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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
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(54) Title: POINT CLOUD DATA METHOD AND APPARATUS

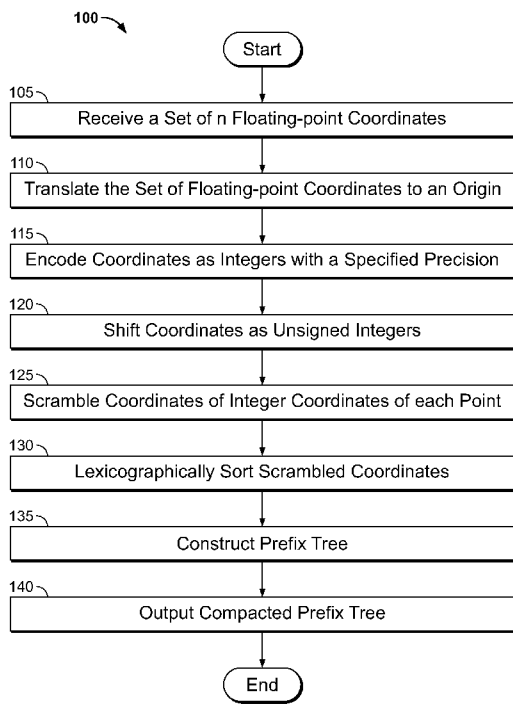


FIG. 1

(57) Abstract: A point cloud rendering method and apparatus for real-time point cloud data collection from a variety of sensor types is provided that delivers enhanced performance including reducing processing requirements, limiting local memory consumption and optimizing overall data visualization.



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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. G06T17/00 G06T9/00
ADD.
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)
G06T
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)
EPO-Internal, COMPENDEX, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SCHON B ET AL: "Octree-based indexing for 3D pointclouds within an oracle spatial DBMS", COMPUTERS & GEOSCIENCES ELSEVIER SCIENCE LTD. UK, vol. 51, February 2013 (2013-02), pages 430-438, XP002786008, ISSN: 0098-3004 abstract; p.432, left col., par.2 p.432, right col., last 6 lines - p.433, left col., par.1; fig.1,4 ----- -/--	1-5, 8-11, 14-16, 19,20

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 24 October 2018	Date of mailing of the international search report 09/01/2019
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Ellerbrock, Thomas
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/041181

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-5, 8-11, 14-16, 19, 20

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5, 8-11, 14-16, 19, 20

- i) the prefix tree is a binary space partition tree (from claim 3) and
- ii) the point cloud data set stems from a LIDAR system (from claim 10) and
- iii) the point cloud data set represents a terrain surface.

2. claims: 6, 7

The floating point data are encoded as unsigned integers with a specified precision. (from claim 6).

3. claims: 12, 13, 17, 18

- i) a spatial query is performed using the prefix tree (from claim 12) and
- ii) it is determined whether the query region intersects with an axis-aligned bounding box (from claim 13).

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2018/041181

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DEVORE R ET AL: "Processing terrain point cloud data", SIAM JOURNAL ON IMAGING SCIENCES 20131001 SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS PUBLICATIONS USA, vol. 6, no. 1, 1 October 2013 (2013-10-01) , XP002786009, DOI: 10.1137/110856009 p.3, section "2. Dyadic cubes and octrees" -----	1-5, 8-11, 14-16, 19,20
A	US 2013/235050 A1 (KARRAS TERO [FI]) 12 September 2013 (2013-09-12) par.42, 48, 51; fig.3 -----	1-5, 8-11, 14-16, 19,20
X	ZHANG YI ED - HEIPKE CHRISTIAN ET AL: "The D-FCM partitioned D-BSP tree for massive point cloud data access and rendering", ISPRS JOURNAL OF PHOTOGRAMMETRY AND REMOTE SENSING, AMSTERDAM [U.A.] : ELSEVIER, AMSTERDAM, NL, vol. 120, 24 August 2016 (2016-08-24), pages 25-36, XP029743900, ISSN: 0924-2716, DOI: 10.1016/J.ISPRSJPRS.2016.08.002 title, abstract; p.32, right col., L6-9; p.28; section "4. The in-core and out-of-core D-BSP data structure and rendering strategy" fig.2 -----	1-5, 8-11, 14-16, 19,20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2018/041181

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013235050	A1	NONE	