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[Continued on next page]

(54) Title: VEHICLE RANGE PROJECTION

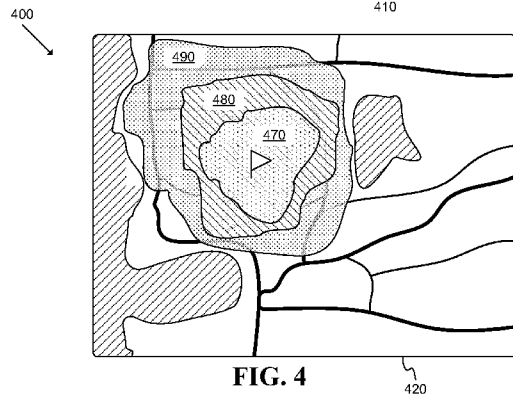
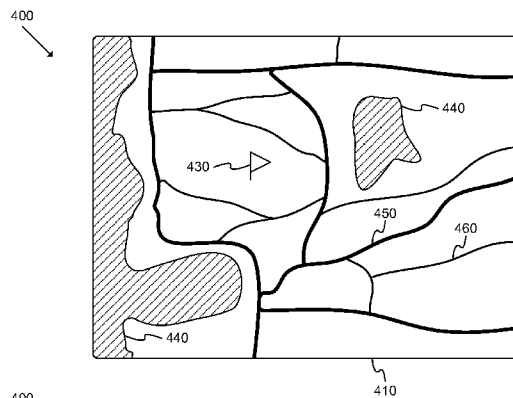


FIG. 4

(57) Abstract: A system adapted to determine a projected range of a vehicle is described. The system includes: a storage element adapted to store a set of parameters associated with a vehicle; a map evaluation element adapted to retrieve information regarding a geographic area associated with a position of the vehicle; and a processing element adapted to determine the projected range of the vehicle based at least partly on the set of parameters and the retrieved information. An automated method of projecting a range of a vehicle includes: generating a set of range projection links; generating a monochrome bitmap based at least partly on the set of range projection links; rendering the set of range projection links within the monochrome bitmap; and tracing the rendered links to generate a polygon outline of the range of the vehicle. An automated method of caching map data for vehicle range projection is described.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/17853

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G01C 21/26 (2015.01); G06G 7/76 (2015.01)

CPC - G01C21/26

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)
CPC: G01C21/26; IPC(8): G01C 21/26 (2015.01); G06G 7/76 (2015.01); USPC: 701/123Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC: G01C21/26, G01C21/3469, G01C21/3697, G01F9/023, G01F9/001, B60R16/0236, G05D1/0005, G06G7/70; USPC: 340/439, 340/438, 701/409, 701/400, 701/123 (keyword limited; terms below)

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

PatBase; Google Scholar

Search Terms: vehicle, car, automobile, projected, range, parameters, map, evaluate, analyze, monochrome, bitmap, trace, outline, polygon

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/0040438 A1 (KLUGE et al.) 17 February 2011 (17.02.2011), entire document, especially abstract and para [0011], [0025], [0027]-[0034], [0037], [0039]-[0040], [0042], [0065], [0108]-[0118], Fig. 1, Fig. 3, Fig. 4, Fig. 5, Fig. 6.	1-5
Y		6-14
Y	US 2009/0238449 A1 (ZHANG et al.) 24 September 2009 (24.09.2009), entire document, especially abstract and para [0025], [0039]-[0042], [0091], [0099]-[0103], [0113], [0115], [0121]-[0123], [0126], [0132].	6, 8-14
Y	US 2013/0054107 A1 (HARVIE) 28 February 2013 (28.02.2013), entire document, especially abstract and para [0108], [0132], [0135].	7
Y	US 2012/0277993 A1 (MUND) 01 November 2012 (01.11.2012), entire document, especially abstract and para [0007]-[0008], [0023]-[0025], Fig. 2.	8-14
Y	US 2011/0087390 A1 (PANDIT et al.) 14 April 2011 (14.04.2011), entire document, especially abstract and para [0073]-[0074], [0080], [0083], Fig. 4B.	11

☐ Further documents are listed in the continuation of Box C.

* 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

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16 APR 2015

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/17853

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 extra 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 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.:
1-14

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.

Continuation of Box No. III, Observations where unity of invention is lacking:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I: Claims 1-14, directed to determining/projecting a range for a vehicle utilizing evaluation of a map and a bitmap-based algorithm.

Group II: Claims 15-20, directed to caching of map data by dividing a map area into a set of tiles and associating retrieved data with the tiles.

The groups of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical feature of the Group I invention is determining a projected range of a vehicle, utilizing a map evaluation element adapted to retrieve information regarding a geographic area associated with a position of the vehicle, and determining the projected range of the vehicle utilizing map link evaluation and a bitmap-based algorithm, not required by Group II. (See Fig. 17 & Fig. 27 for example).

The special technical feature of the Group II invention is caching map data for vehicle range projection using a computer system, by retrieving data corresponding to an area of a map, dividing the map area into a set of tiles, and associating a portion of the retrieved data with each tile in the set of tiles, not required by Group I. (See Fig. 32 & Fig. 34 for example).

Groups I-II share the technical features of, in various combination, determining a projected range of a vehicle through retrieval and evaluation of map data.

However, these shared technical features fail to represent a contribution over the prior art of US 2013/0030630 A1 to Luke et al. (hereinafter 'Luke'), which discloses determining a projected range of a vehicle (para [0109] - "controller of the vehicle or the backend system determines the estimated range based at least in part on one or more environmental parameters of an environment in which vehicle is operated at the present time") through retrieval and evaluation of map data (para [0109] - "terrain of the environment may be sensed using one or more accelerometers, gyroscopes, or from mapped information such as topographical information stored in a database or other information structure. Additionally, or alternatively the terrain may be determined based on mapping data, for instance topographic mapping data. Such may allow elevational changes between a present location and one or more destinations to be taken into account when determining an estimated range").

Thus, the inventions listed as Groups I-II lack unity of invention because they do not share a same or corresponding special technical feature providing a contribution over the prior art.