and to control display of the user selected arbitrary media content on the first display; and
connecting a peripheral device to a port of a processing device and communicating the user selected arbitrary media content via the communications network,
loading a program onto the processing device and running the program on the operating system of the processing device to obtain user selected arbitrary media content, said program leaving a zero footprint on termination, and
triggering transfer of said user selected arbitrary media content to said transmitter through said port after a user action on an input device.

The present invention also provides a peripheral device comprising:
a base

a connector for connection to a plug and play port of a host processing device,
a flexible connection between the base and the connector for transferring data signals and power,
an actuator on the base for actuating a signal and for transferring the signal to the connector for transfer to the port, wherein the base has electronics comprising permanent storage for storing a portable application, a processing engine, a transceiver and a visual indicator.

The present invention also provides a method for providing communication connectivity from a processing device,
setting up a communications network between a base node of the communications network and a peripheral device coupled to the processing device;
transferring media content between the processing device and the peripheral device,
transmitting the media content from the peripheral device to the communications network,
receiving media content from the communications network at the base node and displaying the media content on a display in accordance with a set of rules.

With any of the above embodiments using pairing of the peripheral device, the only user actions required to connect the processing device to the communications network and hence to the first or central display are plug in the peripheral device into the processing device, optionally press the button on the peripheral device. This method allows for an automatic connection of the peripheral device to the display node without any user interaction or configuration

Embodiments of the present invention also include any of the above software code being stored on a non-transitory storage medium.

Definitions

"Plug and play" is a term used to describe the characteristic of a computer bus, or device specification, which facilitates the discovery of a hardware component in a system, without the need for physical device configuration, or user intervention in

resolving resource conflicts. Plug and play devices can be added to a bus of a computing system (while running or when shut down), and the newly added device and possibly the rest of the computing system is automatically configured to make the newly added device work, both from hardware and from software perspective.

Plug and play interfaces include for example (not an exhaustive list): Firewire (IEEE-1394), PCI, Mini PCI, PCI Express, Mini PCI Express, PCMCIA, PC Card, Universal Serial Bus (USB), SDIO cards.

"Auto-configuration" is the automatic configuration of devices without manual intervention, without setting any switches or jumpers, and without any need for software configuration. An example of auto-configuring devices: USB devices. Examples of auto-configuring protocols: DHCP, Zeroconf, Bonjour.

A plug and play device has auto-configuration software by default to make it plug and play. Example: USB devices are made to be plug and play by including the correct auto-configuration software (e.g. host driver, host stack, application software). Autoconfiguration can also refer to a software alone and is not restricted to a physical device.

"Hot swapping and hot plugging" are terms used to describe the functions of replacing computer system components without shutting down the system. More specifically, hot swapping describes replacing components without significant interruption to the system, while hot plugging describes the addition of components that would expand the system without significant interruption to the operation of the system. A well-known example of this functionality is the Universal Serial Bus (USB) that allows users to add or remove peripheral components such as a mouse, keyboard, or printer. Other examples are eSATA, PCIe, FireWire, for example.

A “portable application” (portable app), sometimes also called standalone, is a computer software program designed to run without installation on the target machine. This type of application is stored on a removable storage device such as a CD, USB flash drive, flash card, or floppy disk – storing its program files, configuration

information and data on the storage medium alone. It is a program that can be stored on an electronic device such as a USB flash drive, iPod, memory card, portable hard drive or other portable electronic device and runs on a computer or other processing device coupled to the electronic device without making permanent configuration changes to the host computer. All such programs have a zero-footprint, meaning all temporary files, registry entries, and any other changes to the machine exist only while the program is running.

To be considered a portable application, for purpose of this invention, a software program must:

Not require any kind of formal installation onto a computer's permanent storage device to be executed, and can be stored on a removable storage device such as USB flash drive, iPod, memory card, portable hard drive or other portable electronic storage device thus enabling it to be used on multiple computers.

Settings are stored with, and can be preferably carried around with, the software (i.e., they are written to the electronic device such as a USB drive). Settings are not stored to the registry or any other central system database of the computer.

Leaves a zero (or near-zero) "footprint" on any PC it is run on after being used. i.e., all temporary files/registry settings should be either avoided or at least removed once the program has exited, and files created by the user can be saved directly to the same removable media as the application is stored on.

A portable application does not leave its files or settings on the host computer on which it runs. For example, the application does not write to the Windows registry or store its configuration files (such as an INI file) in the user's profile; instead, it stores its configuration files in the program's directory. Another requirement, since file paths will often differ on changing computers due to variation in Windows drive letter assignments, is the need for applications to store them in a relative format. Preferably, such a program does not require a launcher program to copy necessary settings and files to the host computer when the application starts and move them back to the application's directory when it closes as this may leave a residue on the hard drive in case of power failure.

"Electronic meeting systems" (EMS) need to be distinguished on the one hand from classic groupware, on the other from web conferencing systems. In reality, there is some overlap between minor features of products of the named categories. The main difference from groupware is the intensity of collaboration. EMS should be distinguished from systems with which it is possible to show the contents of an individual computer screen on a remote display with multiple users at the same time.

"Groupware" supports collaboration within groups where the individual contributions remain identifiable. In contrast, EMS enables the group to cooperatively produce a result for which the group is responsible as a whole. In a business process, groupware and electronic meeting systems complement each other: Groupware supports teams when researching and creating documents in the run up to an EMS session or when implementing the results of such a session.

"Web conferencing systems" and "electronic meeting systems" complement each other in the online meeting or workshop: EMS extends the web conferencing system by providing interactive tools for producing and documenting group results. On the other hand, "web conferencing systems" complement EMS with the screen sharing and voice conferencing functionality required in synchronous online meetings and not present in EMS.

"Data conferencing" refers to a communication session among two or more participants sharing computer data in real time. Interaction and presentation devices such as a screen, keyboard, mouse, camera, etc. can be shared. It is a term used to distinguish from video conferencing and audio conferencing. The data can include screen, documents, graphics, drawings and applications that can be seen by the participants of the meeting.

"Application sharing" is an element of remote access, falling under the collaborative software umbrella, that enables two or more users to access a shared application or document from their respective computers simultaneously in real time. Generally, the shared application or document will be running on a host computer, and remote access

to the shared content will be provided to other users by the host user. Application sharing should be distinguished from systems in which collaboration on the applications between different users is not possible but the contents of individual computer screens can be projected onto a remote display with multiple users at the same time.

The term "arbitrary media content" refers to the fact that a user may generate, create or select any media content that is appropriate to display. This differs from client voting on, or selecting of media content that is displayed by another in a meeting or presentation. This term refers to client oriented, distributed rights and privileges for the display of content rather than a central presenter providing content which is presented to the members of the meeting.

"Screen scraping" in our sense refers to reading the video frame buffers and processing them, rather than just rendering them on a display. Screen scraping for presentations is described in US2002/0196378 to Slobodin et al which is included herein by reference.

"Auto composition" or "auto layout" refers to the automatic nature in which multiple graphics/video sources are rendered on a central display, without user intervention and in a way that a user would intuitively expect it to happen.

"Wireless" and "wireless communication network" can be any network that does not use cable links between nodes, e.g. uses RF, optical or InfraRed for communication purposes, such as IrDA, diffuse infra-red, WLAN, WiMax, WiFi, WiFi Direct, Bluetooth or any other wireless communication network known to the person skilled in the art.

"Computer" generally refers to a processing device, i.e. having a processing engine capable of various types of digital processing, such as rendering graphics images for display. A computer can be in the form of a work station, a personal computer, a lap-top, a palm top, a PDA, a smartphone, a tablet etc. Generally a computer has memory such as volatile RAM. Non-volatile memory such as a hard disc, optical disk or solid

state memory can be included in the computer or can be a peripheral device. Currently most computers are electronic but the term “computer” also includes optics based computing devices.

The term "pre-installed generic driver" is intended to mean a driver which is installed on a processing device such as a computer as a standard driver, e.g. is installed with the installation of the operating system. Such a driver is standard for the operating system and can drive a standard class of peripheral devices coupled to or connected to the processing device. The installation of a specific driver for such a peripheral device is not required. Such a generic driver can be a human interface driver (HID) or a mass storage device driver, which has predetermined software components configured for driving mass storage, a CD-ROM, a keyboard etc. or combinations of these. Such devices can be readable and writable computer peripheral memory devices such as USB memory sticks, flash memories, external hard drives, or more.

Brief Descriptions of the drawings

Fig. 1a shows a meeting room that can be used with embodiments of the present invention. Fig. 1b shows a combination of a client processing device, a connection unit, a base node and a display in accordance with an embodiment of the present invention.

Fig 2 shows a screen display in accordance with an embodiment of the present invention.

Figs. 3 to 5 show a base node and a peripheral device and a client processing device in accordance with embodiments of the present invention.

Fig 6 shows a display in accordance with an embodiment of the present invention.

Fig. 7 shows a peripheral device in accordance with an embodiment of the present invention.

Fig. 8 shows a client processing device in accordance with an embodiment of the present invention.

Fig. 9 shows a further client processing device in accordance with an embodiment of the present invention.

Fig. 10 shows an embodiment of a peripheral device in accordance with an

embodiment of the present invention.

Detailed Description of the Embodiments of the present Invention

The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting.

Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. The terms are interchangeable under appropriate circumstances and the embodiments of the invention can operate in other sequences than described or illustrated herein.

Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. The terms so used are interchangeable under appropriate circumstances and the embodiments of the invention described herein can operate in other orientations than described or illustrated herein.

The term "comprising", used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. It needs to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the presence or addition of one or more other features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

Similarly, it is to be noticed that the term "coupled", also used in the description or claims, should not be interpreted as being restricted to direct connections only. Thus, the scope of the expression "a device A coupled to a device B" should not be limited to devices or systems wherein an output of device A is directly connected to an input of

device B. It means that there exists a path between an output of A and an input of B which may be a path including other devices or means.

Elements or parts of the described devices may comprise logic encoded in media for performing any kind of information processing. Logic may comprise software encoded in a disk or other computer-readable medium and/or instructions encoded in an application specific integrated circuit (ASIC), field programmable gate array (FPGA), or other processor or hardware.

References to software can encompass any type of programs in any language executable directly or indirectly by a processor.

References to logic, hardware, processor or circuitry can encompass any kind of logic or analog circuitry, integrated to any degree, and not limited to general purpose processors, digital signal processors, ASICs, FPGAs, discrete components or transistor logic gates and so on.

Embodiments of the present invention provide solutions to three major problems with meetings:

a) the time taken to prepare for a meeting. This is mainly achieved by allowing "on-the-fly" presentation of any displayable information. This information does not have to be linked into any particular presentation software, nor to be compatible with any such presentation software,
b) the time taken to conduct the meeting using electronic meeting tools. This is achieved by reducing the time to connect computers to the display or projection system.
c) the time taken to reflect and review and document the meeting afterwards. This is achieved by providing the possibility of recording the course of the meeting in the same time sequence that it was carried out as well as be able to store all data presented and who presented it.

