PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 06 MAR 2018

Applicant's or agent's file reference
33632-38719/PCT

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US17/68834	28 December 2017 (28.12.2018)	30 December 2016 (30.12.2016)

International Patent Classification (IPC) or both national classification and IPC
IPC - G05D 1/02; G01C 21/34, 21/32, 21/36, 21/26; G01S 15/89; G06T 15/00 (2018.01)
CPC - G05D 1/0088, 1/02; G01C 21/3617, 21/34, 21/32, 21/26; G01S 15/89; G06T 15/205

Applicant DEEPMAP INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	11 February 2018 (11.02.2018)	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

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Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	10, 19	YES
	Claims	1-9, 11-18, 20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-5, 7, 9, 11-15, 17-18 and 20 lack an inventive step under PCT Article 33(3) as being obvious over US 2013/0321401 A1 to APPLE INC. (hereinafter "Apple") in view of US 2015/0300823 A1 to KAHN, P. et al. (hereinafter "Kahn").

As to claims 1, 11 and 20, Apple discloses a method of caching high-definition map data by an vehicle (caching map tiles (data) including high resolution (high-definition) 3D constructs by a client device including an automobile (vehicle) navigation system; paragraphs [0187], [0310], [0605], [0636], [0681]), a non-transitory computer-readable storage medium with encoded instructions to cache high-definition map data by an vehicle that, when executed by a processor, cause the processor to (non-transitory computer-readable medium storing a mapping application (encoded instructions) to cache map tiles including high resolution 3D constructs for an automobile navigation system, executed on a device by a processing unit; claim 1); and a computer system comprising: an electronic processor; and a non-transitory computer-readable storage medium with encoded instructions to cache high-definition map data by an autonomous vehicle that, when executed by a processor, cause the processor to (a dedicated navigation device (computer system) built into an automobile comprising a non-transitory computer-readable medium storing a mapping application (encoded instructions) to cache map tiles including high resolution 3D constructs for an automobile navigation system, executed on the device by a processing unit; paragraph [0310]; claim 1): sending, by the autonomous vehicle to an online system, information describing a route to be travelled by the autonomous vehicle (sending, by the mobile device 4905 to a mapping service (online system) 4900, a route request for a particular region using latitude/longitude information from a starting location to an ending location (describing a route to be travelled) by the automobile; figure 49; paragraphs [0307], [0314], [0315]), receiving a plurality of compressed map tiles from the online system (receiving compressed map tiles from the mapping service map generator 4935; paragraphs [0182], [0314]), wherein each compressed map tile of the plurality of compressed map tiles comprises a section of the three-dimensional map corresponding to a portion of the route (each compressed map tile represents a portion of the 3D map for rendering areas (portion) along the route; paragraphs [0644], [0693]), decompressing the plurality of compressed map tiles into a plurality of accessible map tiles (decompressing the map tiles to prepare a rendering pipeline (accessible map tiles); paragraphs [0460], [0663]); determining localization data describing a position of the wherein the position corresponds to a first portion of the route (a mapping application receives the current location of the user (determining localization data) and uses the location data to generate the route and transmits instructions for at least a portion of the route; paragraphs [0472], [0692], [0693]); identifying a first accessible map tile corresponding to a current section of the three-dimensional map based in part on the localization data (identifying the map tiles needed (first accessible) for at least a portion of the route from the user's location (corresponding to a current section) of the 3D map based on the current location; paragraphs [0665], [0693]); loading the first accessible map tile in a memory random-access memory (RAM), wherein the RAM memory stores accessible map tiles for utilization in driving the vehicle along the route (a tile processor receiving (loading) the map tiles, where the tile processor comprises a volatile memory, or RAM for rendering areas along the route for driving the automobile; paragraphs [0274], [0636], [0638], [0663], [0693], [0737]); loading a first subset of accessible map tiles in the RAM (the tile processor receiving (loading) the map tiles likely to be used, where the tile processor comprises RAM; paragraphs [0638], [0737]); and accessing the first accessible map tile from the RAM for use in driving the vehicle along the route (receiving the map tiles form the tile processor comprising RAM (accessing) for rendering a 3D map view along the route for driving the automobile during route navigation; paragraphs [0638], [0650]). However, Apple does not disclose an autonomous vehicle; and determining a first subset of accessible map tiles based in part on the localization data, each accessible map tile of the first subset of accessible map tiles corresponding to a second portion of the route that the autonomous vehicle is likely to drive through within a threshold time interval. Kahn discloses an autonomous vehicle (self-navigating vehicle; paragraph [0021]); and determining a first subset of accessible map tiles based in part on the localization data, each accessible map tile of the first subset of accessible map tiles corresponding to a second portion of the route that the autonomous vehicle is likely to drive through within a threshold time interval (downloading map tiles (determining first subset of accessible map tiles) in an extended range (second portion of the route) and using predictive caching, where map tiles comprise points of interest, and the process determines if the user of the self-navigating vehicle is likely to stop at a point of interest whether any point of interest below a time-based threshold; paragraphs [0036], [0096], [0097], [0110]-[0112]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the method, medium and system of Apple to include accessing map tiles for the route the vehicle is likely to drive through within a threshold time, as taught by Kahn, for the benefit of using predictive caching to load needed portions of the map even if a wireless connection is slow or temporarily disconnected.