Fig. 1a is a schematic representation of a generic meeting room 30 with a meeting

table that can be used with embodiments of the present invention. Participants 37 have some form of processing device 31 such as a laptop computer, a tablet, a PDA etc. Each of the processing devices 31 can be a host device and has a first connection unit 47 to which it is coupled. The first connection unit 47 provides access to a network 50 which in this case is a wireless network, but could be a wired network. Each connection unit 47 may be coupled to an input device 48 which will be described in more detail later. A user 37 will typically at a distance from the processing device 37 which is ergonomically satisfactory. This ergonomic boundary is typically an area of about 1000 sq cm to 4000 sq cm. This ergonomic boundary will typically have the user as one side of the boundary and the comfortable reach of the arms will determine an area on the left and right of the processing device which falls within the ergonomic boundary and the far edge of the boundary of the processing device (normally delimited by a display screen) will determine the other side of the ergonomic boundary. The area defined by the ergonomic boundary will overlap or include the processing device 31 itself. The processing device will also have an outer physical boundary. The input device 48 is preferably arranged to operate outside the boundary of the processing device 31 but within the ergonomic boundary. Preferably the input device is arranged to function when it is flat on the table. The input device preferably has an size of activation area of between 1 and 144 square cm.

Preferably the network 50 is a local area network, i.e. preferably local to the meeting room for security reasons but the network 50 may have access to other local or wide area networks such as 51 or to a larger corporate network or the internet 43, for example via a router 42. Another node of the network 50 is the base or display node 36. This node 36 may optionally be a wireless access point. The base node 36 may also be a processing device or host computer and may be coupled to a second connection unit 49 that provides access to the network 50 thus linking all of the processing devices 31, 36 together. The connection unit may have an input device as described above. Alternatively, network connections installed on the base node 36 can be used. Audio equipment 46 may be provided, e.g. a telephone that allows other members of the meeting to call in from remote destinations.

The display node 36 is coupled to and adapted to allow display of media on some kind

of display 44. The display node is in embodiments of the present invention a base node of the communications network 50. The display 44 may be a projector and screen, the projector being coupled to the base node 36. A whiteboard 45 can optionally be provided that can be optionally coupled to the display 44 and/or the base node 36, e.g. when the whiteboard can record electronically what is written on it. Optionally, a camera 35 may be provided to record the entries on the whiteboard 45. The camera 35 may have a third connection unit 52 for connecting the camera 52 to the network 50 so that the data from the whiteboard can be recorded and stored or transmitted to other networks via router 42. The connection unit 52 may have an input device as described above.

Optional equipment can be cameras 39, 40, 41 for recording the progress of the meeting. These cameras can be linked by a network 51, e.g. a cable network to the router 42 and/or the base node 36. Another optional item is a microphone or microphones 38 that can be used to transfer audio, e.g. to the processing devices 31 and to loud speakers (not shown) attached to the base node 36 or part of the display 44.

Any or all of the outputs of the processing devices 31, the cameras, the whiteboard, etc. can be recorded and stored digitally, e.g. in node 36 or elsewhere to provide a complete record with correct time sequence.

Summarizing the above, the present invention provides an electronic meeting tool for communicating arbitrary media content between different users 37 (with their own processing devices 31, e.g. PC, mobile phone, or tablet) and one display or projector or multiple displays or projectors 44 in the meeting room 50.

Referring to Figs. 1a and 1b embodiments of the present invention comprise a base or display node 36 being a processing device, e.g. a host computer adapted to receive user selected arbitrary media content, the base node 36 being coupled to a central display 44 which can be a fixed format display or a projector or similar. The arbitrary media content can be provided from any of the user processing devices 31. The base node 36 can be adapted to display the received user selected arbitrary media content in

accordance with a set of rules, e.g. FIFO, automatically, on request or approval, forced to display, in accordance with a priority etc. Optionally the base node 36 is adapted to force display of the received user selected arbitrary media content, i.e. to allow participation in the meeting by an individual user displaying own selected content on display 44 independently of the person who is nominally responsible for giving a presentation or chairing the meeting. Forcing the display can also be considered as a rule. The meeting tool can also be adapted to allow a priority setting. This means that a user can set a priority setting for the media to be displayed. A priority of "1" for example can be interpreted by the base node as a forced display, a priority "2" can be interpreted by the base node as display as soon as possible, priority "3" can be interpreted by the base node as place in queue and display as the time comes etc. Setting and using priorities for display are also considered to be working to rules. To execute the rules, the base node 36 may have a decision module. The base node 36 may be a host computer having a processing engine such as a microprocessor and a memory. Preferably, the base node 36 is adapted to treat media content passed to the base node 36 from any or all of the connection units 47 in an equal manner. The base node 36 may be adapted to auto compose the media content on the central display 44 connected to it, e.g. from one or more processing devices 31.

An independent aspect of the present invention is at least one connection unit 47, (optionally 49 for receiving) adapted to communicate the user selected arbitrary media content to said base node 36. Preferably the connection units 47 and/or optionally 49 are physical plug-and-play devices. An example of a connection unit is shown schematically in Fig. 10.

The connection unit 47 may integrated into a user processing device 31, e.g. as an internal peripheral device or may preferably be an external peripheral device comprising a connector adapted to couple to a port of a user processing device 31. The processing device 31 may have a client display, a processing engine such as a microprocessor, a memory and an operating system. The optional connection unit 49 may integrated into the base node 36, e.g. as an internal peripheral device or may be an external peripheral device comprising a connector adapted to couple to a port of the base node 36. The connection unit 49 may be fully integrated into the base node 36,

e.g. is an internal network interface of the base node 36. The base node 36 may have a processing engine such as a microprocessor, a memory and an operating system.

The user processing devices 31, the connection units 47, (optionally 49) and the base node 36 co-operate to form a communication network 50 for linking between at least one of the plurality of processing devices 31, 36 and the central display device 44. The communication network 50 is adapted to receive arbitrary media content from at least one of the plurality of processing devices 31 and to transmit the arbitrary media content of at least one of the plurality of processing devices to the central display device 44.

An independent aspect of the present invention is a portable application 60 adapted to be loaded onto a client processing device 31 and to be run on the operating system of the client processing device 31. The portable application 60 runs as a process on the client processing device 31 that is adapted to deliver an arbitrary media content from the client processing device 31 to the communication network 50 in response to a user action applied to an input device 48, the process leaving a zero footprint on termination. Optionally the portable application 60 is stored on each connection unit 47 and optionally 49. Preferably the portable application 60 is adapted to "screen scrape" content of the client display of the client processing device 31. Optionally the portable application 60 when run on a processing device 31 is adapted to "screen scrape" content of the client display of this client processing device 31 and to transmit it via a connection unit 47. Optionally the portable application 60 when run on the processing device is adapted to "screen scrape" content of the client display of the client processing device 31 and to transmit it via a network interface of the processing device 31, for example if the connection unit 47 has no transmitter.

The connection unit 47 for communicating with said base node 36 has a network interface e.g. comprising a transmitter 62. The transmitter 62 is preferably a transceiver. Optionally the transmitter/receiver can be a wireless transmitter/receiver.

The base node 36 for communicating with the connection unit 47 has a receiver 63 which can be included in the connection unit 49 or integrated into the base node 36.

The receiver is preferably a transceiver. Optionally the transmitter/receiver can be a wireless transmitter/receiver.

The input device 48 allows a user interaction with the connection unit 47. Preferably the input device 48 is physical actuator coupled to the connection unit 47. The user action applied to the input device 48 generates a signal that can trigger transfer of data from the processing device 31 (to which the connection unit 47 is coupled) to the network 50. Preferably the input device 48 has an activating surface that is between 100 and 14,400 square mm. Optionally, the input device 48 can be a key displayed on the client display 1 of a client processing device 31. This key can be activated, e.g. by use of a pointing device such as a mouse trigger transfer of data from the processing device 31 to the network 50.

The connection unit 47 is preferably provided with a visual indicator 61, e.g. for allowing user feedback from the connection unit 47 of the status of any activity.

The system also can include a server program 64 adapted to be loaded onto the base node 36, said program 64 being adapted to receive arbitrary media content from one or a plurality of client processing devices 31 through said connection units 47, (optionally 49), and to show this plurality of arbitrary media content streams on one or a plurality of displays 44. The server program 64 may be adapted to allow display in accordance with one or more rules, e.g. FIFO, automatically, on request, forced, in accordance with a priority etc. To execute the rules, the server program 64 may have a decision module.

Preferably, the server program 64 is adapted to treat media content passed to it from any or all of the connection units 47 in an equal manner. The server program 64 may be adapted to auto compose the media content on the central display 44.

The server program 64 may be a portable application adapted to be loaded onto the base node 36 and to be run on the operating system of the base node 36. The portable application 64 runs a process on the base node 36 that is adapted to display an arbitrary media content received from the client processing device 31 via the

communication network 50, the process leaving a zero footprint on termination. Optionally the portable application 64 is stored on each connection unit 49 and optionally 7 and can be installed therefrom.

The system may also include a central display device 44 and optionally a whiteboard 45 or other display means such as a printer. The display 44 being adapted to receive user selected arbitrary media content, and may be adapted to allow display of the received user selected arbitrary media content in accordance with one or more rules, e.g. FIFO, automatic, forced, on request or approval, in accordance with a priority etc.

Optionally, one of the connection units 47 can be adapted to be a master connection unit. Such a master connection unit may be adapted to instruct the base node when media content from a client processing device 31 may be displayed or which of the processing devices may be allowed to send content for display.

In embodiments of the present invention, at least one portable application is used, e.g. for the client software on a client procesing device 31 or optionzlly on the base node 36. In these embodiments, one of the pre-installed generic drivers of the operating system on the relevant computer device 31, 36 is exploited for setting up communication from the computer device 31, 36 to the network 50 via the connection unit 47, (optionally 49). The generic driver is used in connection with the connection unit 47, (optionally 49) operating as a peripheral device but the use can go beyond that of the standard class of peripheral devices for which the generic driver is intended. In some embodiments the connection unit 47, (optionally 49) operated as a peripheral device communicates with the relevant processing device 31, 36 by using a generic communication protocol provided by the pre-installed generic driver. Pre-installed USB drivers are examples. Preferably the setting up of the communication of network 50 using connection unit 47, (optionally 49) does not alter or affect the networking capability of the relevant processing device 31, 36. For example, if a browser is started on the client processing device 31, this browser can use the standard network interfaces on the processing device 31. This means that transfer of data via the connection unit 47 (optionally 49) is independent of transfer of data over the network interfaces of processing device 31 or 36. This has the advantage that each user can

carry out processing such as searching on the internet to gather data independently of the transfer of data to be diplayed during a meeting, or receive emails etc.

The use of a portable application has the advantage that any modification to settings in the register or generally in the operating system can be avoided, so that upon any form of termination, e.g. disconnecting the electronic device, system crash, no trace is left. This is generally termed "zero footprint".

The present invention has the advantage of scalability. It can provide a display system for use by a plurality of users in meetings. Every user in the meeting thus can have a client processing device 31 for coupling to a connection unit 47. A first user action connects the client processing device 31 to the base node 36, e.g. by inserting a connection unit 47 into the relevant interface connector on the processing device 31, e.g. a USB interface. A second user action comprising activating a button or key on the input device (e.g. by depressing it) then starts the process of transmitting arbitrary media content from the client processing device 31 to the base node 36. This process preferably includes screen scraping data from the processing device. Using screen scraping avoids special programs being installed on the base node 36 to carry out graphical commands sent from the processing device 31. When the base node 36 receives the plurality of arbitrary media content, it can allow auto composition of this media content on the central display connected to it.

The present invention will now be described further with reference to certain more specific embodiments.

With reference to Fig. 2, the base node software (6) running on a base node 36 can be adapted to display on the central display a splash screen (21) showing its readiness to receive arbitrary media content over its receiver. This splash screen (21) can also show instructions on how to use the system, as well as the configuration parameters (see later) to reach the base node 36. These configuration parameters are also shown in a transparent canvas at the bottom of the central display (22).

A client processing device 31 that wants to have its arbitrary media content displayed

on the central display connected to the base node 36 is connected to a connection unit 47. The portable application 60 will be executed on the client processing device 31 as a host device. A first user interaction creates a connection between the portable application 60 and the base node 36 using the transmitter in the connection unit 47 and the receiver in the base node 36. A second user interaction, this time on the input device 48, activates screen scraping by the portable application of the arbitrary media content from the client processing device display, which is then sent over the connector unit 47 to the base node.

The base node 36 receives the plurality of arbitrary media content coming from one or more connection units 47, and auto composes this media content for rendering on the central display.

The visual indicator 61 on the connection unit 47 indicates to the user and to other participants in the meeting that media content is being sent by that connection unit 47 to the base node 36 for display.

Repeating the second user interaction on the input device 48 of a connection unit 47 decouples the media content from that connection unit 47 from the base node 36. The base node 36 removes that media content from the composed image on the central display and recomposes the remaining content on the central display.

The content on the central display/projector is auto arranged as shown in figure 2. When user 1 adds content, his/her display will be scaled to fill the available central display canvas as much as possible, but without affecting the aspect ratio. When user 2 adds in, his content is added to the side of the first image. When user 3 adds his content, the arrangement is triangle wise. Adding user 4, the image becomes a 2 by 2 tiling, which is the maximum available. When an additional user attempts to add content, he will be blocked. When a user initiates action to remove his/her content, his/her media content is removed from the central display and one moves backward in the composition sequence shown in figure 2.

Base node software

The base node software has one or more of the following features:

- First code for providing a means or a method step for correctly configuring the receiver of the base node as an access point.
- Second code for providing a means or a method step for listening for output of connection units trying to connect on a specific port.
- Optionally, third code for providing a means or a method step for a GUI for administration purposes, offered for example over a web interface.
- Optionally, fourth code for providing a means or a method step for publishing its presence over the network using the zeroconf protocol.
- Optionally, fifth code for providing a means or a method step for accepting and installing software updates of the base node as well as for the portable application software for the connection units.
- Sixth code for providing a means or a method step for providing facilities for pairing of connection units to the base node.
- Seventh code for providing a means or a method step for auto-composiing of different incoming arbitrary media streams and rendering of composited image on display or projector screen.
- Eighth code for providing a means or a method step for receiving, decrypting and decoding incoming arbitrary media content.
- Optionally ninth code for providing a means or a method step for scaling of incoming arbitrary media streams
- Optionally tenth code for providing a means for displaying incoming arbitrary media content in accordance with a set of one or more rules.

Any of the above code may be stored on a non-transitory machine readable storage medium such as an optical disk, a magnetic disk, magnetic tape, solid state memory etc.

Portable application for the client processing device

The portable application comprises an algorithm for screen scraping. Screen scraping algorithms include VNC and RDP or similar. The algorithm may include a combination of algorithms such as VNC and RDP that are optimized for different

content, e.g. static text or video. The portable application has one or more of the following features:

- Eleventh code for providing a means or a method step for connecting to a network including the base node.
- Twelfth code for providing a means or a method step for capturing video frame buffers of the client processing device, i.e. computer (C), also called screen scraping.
- Thirteenth code for providing a means or a method step for encoding, compressing and optionally encrypting these video frames and sending them over a secure link to the base node. Only changed areas such as rectangles or triangles of the screen need to be transferred, and different types of rectangles or triangles are encoded in different ways (e.g. RLE, JPEG,...) to optimise performance.
- Fourteenth code for providing a means or a method step for handling the connection unit.
- Fifteenth code for providing a means or a method step for initiating connection to base node.
- Sixteenth code for receive inputs from the input device on the connection unit.
- Seventeenth code for providing a means or a method step for sending state changes to the visual indicator on the connection unit.
- Optionally, eighteenth code for providing a means or a method step for presenting the user a GUI (18).
- Optionally, nineteenth code for presenting GUI for administration of the portable application.
- Optionally, twentieth code for providing a means or a method step for displaying and activating a key on the display of the client processing device for allowing a user input to start the transfer of data from the client device to the base node.

Any of the above code may be stored on a non-transitory machine readable storage medium such as an optical disk, a magnetic disk, magnetic tape, solid state memory etc.

In this embodiment the portable application stored on the connection unit, and is executed in an execution context on the client processing device. The portable application does not need to be copied to or installed on the computer. It can be executed directly from the connection unit. It will only be copied temporarily into an execution context on the client processing device. There are also no changes in configuration or settings in the client processing device. This means that nothing will remain on the client processing device when the connection unit is removed. It also implies that the portable application will run on client processing devices where the user does not have the necessary access rights to install software.

The portable application is designed in such a way that

- No specific drivers need to be installed on the client processing device.
- Pre-installed drivers are used, e.g. for classes of peripheral devices.
- It is independent from vendor specific graphics hardware.
- It runs on at least one and preferably on a variety of different client processing devices, including Windows, Mac OS/X, Linux, Android, iOS and many others.

Advantages

The present application has one or more of the following advantages:

- No need for a master role in the meeting
- Standard plug and play connectivity of connection units to base node
- Simple and well known user actions are employed
- Own networking facilities of client processing devices not blocked
- No configuration changes on the client processing device
- Input devices are easily accessible; e.g. large size
- Program updates of portable application and server program can be performed locally
- Portable applications are used, no installation, multi-platform, no vendor specifics
- Particular implementation of screen scraping done by portable application avoids vendor specific graphics devices

- Standard drivers are used
- No configuration changes on the client processing devices
- Zero footprint applications on client processing devices – nothing to clear up or adjust or reset
- Own networking facilities of client processing devices not blocked
- No configuration changes on the user computers
- Low virus, malware and spyware risk

The portable application may be stored on a non-transitory machine readable storage medium such as an optical disk, a magnetic disk, magnetic tape, solid state memory etc.

Second Embodiment

In the second embodiment, referring to Figs. 2 to 5, the base node is a separate physical processing device called base unit (B), comprising permanent storage, memory, a processing engine, a wireless access point (4), a plug and play interface such as a USB port (11), a graphics display output adapter (5) like VGA/DP/DVI/HDMI, and optionally an audio output adapter (27). An input device having an actuator such as a button 13 and a visual indicator 14 are optional.

The connection unit is a physical device in the form of an external peripheral device (shown in the drawings as a "dongle" D) comprising permanent storage storing the portable application (7) and configuration parameters (12), memory, a processing engine (e.g. CPU, FPGA), a wireless transmitter such as WiFi (3), a plug and play interface such as a USB interface (2), a button as input device (9), an LED ring as visual indicator (10). The portable application is stored on the peripheral device (7).

The client processing device is host device, for example a computer or laptop comprising a display, a plug and play interface such as a USB port (2), memory, and a processing engine such as a microprocessor.

The system thus comprises

- an external peripheral device (D) that has a plug and play interface such as a USB interface (2) on one end and a communications interface such as a wireless interface configured as client (3) on the other end.
- a base unit (B) that has a communications interface such as a wireless interface configured as access point on one end (4) and a video card adapter (5) like VGA, DVI, DP or HDMI on the other end.
- a portable application (7) stored on the peripheral device (D) but executed on the client processing device (C)
- a base node software (6) stored and executed on the base unit (B)

The external peripheral device (D) also preferably has any one or any combination of:

- a large button as actuator for the input device (9) allowing user interaction with the peripheral device. The button preferably has an actuation surface area of between 100 and 14,400 square mm.
- visual indication such as a LED (10) allowing user feedback from the peripheral device

An advantage of embodiments of the present invention is to provide data transfer to the peripheral device via a peripheral interface such as a USB interface on any processing device such as a computer in a manner that is largely operating system independent and without leaving a footprint (Zero-Footprint). Installation of drivers and/or applications onto such a processing device as a computer is not necessary wherever pre-installed generic drivers are present. Administrator rights on the processing device such as a computer are preferably not necessary. To avoid the need for administrator rights, embodiments of the present invention use other peripheral device pre-installed drivers such as USB class drivers supported without any extra installation. Embodiments of the present invention route at least screen scraped data presented by client software running on the processing device for transfer to a communications network via a peripheral device such as a USB device. This bypasses any network interface of the processing device (and hence many firewalls) but only for the specific client software. Other applications are not affected and can make use of the standard network interfaces, i.e. packets from/to the TCP/IP stack are transferred to

a network device as normal. The client software is launched from the peripheral device such as a USB composite device or storage device as a portable application, which can avoid that any traces are left on the host OS.

Basic usage scenario of the second embodiment

The base node software (6) displays on the projector a splash screen – (21) in figure 5 - showing its readiness to receive arbitrary media content over its receiver (4). This splash screen (21) also shows instructions on how to use the system, as well as the configuration parameters (see later) to reach the base node. These configuration parameters are also shown in a transparent canvas at the bottom of the central display (22).

To avoid user interaction for the configuration of the connection between peripheral device and base unit, a pairing process is used. This pairing process provides the peripheral device, i.e. the connection unit with networks parameters needed to set up the local network. As an example, the peripheral device can be briefly plugged into the USB port (11) of the base unit (B). The base unit then optionally does a software validity check, optionally does a software update of the portable application stored on the peripheral device, and writes the connection parameters on the peripheral device (D) required for the peripheral device and base unit to find each other to the permanent storage (8). For example, when using WiFi, this would be the SSID, WEP/WPA2 and IP address of the base unit's receiver, as well as the port number used by the base node software.