-***-Continued Within the Next Supplemental Box-***-

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Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claim 19 is objected to under PCT Rule 66.2(a)(iii) as containing the following defect in the form or contents thereof: claim 19, line 6 recites "route is predicts movement", which is a grammatical error. As best understood, claim 19, line 6 will be interpreted as "route predicts movement".

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Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

-***-Continued from Box V: Citations and Explanations-***-
As to claims 2 and 12, Apple and Kahn disclose the method of claim 1, and the medium of claim 11, respectively, and Apple further discloses wherein each section of the three-dimensional map corresponding to a portion of the route overlaps with one or more other sections of the thre•Ł dimensional map which are adjacent to that section (identifying overlapping areas (portions) between different regions (section) of the 3D map and including the overlapping area in the region with the border that preserves the most data border points (adjacent sections); paragraph [0445]).

As to claims 3 and 13, Apple and Kahn disclose the method of claim 1 and the medium of claim 11, respectively, and Apple further discloses wherein receiving a plurality of compressed map tiles from the online system by the autonomous vehicle comprises storing the plurality of compressed map tiles in a first cache memory (caching the map tiles in a first tile cache (accessible) stored in memory; paragraphs [0636], [0663]);

As to claims 4 and 14, Apple and Kahn disclose the method of claim 3 and the medium of claim 13, respectively, and Apple further discloses wherein decompressing the plurality of compressed map tiles into a plurality of accessible map tiles comprises storing the plurality of accessible map tiles in a second cache memory, wherein the accessible map tiles are loaded from the second cache memory into the RAM, wherein the second cache memory has a faster access time than the first cache memory (storing the map tiles in a second tile cache, where the tiles are received (loaded) by the tile processor RAM, where the first tile cash is stored on non-volatile memory and the second tile cache is stored in RAM (has a faster access); paragraphs [0638], [0663], [0737]).

As to claims 5 and 15, Apple and Kahn disclose the method of claim 1 and the medium of claim 11, respectively, and Apple further discloses wherein decompressing the plurality of compressed map tiles into a plurality of accessible map tiles comprises partitioning each accessible map tile into a plurality of sub-sections (decompressing the map tiles to prepare a rendering pipeline (accessible), where tiles are added to a request list to be available for different zoom levels (plurality of sub-sections); paragraphs [0460], [0663], [0666]).