A client processing device that wants to have its arbitrary media content displayed on the central display connected to the base node (5) connects a peripheral device (D) to its USB port via (2). The peripheral device presents itself to the computer over interface (2) as a composite device comprising a mass storage device and a keypad. This has the major advantage that no specific driver is required, since all these devices are natively supported in every personal computer system that has a USB port. If autorun is enabled, then the computer will automatically execute the client software (7) stored in mass storage (8) on the peripheral device. The first user interaction

mentioned in the general case is then just the connection of the peripheral device to the USB port. If security measures disabled auto-run, the user needs to explore the mass storage on the mass storage of the peripheral device and start the portable application manually.

The portable application will use the wireless, e.g. wifi interface of the peripheral device (3) to connect to the correct base node. To know the right base unit to connect to, the configuration parameters needed to make this connection are stored in the database (12) on the mass storage device (8) during the pairing process described earlier.

Once the connection is made, the peripheral device goes into connected mode. This means that there is now at least one channel from the peripheral device to the base unit. The content is not shown yet. The LED (10) on the peripheral device now turns white to give a visual indication of this new state.

When the user at the computer (C) wants to show her content, she presses the button (9). When the button was previously in state "connected" (see figure 6), it will check the state of the base unit (P). If the base unit is not in state "full", the peripheral device will send the screen scraped arbitrary media content to the base unit (B), which will add the media content to the composition on the central display. The peripheral device LED (10) now turns red to indicate "showing" state (figure 6).

The button (9) acts as a toggle. When the user presses the button again, that computer displays content will be removed from the projector. The LED (10) goes back to white.

Use of the auto-run feature is optional if possible and enabled on the computer (C) to start the client software (7) as soon as the peripheral device is plugged in. On Windows for example, this means mounting the peripheral device as a mass storage device and using the autorun.inf file stored on the peripheral device.

In many cases however, this auto-run feature will be disabled for security reasons. In

that case, we will, if possible and enabled on the computer (C), use the auto-play feature to show the logo of the connected peripheral device on the desktop of the computer. The user then needs to double click on that logo to start the client software. If the auto-play feature as described above is also not possible or enabled, the user must browse to the file system of the connected peripheral device and start the application manually. This means double clicking the client.exe file on Windows, client.app on Mac OS/X or tapping the appropriate application icon on a tablet or any mobile device with touch screen.

Third Embodiment: Portable application stored on standard solid state memory such as a USB stick.

In the third embodiment, the portable application is stored on a solid state memory such as a regular USB memory stick (figure 7).

With a solid state memory such as a regular USB memory stick, there is no input device, visual indicator or transmitter of the kinds described above for the connection unit. This means that the system needs to:

- Use the transmitter/receiver from the client processing device.
- Use as input device a key or button on the client processing device like a physical key on the keyboard, a special mouse press, a button area on a touch screen, a button displayed on the screen to be clicked on with a mouse pointer.
- Present the visual indicator on the client processing device's display.

The client processing device then looks like figure 8.

This embodiment provides a peripheral interface such as the USB interface on any processing device acting as a host device such as a computer in a manner that is largely operating system independent. Installation of drivers and/or applications onto such a processing device as a computer is not necessary wherever pre-installed generic drivers are present. Administrator rights on the processing device such as a computer are preferably not necessary. To avoid the need for administrator rights, this embodiment uses other peripheral device pre-installed drivers such as USB class drivers supported without any

extra installation. This embodiment of the present invention routes at least screen scraped data presented by client software running on the processing device for transfer to a communications network via a network connection of the processing device. The client software is launched from the peripheral device such as the USB device as a portable application.

The first user operation then comprises:

- plugging in the solid state device such as a USB memory stick,
- starting the portable application (if autorun is disabled)
- configuring the transmitter on the client processing device to connect to the correct base node, using the configuration parameters (22) shown on the central display
- triggering the connection of the portable application with the base node, for example by interacting with an element on the GUI (18) of the portable application presented on the display of the client processing device.

Presenting visual feedback on user actions is in this embodiment also done using elements in the GUI of the display of the client operating device.

In this embodiment, the advantage of zero footprint is partly realized by the portable application in the sense that no software is installed on or copied to the client operating device, but there is a configuration change needed to connect the transmitter of the client operating device with the base node, which needs to be undone afterwards.

Optionally, the portable application can make the configuration changes to the transmitter for the user.

Advantages lost in this embodiment

- Partial loss of zero footprint nature of portable application
- More complex first user interaction
- More expertise required from user
- GUI needed on client operating device display, which is possibly also shown on central display
- Need to find free key on client operating device when using physical key for

second user action

- Network interface is blocked from other uses by portable application

Optionally, the last point can be avoided by using the base unit as a gateway to the network that the client operating device wanted to connect to through its own interface.

Advantages are:

- tight control of user connectivity to corporate network through settings on the base unit
- keep network connectivity intact even when transmitter is now also used for display purposes

Disadvantage is a higher vulnerability of the system because the display connection is now possible a doorway into the corporate network.

What remains as advantages are

- the availability of a physical medium to distribute the portable application to users
- no need to install or copy software to client operating device
- easy way to maintain software updates on the connection units (here: memory sticks) via the base unit
- possibility to write configuration data on the connection unit by the base unit, for example in the form of a configuration profile that can be read and used by the client operating device

Fourth Embodiment: Software only client installed on the client processing device.

This embodiment is similar to the third embodiment, with as only difference that the software is copied on the client operating device (figure 9). In this case, no plug and play port such as a USB port is required on the client operating device.

This embodiment will typically be used for tablet PC's and mobile devices. In that case

- there is often no USB port available
- application distribution is easy and widely accepted through application stores

Fifth embodiment: Base node software OEM'ed to projector or display equipment

In this embodiment, the base node is not realized as a separate physical box, but integrated into the processing unit inside a display or projector. All other details are as previously described.

Sixth embodiment

In this embodiment, the base node is not realized as a separate physical box, but integrated into the codec of a video conferencing equipment. All other details are as previously described.

Seventh embodiment: Remote meeting participant

In this embodiment, one or multiple client operating devices are not in the direct vicinity of the base node but on a remote location.

To accommodate this case, the following adaptations are needed:

- further compression and or scaling of the arbitrary media content to allow use of low bandwidth connection
- possibility to communicate connection parameters of the base node to a remote user
- connectivity of the base node to the WAN network to which the remote user is connected

All other details are as previously described.

Eighth embodiment: multiple base nodes

In this embodiment, multiple base nodes are used. This can be done for different purposes:

- connectivity of multiple central displays
- extension of real estate of central display

- connectivity of base nodes in different remote locations

Thi provides the advantage that one can present on multiple base units from a single peripheral device. This is usefull for a number of cases:
- personal peripheral device: user can have a personal peripheral device that is paired with multiple meeting rooms that he regularly uses
- use in meeting room with multiple base units each controlling a different display in the same meeting room

The proposal uses a special variant of the peripheral device called a multi base peripheral device. The multi base peripheral device is equiped with a rotating wheel around the circular central "show me" button. This could be a mechanical rotating multi-position switch or something like the touch wheel on the iPod classic.

The pairing of this multi-base variant of the peripheral device:
- the rotation wheel is put in the position of the corresponding base unit.
- the peripheral device is paired to the base node in the regular way
- the configuration parameters are stored in a permanent storage location; every position of the rotating wheel has a corresponding set of connection parameters (e.g. different rows in a table) each corresponding with a particular base

The connection of the peripheral device is as follows:
- multi-base peripheral device X is plugged into a PC
- rotation wheel on peripheral device X is put in position A
- peripheral device X reads configuration parameters in position A of its internal memory
- peripheral device X connects to base node A
- base node A indicates connection of multi-base peripheral device X on central display screen
- rotation wheel on peripheral device X is put in position B
- peripheral device X reads configuration parameters in position B of its internal memory
- peripheral device X connects to base node B
- base node B indicates connection of multi-base peripheral device X on screen
- continue until correct base is selected with rotation wheel

- click the peripheral device input device e.g. button to show content on central display of base node
- rotating the wheel always first clicks away content from the base of the last position

Ninth embodiment

Fig. 10 shows a peripheral device 47 in accordance with an independent embodiment of the present invention including an input device. This embodiment can be used with any of the embodiments described above.

The peripheral device is configured as a connection unit and is a physical device in the form of a connector for a plug and play interface of a user processing device as a host computer such as a USB connection, a flexible data and power connection connected to the connector and a base, the base having an actuator, e.g. a button configured to be an input device with the functions as described above.

The base and/or the actuator is preferably large in size, e.g. having a surface area between 100 and 14,400 square mm. The base can be square, rectangular, round, hexagonal, oval, polygonal in shape or any other ergonomically suitable shape. The actuator is preferably round but can be square, rectangular, hexagonal, oval, polygonal in shape etc. there can be more than one actuator on one base.

The length of the flexible data and power connection, e.g. cable is preferably adapted to place the peripheral device (when in its connected in its operating position), especially the base and the actuator, in the region between the boundary of the connected user processing device and the ergonomic boundary as defined above. In addition the flexible data and power connection should be adapted so that the base lies flat on the meeting table independent of the orientation of the connector needed to insert the connector into the plug and play interface. The flexible data and power connection can be a cable that is firmly fixed to and integrated into the base. Alternatively the flexible data and power connection can be a separate cable that connectors to a suitable connector in the base, e.g. a USB connector.

The base preferably includes electronics such as having permanent storage for storing the portable application and the network configuration parameters, memory, a processing engine (e.g. CPU, FPGA), a wireless transmitter/receiver such as for WiFi, a plug and play interface such as a USB interface, a LED ring as visual indicator. The portable application can be stored on the peripheral device, i.e. in the base. The visual indicator is for allowing user feedback from the connection unit of the status of any activity.

- Some examples for activation of the actuator which can be used with any of the embodiments of the present invention:

    - Sound activated (hand clap, voice recognition, computer sound, music, ...)
    - Remote controlled via wireless connected device (IR, Bluetooth, WiFi, ...)
    - Light activated
    - Pressure activated, e.g. depression with a finger or hand.
    - Touch activated
    - Proximity ('near-touch' on the actuator or bringing the actuator close to some object
    - Biometric reader such as Fingerprint reader, Iris scanner, DNA analyser
    - Keypad, e.g. for entering Keycode e.g. a password

Alternative embodiments

In the above embodiments, once the connection is made between the connection device and a host computer, the peripheral device goes into connected mode. This means that there is at least one channel from the peripheral device to the base node. In accordance with any of the embodiments of the present invention a plurality of channels can be set up between the connection device and the base node. These channels may be logical channels.

Some examples for such a multichannel arrangement may include the first and one or more of the additional channels:

- First channel is for the Scraped image stream (XDS)
- Second channel is for GPU commands (OpenGL, DirectX)
- Third channel is for Mouse pointer coordinates (absolute, relative)

- Fourth channel is for Mouse pointer icons
- Fifth channel is for Image data files (JPEG, PNG, GIF, …)
- Sixth channel is for Multimedia data files or streams (MPEG2, MPEG4, OGG, H.26x, …)
- Seventh channel is for Audio data files or streams (MP3, MP4, AAC, WMA, …)
- Eighth channel is for text or Document data files (DOC, DOCX, PPT, PPTX, ODT, ODS, PDF, …)
- Ninth channel is for transmission of a priority value 1,2, 3… as described above.

In the above embodiments, a particular method of pairing the peripheral device with the base node has been described. Any of the embodiments of the present invention may include other pairing mechanisms of which some examples are given below.

- Some examples for pairing
  - Plug in the peripheral device, to a generic peripheral device port such as a USB port of the base node or other USB enabled device. Pairing info is transmitted over the generic peripheral interface such as USB.
  - The Signal strength of the wireless channel to the base node is used to identify which base nod is to be used
  - The Signal strength of the wireless channel or any other channel. Example is an NFC/RFID transmitter can be provided underneath the meeting room table. Putting the user processing device such as a laptop and the peripheral device plugged in on this table automatically pairs the peripheral device with the base of this meeting room
  - Manual pairing (e.g. by entering IP address, hostname, wireless ID (like SSID on WiFi))

What is claimed is

1. An electronic meeting tool for communicating arbitrary media content from users at a meeting comprising:

a node configuration arranged to operate a display node of a communications network, the display node being coupled to a first display, the node configuration further being arranged to receive user selected arbitrary media content and to control display of the user selected arbitrary media content on the first display;

at least one peripheral device configured to communicate the user selected arbitrary media content via the communications network, wherein the peripheral device is a connection unit comprising:

(a) a connector arranged to couple to a port of a processing device having a second display, a memory and an operating system; and

(b) a transmitter arranged to communicate with the communications network,

a program configured to be loaded onto the processing device and to run on the operating system of the processing device, said program being arranged to obtain user selected arbitrary media content, said program leaving a zero footprint on termination, and

an input device enabling the user to carry out a user action that triggers transfer of said user selected arbitrary media content to said transmitter through said port.

2. The electronic meeting tool of claim 1, wherein the program is stored on the peripheral device.

3. The electronic meeting tool of claim 1, wherein the transmitter is a wireless transmitter or transceiver.

4. The electronic meeting tool of claim 1, wherein the peripheral device is a plug-and-play device.

5. The electronic meeting tool of claim 1, wherein the program is arranged to screen scrape content of the second display.

6. The electronic meeting tool claim 1, wherein the input device is physical actuator coupled to the peripheral device.

7. The electronic meeting tool of claim 6, wherein the physical actuator has a surface area of between 100 and 14,400 square mm.

8. A method for connecting a processing device to a communications network, the processing device having a memory, a display and an operating system with at least one pre-installed generic driver providing a generic communications protocol for communication between processing device and a standard class of peripheral devices, the method comprising the steps of:
a) coupling a peripheral device to the processing device, the peripheral device having a transceiver;
b) setting up, by means of the pre-installed generic driver of the operating system, an arrangement for communication between the peripheral device and the processing device;
c) coupling the processing device to a communications network via the peripheral device;
d) routing screen scraped data between the processing device and the communication network via the arrangement for communication, wherein the generic communication protocol is used for transferring the screen scraped data between the processing device and the peripheral device.

9. The method of claim 8, wherein said setting up according to step b) comprises:

presenting the peripheral device to the processing device as a human interface device and wherein the pre-installed generic driver comprises a human interface device driver, or

presenting the peripheral device to the processing device as a mass storage device and wherein the pre-installed generic driver is a mass storage device driver, or

presenting the peripheral device to the processing device as a composite device and wherein pre-installed generic drivers drive different device interfaces independently.

10. The method of claim 8, wherein a client application is stored on the peripheral device which when run on the processing device obtains the screen scraped data.

11. The method of claim 10, wherein the client application is a portable application.

12. A method for communicating arbitrary media content from users at a meeting comprising:
operating a display node of a communications network, the display node being coupled to a first display, to receive user selected arbitrary media content and to control display of the user selected arbitrary media content on the first display; and
connecting a peripheral device to a port of a processing device and communicating the user selected arbitrary media content via the communications network,
loading a program onto the processing device and running the program on the operating system of the processing device to obtain user selected arbitrary media content, said program leaving a zero footprint on termination, and
triggering transfer of said user selected arbitrary media content to said transmitter through said port after a user action on an input device.

13. The method of claim 12, further comprising configuring the peripheral device to connect to the communications network by pairing the peripheral device with the display node.

14. The method of claim 13, wherein the pairing is performed by plugging the peripheral device into the display node.

15. A peripheral device, for use with a connector for connection to a plug and play port of a host processing device, and a flexible connection for use with the connector, the flexible connection being for transferring data signals and power, the peripheral device comprising:
a base, and
an actuator on the base that actuates a signal and transfers the signal to the connector for transfer to the port,
wherein the base has electronics comprising permanent storage that stores a portable application, a processing engine, a transceiver and a visual indicator.

16. A method for providing communication connectivity from a processing device, comprising:

setting up a communications network between a display node of the communications network and a peripheral device coupled to the processing device;

transferring media content between the processing device and the peripheral device,

transmitting the media content from the peripheral device to the communications network,

receiving media content from the communications network at the display node and displaying the media content on a display in accordance with a set of rules.

17. The method of claim 16, further comprising configuring the peripheral device to connect to the communications network by pairing the peripheral device with the display node.

18. The method of claim 17, wherein the pairing is performed by plugging the peripheral device into the display node.

19. A peripheral device for providing communication connectivity to a processing device which is provided with memory, a display and an operating system with at least one pre-installed generic driver providing a generic communication protocol for communication between the processing device and a standard class of peripheral devices, the peripheral device comprising a memory in which executable software code is stored for execution on the processing device, said executable software code comprising:

a first software code portion for setting up, by means of the pre-installed generic driver of the operating system, an arrangement for communication between the peripheral device and the processing device;

a second software code portion arranged to connect the processing device to a communications network via the peripheral device, the peripheral device having a transceiver;

a third software code portion enabling screen scraping data from the processing device; and

a fourth software code enabling routing screen scraped data between the processing device and the communications network over the arrangement for communication;

wherein the first software code portion is configured to use the generic communication protocol to transfer the screen scraped data between the processing device and the peripheral device.

Abstract

An electronic meeting tool and method for communicating arbitrary media content from users at a meeting is described. These can include a node configuration means adapted to operate a display node of a communications network, the display node being coupled to a first display. The node configuration means is adapted to receive user selected arbitrary media content and to control display of the user selected arbitrary media content on the first display. At least one peripheral device adapted to communicate the user selected arbitrary media content via the communications network is provided, wherein the peripheral device is a connection unit that includes a connector adapted to couple to a port of a processing device having a second display, a memory and an operating system; and a transmitter for communicating with the communications network. A program is provided that is adapted to be loaded onto the processing device and to run on the operating system of the processing device, the program being adapted to obtain user selected arbitrary media content, and to leave a zero footprint on termination. An input device is provided to allow the user to carry out a user action that triggers transfer of said user selected arbitrary media content to said transmitter through said port.

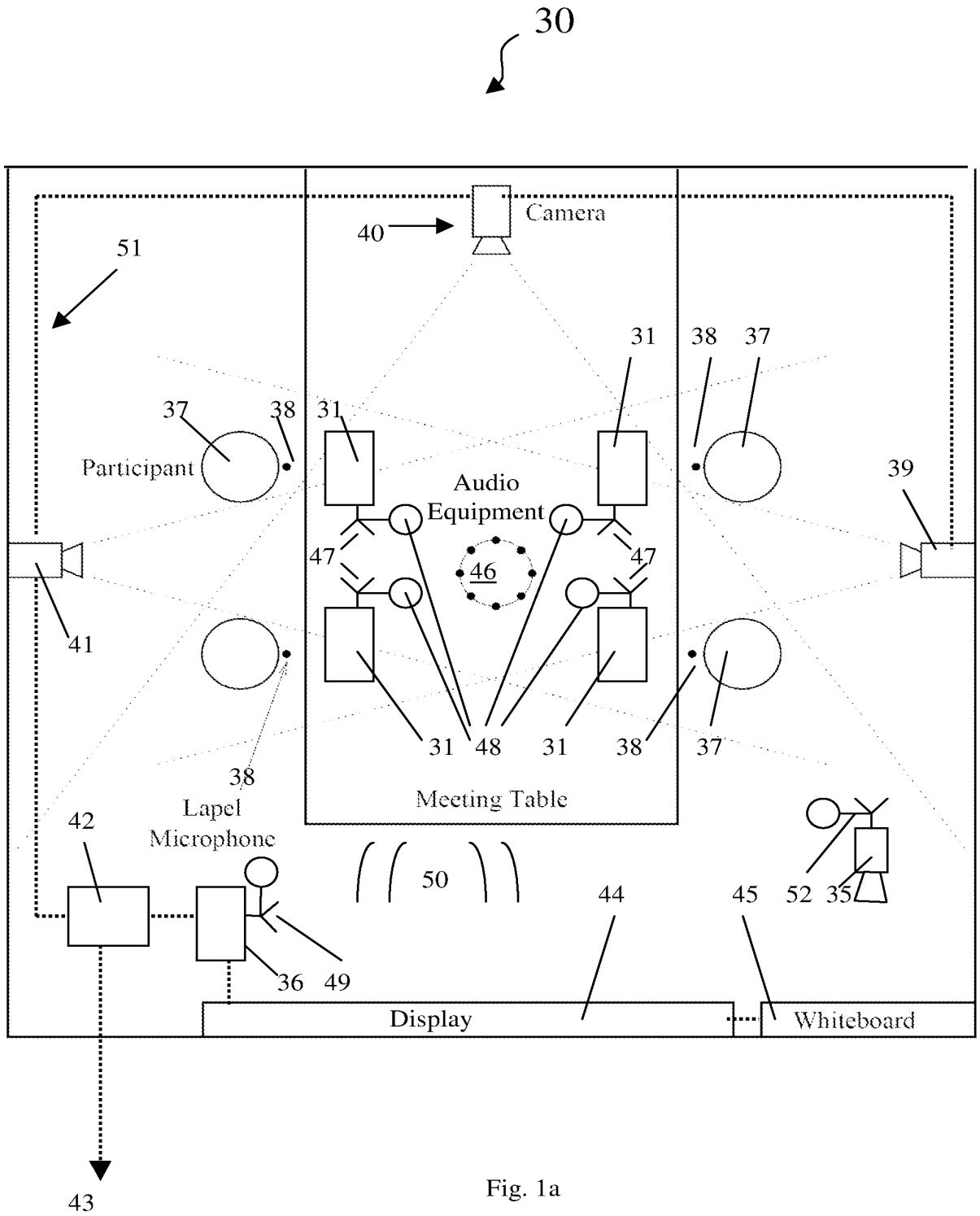

30
Camera
40
51
31
38
37
37
38
31
Participant
Audio
Equipment
39
47
46
47
41
31
48
31
38
37
38
Lapel
Microphone
Meeting Table
42
50
44
45
52
35
36
49
Display
Whiteboard
43