As to claims 7 and 17, Apple and Kahn disclose the method of claim 5 and the medium of claim 15, respectively, and Apple further discloses accessing the first accessible map tile from the RAM for use in driving the autonomous vehicle along the route comprises accessing a sub-section of the first accessible map tile based at least in part on the localization data (a map rendering engine 9825 receives the current location of the user (determining localization data) and uses (based on) the location data to access map tiles form the request list; figure 98; paragraphs [0688], [0692], [0693]).

As to claims 9 and 18, Apple and Kahn disclose the method of claim 1 and the medium of claim 11, respectively, and Apple further discloses wherein determining a first subset of accessible map tiles based in part on the localization data comprises identifying accessible map tiles each having a proximity to the position under a threshold distance (determining (identifying) the 3D map tiles in the first tile cache likely to be used in the near future (first subset of accessible map tiles) based on the user location within a region of a particular (threshold) distance; paragraphs [0646], [0650], [0676]), however, Apple does not disclose the autonomous vehicle. Kahn discloses the autonomous vehicle (self-navigating; paragraph [0021]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the method and medium of Apple to include an autonomous vehicle, as taught by Kahn, for the benefit of applying the automated mapping system to self-driving vehicles to improve the usage of the vehicles.

Claims 6 and 16 lack an inventive step under PCT Article 33(3) as being obvious over Apple in view of Kahn, and further in view of US 2005/0270311 A1 to RASMUSSEN, J. et al. (hereinafter "Rasmussen").

As to claims 6 and 16, Apple and Kahn disclose the method of claim 5 and the medium of claim 15, respectively, however, Apple does not disclose wherein all sub-sections of accessible map tiles are partitioned in a grid with each sub-section indexed with coordinates of the grid. Rasmussen discloses wherein all sub-sections of accessible map tiles are partitioned in a grid with each sub-section indexed with coordinates of the grid (map tiles are assembled (partitioned) into a tile grid and aligned relative to clipping shapes (sub-sections) where each tile grid is assigned (indexed) a coordinate pair relative to the clipping grids; paragraphs [0013], [0097]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the method and medium of Apple to include partitioning map tiles in a grid, as taught by Rasmussen, for the benefit of improving the use of map tile by preparing a grid for each section for faster map loading and improving the user experience..

Claim 8 lacks an inventive step under PCT Article 33(3) as being obvious over Apple in view of Kahn, and further in view of US 2012/0143430 A1 to BROGGI, A. et al. (hereinafter "Broggi").

As to claim 8, Apple and Kahn disclose the method of claim 1, and Apple further discloses wherein determining localization data describing a position of the autonomous vehicle (a mapping application receives the current location of the user (determining localization data) and uses the location data to generate the route and transmits instructions for at least a portion of the route; paragraphs [0472], [0692], [0693]); wherein the position corresponds to a first portion of the route comprises receiving a set of coordinates (receiving longitudinal, altitudinal and latitudinal coordinates in a GPS signal (determining localization data describing a position); paragraph [0142]), however, Apple does not disclose determining the position of the autonomous vehicle by a detection and ranging sensor mounted on the autonomous vehicle. Broggi discloses determining the position of the autonomous vehicle by a detection and ranging sensor mounted on the autonomous vehicle (determining the position of the autonomous vehicle via a LIDAR (detection and ranging) sensor coupled (mounted) to the bumper or roll cage of the autonomous vehicle; figures 7, 8; paragraph [0006]). It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the method of Kahn to include a detection and ranging sensor, as taught by Broggi, for the benefit of detecting obstacles and the vehicle positon for obstacle avoidance in the autonomous vehicle.

-***-Continued Within the Next Supplemental Box-***-

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Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

-***-Continued from Previous Supplemental Box-***-
Claim 10 meets the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest: identifying a lane within the first accessible map tile in which the autonomous vehicle is based on the position of the autonomous vehicle in the first accessible map tile, wherein the lane is associated with one or more accessible map tiles which are potential routes from the lane; and determining the first subset of accessible map tiles based in part on the lane.