Fig. 1a

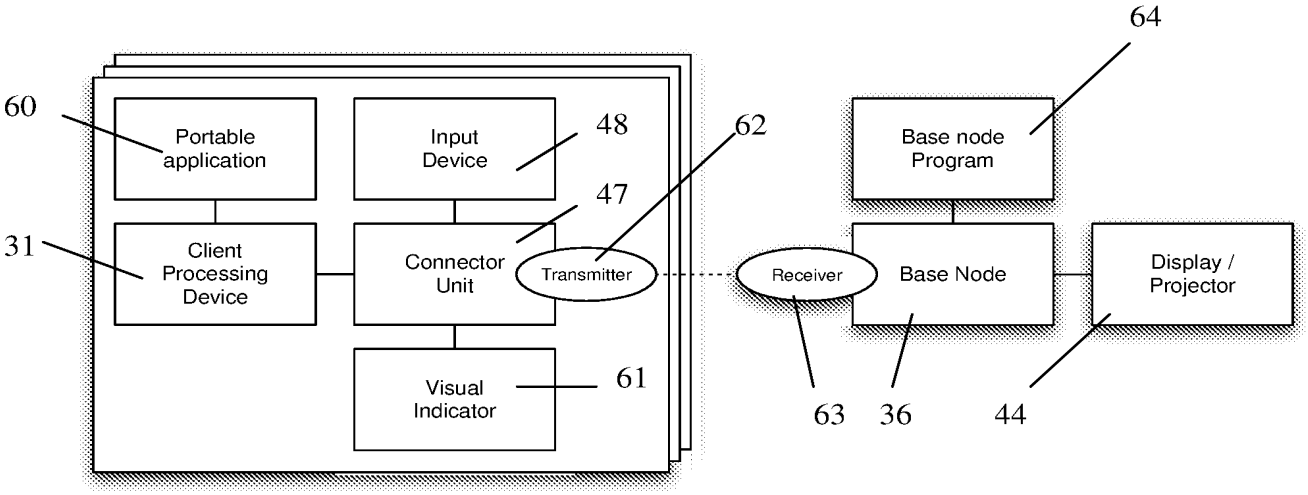

64
60
Portable application
Input Device
48
62
Base node Program
47
31
Client Processing Device
Connector Unit
Transmitter
Receiver
Base Node
Display / Projector
Visual Indicator
61
63
36
44

Fig. 1b

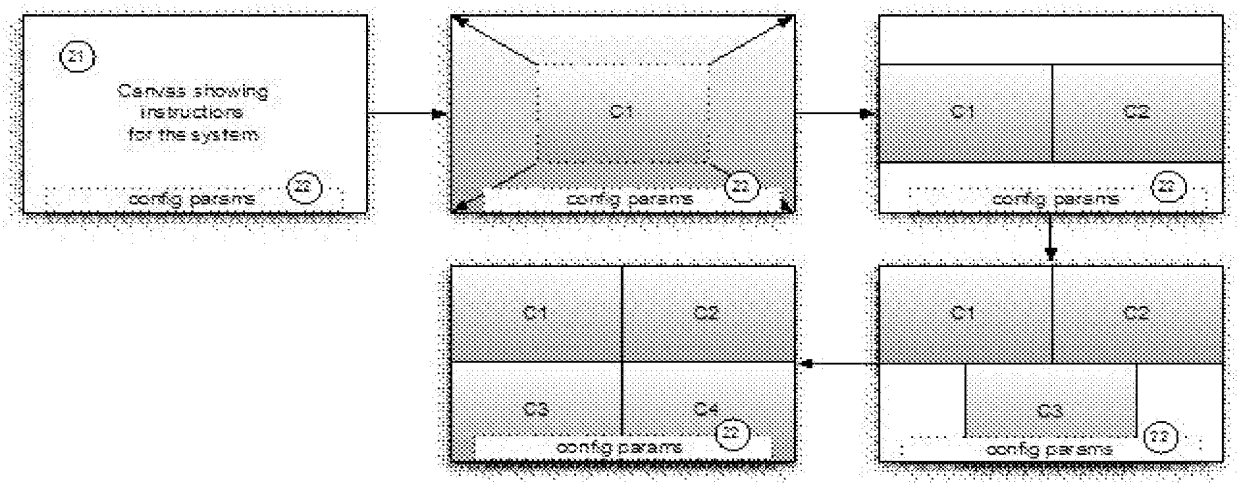

21
Canvas showing instructions for the system
config params
22
C1
C2
C3
C4

Fig. 2

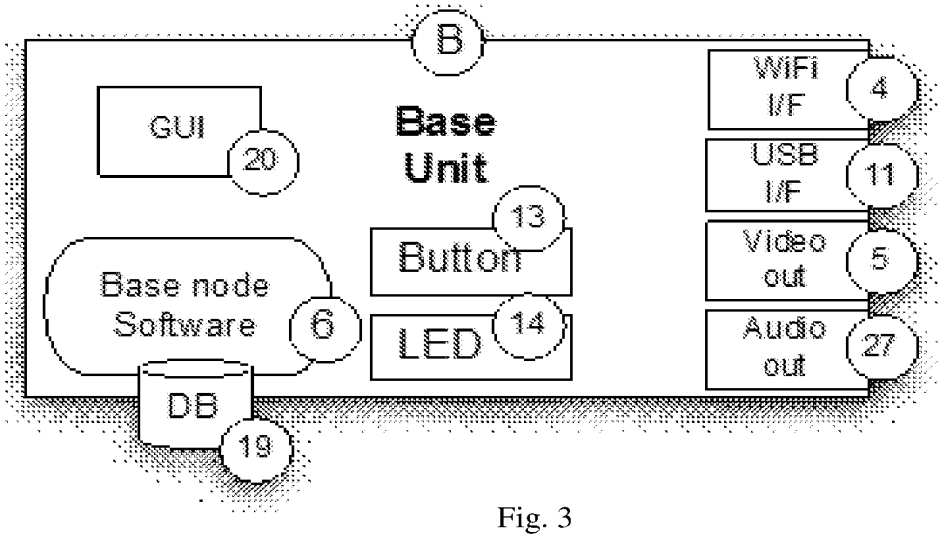


Fig. 3

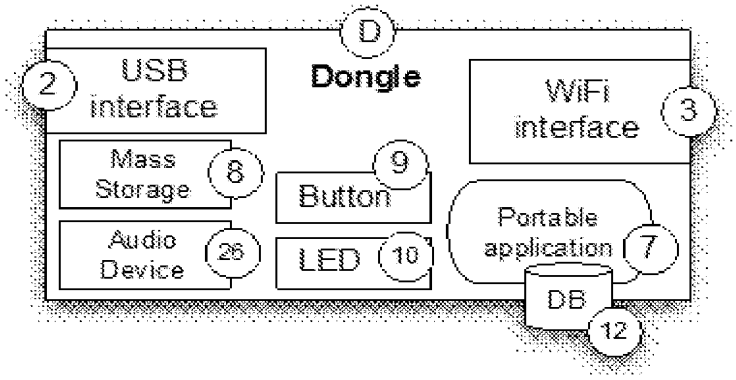


Fig. 4

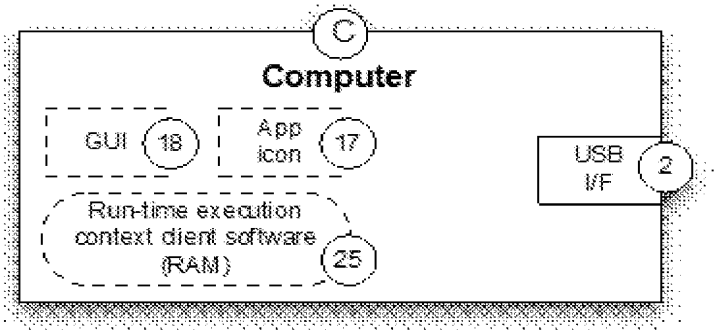


Fig. 5

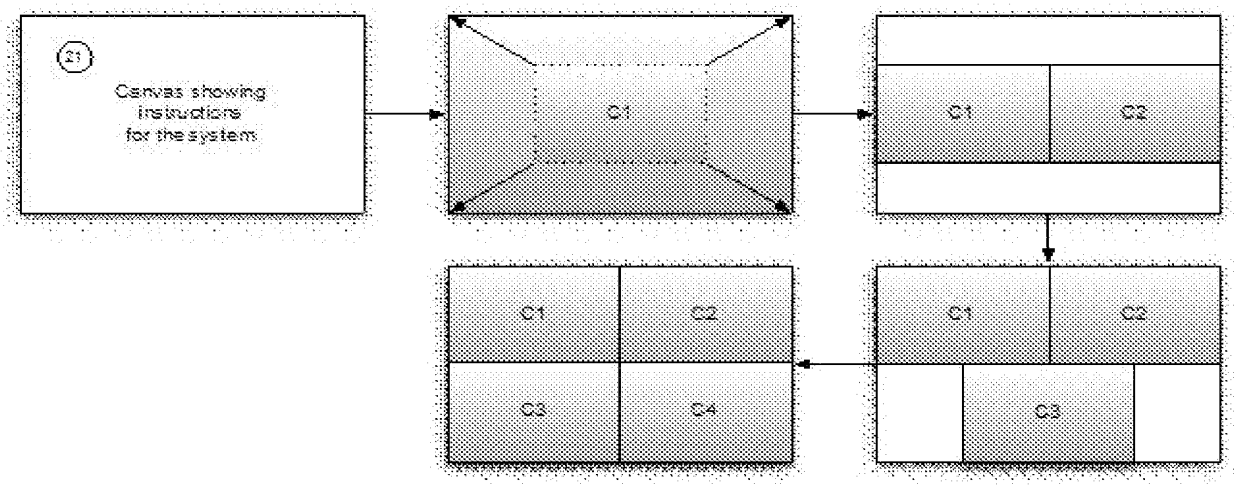


Fig. 6

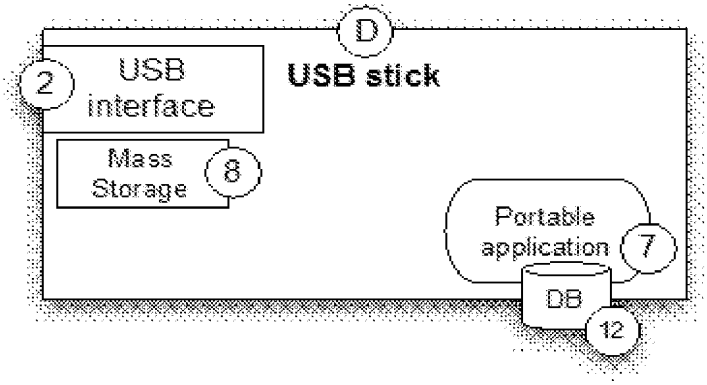


Fig.7

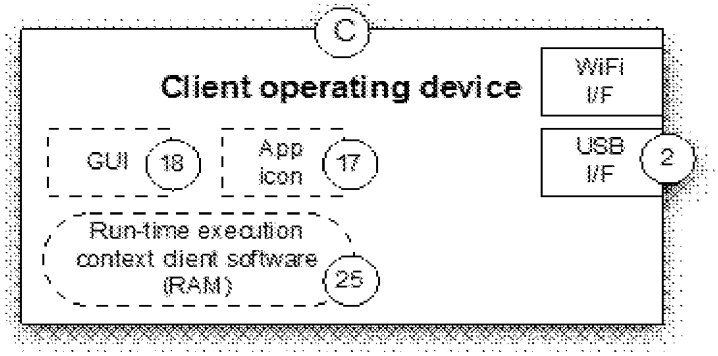


Fig. 8

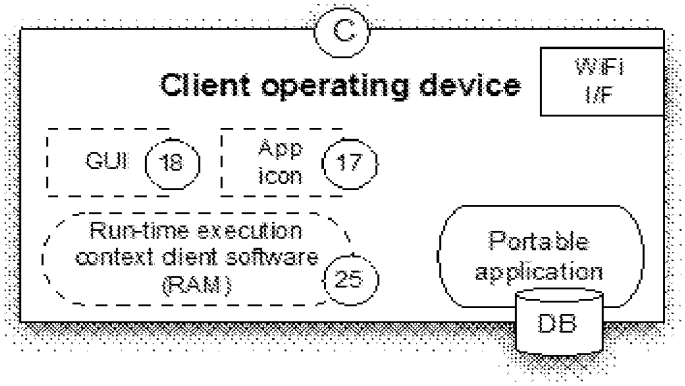

C
Client operating device
WiFi I/F
GUI
18
App icon
17
Run-time execution context client software (RAM)
25
Portable application
DB

Fig. 9

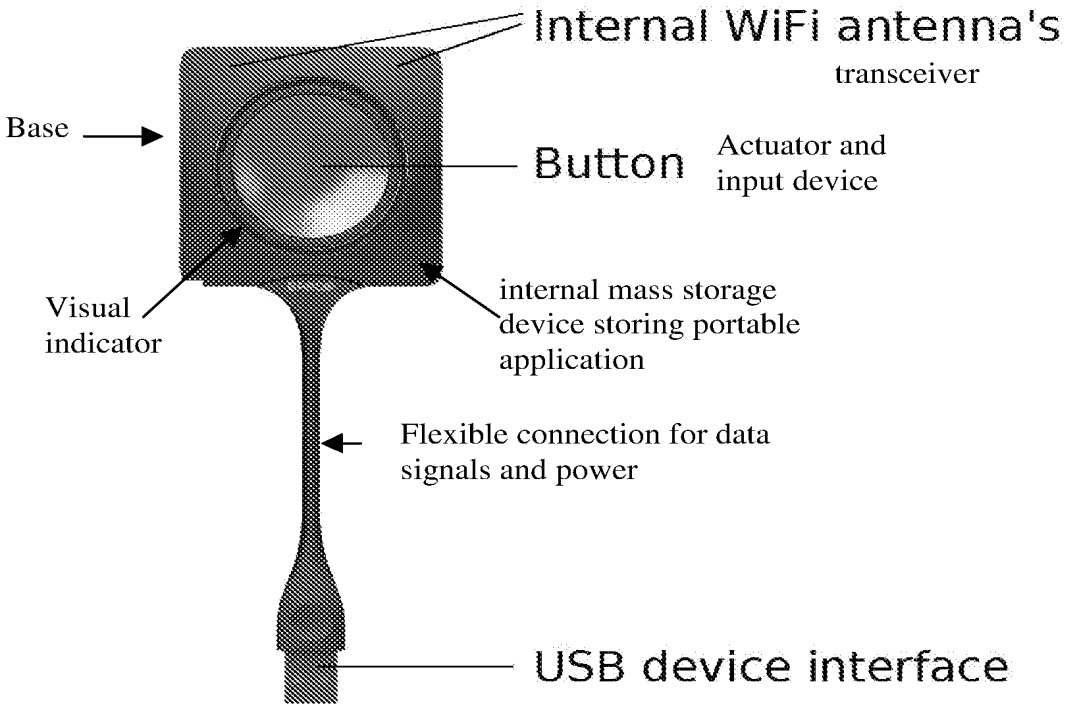

Internal WiFi antenna's
transceiver
Base
Button
Actuator and input device
Visual indicator
internal mass storage device storing portable application
Flexible connection for data signals and power
USB device interface

Fig. 10

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Continuation Patent Application of:
U.S. App. No. 14/278,442

Parent Filing Date:	May 15, 2014	**Parent Art Unit:**	2181
First Inventor:	Koen Simon Herman BEEL	**Customer No.:**	23364
Attorney No.:	BEEL3001C4/TL	**Confirm. No.:**	TBD
For:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS		

PRELIMINARY AMENDMENT BEFORE EXAMINATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INTRODUCTORY COMMENTS

This paper accompanies documents submitted to initiate processing of the above-identified patent application.

Before calculating the filing fee and before formal examination of the application on the merits, it is desired to amend the application in accordance with the following particulars.

AMENDMENTS

AMENDMENT TO THE ABSTRACT

An amendment to the abstract is shown in the following pages under the heading AMENDMENT TO THE ABSTRACT.

AMENDMENT TO THE SPECIFICATION

An amendment to the specification is shown in the following pages under the heading AMENDMENT TO THE SPECIFICATION.

AMENDMENTS TO THE CLAIMS

The claims are amended as shown in the following pages under the heading "LIST OF CURRENT CLAIMS". This listing of claims supersedes all prior listing of claims presented in this application, shows currently proposed amendments and shows the current status of all claims in the application.

AMENDMENT TO THE ABSTRACT

Please cancel the original Abstract and insert therefor the following amended Abstract:

ABSTRACT

An electronic meeting tool for communicating arbitrary media content from at least a first user and a second user at a meeting. The method including operating a base unit of a wireless communications network, the base unit being adapted to receive user selected arbitrary media content from at least a first processing device from the first user and to send the user selected arbitrary media content to at least a second processing device. The method further includes connecting a peripheral device to a port of the first processing device and communicating the user selected arbitrary media content to the base unit of the wireless communications network; and sending the user selected arbitrary media content from the base unit to a second peripheral device connected to the second processing device of the second user.

AMENDMENT TO THE SPECIFICATION

Please amend the following paragraph starting on page 1, line 5 of the specification:

This application is a continuation application claiming benefit to U.S. patent application 14/278,442 filed May 15, 2014, which is a continuation application claiming the benefit of U.S. patent application 13/270,659, filed October 11, 2011, granted as U.S. patent 8,756,348, which claims the benefit of U.S. provisional application No. 61/534,592 filed September 14, 2011 ~~is claimed and said application is~~ the entirety of said applications being incorporated herein by reference.

LIST OF CURRENT CLAIMS

1-19. (Cancelled)

20. (New) A method for communicating arbitrary media content between at least a first user and a second user at a meeting comprising:

operating a base unit of a wireless communications network, the base unit being adapted to receive user selected arbitrary media content from at least a first processing device from the first user and to send the user selected arbitrary media content to at least a second processing device;

connecting a peripheral device to a port of the first processing device and communicating the user selected arbitrary media content to the base unit of the wireless communications network; and

sending the user selected arbitrary media content from the base unit to a second peripheral device connected to the second processing device of the second user.

21. (New) The method according to claim 20, wherein said connecting comprises loading a program onto the first processing device and running the program on an operating system of the first processing device to obtain the user selected arbitrary media content, and triggering transfer of said user selected arbitrary media content on said first processing device to a transmitter on the first peripheral device through said port after a user action on an input device on the peripheral device and from the transmitter to the wireless communications network to the base unit of the wireless communications network.

22. (New) The method according to claim 20, wherein said program is adapted to screen scrape content from the first processing device.

23. (New) The method according to claim 20, wherein the input device is a physical actuator coupled to the first peripheral device.

24. (New) The method according to claim 21, wherein the first processing device has a memory, and a display, the operating system having at least one pre-installed driver

providing a communications protocol for communication between said first processing device and a standard class of peripheral devices, the method further comprising the steps of:

setting up, by means of the pre-installed driver of the operating system, a means for communication between the first peripheral device and the first processing device;

coupling the first processing device to the wireless communications network via the first peripheral device;

routing screen scraped data between the first processing device and the wireless communication network via the means for communication, wherein the communication protocol is used for transferring the screen scraped data between the first processing device and first the peripheral device.

25. (New) The method according to claim 24, wherein the first peripheral device is presented to the first processing device as a human interface device and wherein the pre-installed driver is a human interface device driver, or

wherein the first peripheral device is presented to the first processing device as a mass storage device and wherein the pre-installed driver is a mass storage device driver, or

wherein the first peripheral device is presented to the first processing device as a composite device and wherein pre-installed drivers drive different device interfaces independently.

26. (New) The method according to claim 21, wherein the program is a portable application.

27. (New) The method according to claim 21, further comprising configuring the first peripheral device to connect to the wireless communications network by pairing the first peripheral device and/or the second peripheral device with the base unit.

28. (New) The method according to claim 27, wherein the pairing is performed by plugging the first peripheral device into the base unit.

29. (New) The method according to claim 21, further comprising displaying the user selected arbitrary media content on a first display connected to the base unit in accordance with a set of rules.

30. (New) The method according to claim 20, wherein the sending of the user selected arbitrary media content from the base unit to a second peripheral device connected to a second processing device of the second user is independent of transfer of data over network interfaces of the second processing device.

31. (New) The method according to claim 20, wherein the user selected arbitrary media content is communicated to the base unit of the wireless communications network over at least one channel connecting the first peripheral device to the base unit.

32. (New) The method according to claim 20, wherein the second user is at a remote location.

33. (New) The method according to claim 32, further comprising compressing and/or scaling of the user selected arbitrary media content.

34. (New) The method according to claim 32, further comprising communicating connection parameters of the base unit to the second peripheral device of the second user.

35. (New) An electronic meeting tool for communicating arbitrary media content between at least a first user and a second user at a meeting comprising:

a base unit of a wireless communications network, the base unit being adapted to receive user selected arbitrary media content from at least a first processing device from the first user and to send the user selected arbitrary media content to at least a second processing device; and

a first peripheral device connected to a port of the first processing device and configured to communicate the user selected arbitrary media content to the base unit of the wireless communications network,

wherein said base unit is configured to send the user selected arbitrary media content from the base unit to a second peripheral device connected to the second processing device of the second user.

36. (New) The electronic meeting tool according to claim 35, further comprising a program adapted to be loaded onto at least the first processing device and to run on an operating system of the first processing device, said program being adapted to obtain the user selected arbitrary media content from at least the first processing device.

37. (New) The electronic meeting tool of claim 36, wherein said program leaves a zero footprint on termination.

38. (New) The electronic meeting tool of claim 35, wherein the at least first peripheral device is a connection unit comprising:

(a) a connector adapted to couple to a port of the first processing device, the first processing device having a second display, and a memory;

(b) a transmitter for communicating with the wireless communications network, and

(c) an input device configured to allow the user to carry out a user action that triggers transfer of said user selected arbitrary media content on said first processing device to said transmitter on the first peripheral device through said port.

39. (New) The electronic meeting tool according to claim 38, wherein at least one channel is formed between the transmitter of the first peripheral device over the wireless communications network to the base unit that is independent from the networking capability of the first processing device.

REMARKS

Examination of the application as amended is respectfully requested. No new matter is added by way of amendments.

Please charge any additional fees required or credit any overpayments in connection with this paper to Deposit Account No. 02-0200.

If any issues remain that may be resolved by a telephone or facsimile communication with the applicants' attorney, the examiner is invited to contact the undersigned at the numbers shown below.

Respectfully submitted,
BACON & THOMAS, PLLC

/Thomas Lee/

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Attorney for Applicant
Registration No. 66,396

Dated: August 11, 2020

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Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Filer:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TL

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1720**

Electronic Acknowledgement Receipt

EFS ID:	40249896
Application Number:	16990215
International Application Number:	
Confirmation Number:	5914
Title of Invention:	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
First Named Inventor/Applicant Name:	Koen Simon Herman BEEL
Customer Number:	23364
Filer:	Thomas Lee/Shelly Darrenkamp
Filer Authorized By:	Thomas Lee
Attorney Docket Number:	BEEL3001C4/TL
Receipt Date:	11-AUG-2020
Filing Date:	
Time Stamp:	13:35:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1720
RAM confirmation Number	E20208AD36113063
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	BEEL3001C4_Utility_trans.pdf	295253 e234b10ad2f1c5d59517d075166236ebb18462d7	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	BEEL3001C4_Fee_Transmittal.pdf	235284 5a613b7bda07a5267ddf8a40ae030b88b0c121de	no	2
Warnings:					
Information:					
3	Application Data Sheet	BEEL3001C4_ADS.pdf	1256539 06ffb0e9250d412dbe02821fb62c3a86448367a5	no	10
Warnings:					
Information:					
4	Oath or Declaration filed	BEEL3001C2_Declaration_parent.pdf	205384 55084fcf4720b49226174579ceb45c6eccba292f	no	2
Warnings:					
Information:					
5	Power of Attorney	GENERAL_POA_BARCO.pdf	158558 28c4f1a66fb792dec0424ac70f226a829279744a	no	1
Warnings:					
Information:					
6		BEEL3001C4_Spec.pdf	316780 258bf93e72b715a023e21b89801fb1658564aa72	yes	50
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	

	Specification		1		44
	Claims		45		49
	Abstract		50		50
Warnings:					
Information:					
7	Drawings-only black and white line drawings	BEEL3001C4_Drawings.pdf	1015594 2f856b7c8b27b43658d055dae1d0dd4efb7defdf	no	5
Warnings:					
Information:					
8		BEEL3001C4_PrelimAmend.pdf	46457 6b39f7fc4ea80586b3b39d635b0328f55a997f6b	yes	8
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**		**End**
	Preliminary Amendment		1		1
	Abstract		2		2
	Specification		3		3
	Claims		4		7
	Applicant Arguments/Remarks Made in an Amendment		8		8
Warnings:					
Information:					
9	Fee Worksheet (SB06)	fee-info.pdf	34666 c503d6ef4d66960d3c6d1f8d3e8d200997411d6d	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	3564515		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Koen	Simon Herman	BEEL	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Eke	Country of Residence i	BE

Mailing Address of Inventor:

Address 1	Zandstraat 20a
Address 2	

City	Eke	State/Province	
Postal Code	9810	Country i	BE

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yoav		NIR	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Komen	Country of Residence i	BE

Mailing Address of Inventor:

Address 1	rue de Ten Brielen 19
Address 2	

City	Komen	State/Province	
Postal Code	B-7780	Country i	BE

Inventor 3 Remove

Legal Name

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Filip	Josephine Johan	LOUWET	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Knesselare	Country of Residence [i]	BE

Mailing Address of Inventor:

Address 1	De Wijngaard 1		
Address 2			
City	Knesselare	State/Province	
Postal Code	9910	Country [i]	BE

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Guy		COEN	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Aalst	Country of Residence [i]	BE

Mailing Address of Inventor:

Address 1	Louis Camustraat 25		
Address 2			
City	Aalst	State/Province	
Postal Code	9300	Country [i]	BE

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	23364		
Email Address	mail@baconthomas.com	Add Email	Remove Email

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

Application Information:

Title of the Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS		
Attorney Docket Number	BEEL3001C4/TL	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	23364		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	14278442	2014-05-15

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14278442	Continuation of	13270659	2011-10-11	8756348	2014-06-17

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13270659	Claims benefit of provisional	61534592	2011-09-14

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	BARCO N.V.		
Mailing Address Information For Applicant:			
Address 1	PRESIDENT KENNEDYPARK 35		
Address 2			
City	KORTRIJK	**State/Province**	
Country	BE	Postal Code	B-8500
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	BARCO N.V.

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	PRESIDENT KENNEDYPARK 35		
Address 2			
City	KORTRIJK	**State/Province**	
Country i	BE	Postal Code	B-8500
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Thomas Lee/			Date (YYYY-MM-DD)	2020-08-11
First Name	THOMAS	Last Name	LEE	Registration Number	66396

Additional Signature may be generated within this form by selecting the Add button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BEEL3001C4/TL
	Application Number	
Title of Invention	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Attorney Docket: BEEL3001C/TJM/JSW

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (APPLICATION DATA SHEET (REQUIRED))

TITLE OF INVENTION: ELECTRONIC TOOL AND METHODS FOR MEETINGS

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The accompanying utility or design patent application, or

☒ U.S. patent Application No. 14/278,442, filed May 15, 2014.

1. The above-identified application was made or authorized to be made by me.

2. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

3. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR/ASSIGNOR			
Name:	Koen Simon Herman BEEL	Date:	X 30/1/2015
Signature:	X		

By signing this declaration, the inventor confirms that the application, including the claims, has been read and understood and that the inventor is aware of the duty to disclose to the U.S. Patent and Trademark Office all information known to the inventor to be material to patentability as defined in 37 CFR§1.56.

☒ Additional inventor(s) is/are being named on the supplemental sheet(s) attached hereto.

Attorney Docket: BEEL3001C/TJM/JSW

Additional Inventor(s) Page 2 of 2

SUPPLEMENTAL SHEET FOR DECLARATION

LEGAL NAME OF INVENTOR/ASSIGNOR			
Name:	Yoav NIR	Date:	X 23/02/2015
Signature:	X		

LEGAL NAME OF INVENTOR/ASSIGNOR			
Name:	Filip Josephine Johan LOUWET	Date:	X 30/1/15
Signature:	X LOUWET		

LEGAL NAME OF INVENTOR/ASSIGNOR			
Name:	Guy COEN	Date:	X 30/1/15
Signature:	X		

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	BEEL3001C4/TL
First Named Inventor	Koen Simon Herman BEEL
Title	ELECTRONIC TOOL AND METHODS FOR MEETINGS BETWEEN TWO USERS
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [✔] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [ ] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✔] **Specification** [*Total Pages* 50] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✔] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 5]
6. **Inventor's Oath or Declaration** [*Total Pages* 2] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [ ] Newly executed (original or copy)
   b. [✔] A copy from a prior application (37 CFR 1.63(d))
7. [✔] **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [✔] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [ ] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [✔] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [✔] **Other:** Applicant incorporates by reference parent application no. 14/278,442.

Note*: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✔] The address associated with Customer Number: 23364 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Thomas Lee/	Date	August 11, 2020
Name (Print/Type)	THOMAS LEE	Registration No. (Attorney/Agent)	66396

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/17 (01-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it displays a valid OMB control number

FEE TRANSMITTAL

Complete if known	
Application Number	
Filing Date	August 11, 2020
First Named Inventor	Koen Simon Herman BEEL
Examiner Name	
Art Unit	
Practitioner Docket No.	BEEL3001C4/TL

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT ($) 1720

METHOD OF PAYMENT (check all that apply)

☐ Check ■ Credit Card ☐ Money Order ☐ None ■ Other (please identify): EFS Web

■ Deposit Account Deposit Account Number: 02-0200 Deposit Account Name: Bacon & Thomas, PLLC

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

■ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

■ Charge any additional fee(s) or underpayment of fee(s) under 37 CFR 1.16 and 1.17 ■ Credit any overpayment of fee(s)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**Fees Paid ($)**
Utility	300	150*	75	660	330	165	760	380	190	1720
Design	200	100	50	160	80	40	600	300	150	
Plant	200	100	50	420	210	105	620	310	155	
Reissue	300	150	75	660	330	165	2,200	1,100	550	
Provisional	280	140	70	0	0	0	0	0	0	

* The $150 small entity status filing fee for a utility application is further reduced to $75 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	**Undiscounted Fee ($)**	**Small Entity Fee ($)**	**Micro Entity Fee ($)**
Each claim over 20 (including Reissues)	100	50	25
Each independent claim over 3 (including Reissues)	460	230	115
Multiple dependent claims	820	410	205

Total Claims		**Extra Claims**	**Fee ($)**		**Fee Paid ($)**
20	-20 or HP =	0 x		=	

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		**Extra Claims**	**Fee ($)**		**Fee Paid ($)**
2	-3 or HP =	0 x		=	

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	**Fee ($)**	**Fee Paid ($)**

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		**Extra Sheets**		**Number of each additional 50 or fraction thereof**		**Fee ($)**		**Fee Paid ($)**
55	- 100 =		/ 50 =		(round **up** to a whole number) x		=	

4. OTHER FEE(S) **Fees Paid ($)**

Non-English specification, $130 fee (no small or micro entity discount)

Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity)

Other (e.g., late filing surcharge):

SUBMITTED BY

Signature	/Thomas Lee/	Registration No. (Attorney/Agent) 66396	Telephone 703-683-0500
Name (Print/Type)	THOMAS LEE		Date August 11, 2020

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SCORE Placeholder Sheet for IFW Content

Application Number: 16990215 Document Date: 08/11/2020

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: March 1, 2019