In the closest prior art, JP 2012168169 A to HARMAN BECKER AUTOMOTIVE SYSTEM GMBH (hereinafter "Harman") discloses identifying a lane within the first accessible map tile in which the vehicle is based on the position of the vehicle in the first accessible map tile (identifying a lane in the data of a map tile based on the position of the vehicle; page 20, 6th paragraph; page 25, 3rd paragraph); wherein the lane is associated with one or more accessible map tiles which are potential routes from the lane (the lane identified in the map tile is based on a route search (potential routes) from the lane; page 20, 5th and 6th paragraphs).

In additional prior art, Kahn discloses an autonomous vehicle (self-navigating vehicle; paragraph [0021]); and determining a first subset of accessible map tiles (downloading relevant map tiles (determining first subset of accessible map tiles); paragraphs [0036], [0096]).

In additional prior art, Apple discloses determining localization data describing a position of the wherein the position corresponds to a first portion of the route (a mapping application receives the current location of the user (determining localization data) and uses the location data to generate the route and transmits instructions for at least a portion of the route; paragraphs [0472], [0692], [0693]); identifying a first accessible map tile corresponding to a current section of the three-dimensional map based in part on the localization data (identifying the map tiles needed (first accessible) for at least a portion of the route from the user's location (corresponding to a current section) of the 3D map based on the current location; paragraphs [0665], [0693]).

Since Harman, Kahn and Apple fail to disclose identifying a lane within the first accessible map tile in which the autonomous vehicle is based on the position of the autonomous vehicle in the first accessible map tile, wherein the lane is associated with one or more accessible map tiles which are potential routes from the lane; and determining the first subset of accessible map tiles based in part on the lane, it would not have been obvious to one of ordinary skill in the art at the time the invention was made to have employed this method because the references taken solely, or in combination, fail to provide the required limitations, and modification of any complementary combination of the references of record would be impermissible and not provide any advantages over the present application.

Although both autonomous vehicles and caching map tile data in navigation systems are well known in the art, the addition of identifying a lane and determining map tiles to cache based on the location of the autonomous vehicle in a lane, improves upon prior art systems by adding both increased accuracy and prediction of a route in an automated mode, and therefore improving the speed and accuracy of predictively caching needed map tiles for navigation, and would require a complexity beyond the level of ordinary skill, and therefore this claim meets the PCT criteria for patentability.

Claim 19 meets the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest: wherein the predicted route predicts movement of the autonomous vehicle calculated from the autonomous vehicle driving with the velocity after a time interval from the position of the autonomous vehicle.

In the closest prior art, EP 2120014 B1 to RESEARCH IN MOTION LIMITED (hereinafter "RIM") discloses a velocity of the vehicle (velocity of a device in a vehicle; paragraph [0073]) comprising further instructions that, when executed by the processor, cause the processor to (computer readable medium comprising code, which, when loaded into memory and executed on a processor, carry out the method; paragraph [0007]): determine a predicted route based on the localization data (determine a route to a predicted area of interest based on the GPS location (data); paragraphs [0067], [0071]); wherein the predicted route predicts movement of the autonomous vehicle calculated from the vehicle driving with the velocity (the predicted route is based on the velocity of the device in a vehicle; paragraphs [0073], [0080]); and identify accessible map tiles based on the predicted route (predicting map tiles based on areas of interest and predictively downloading map tiles required along the route to the areas of interest; paragraphs [0067], [0071]).

In additional prior art, Kahn discloses an autonomous vehicle (self-navigating vehicle; paragraph [0021]); and determining a first subset of accessible map tiles (downloading relevant map tiles (determining first subset of accessible map tiles); paragraphs [0036], [0096]).

Since RIM and Kahn fail to disclose wherein the predicted route predicts movement of the autonomous vehicle calculated from the autonomous vehicle driving with the velocity after a time interval from the position of the autonomous vehicle, it would not have been obvious to one of ordinary skill in the art at the time the invention was made to have employed this medium, because the references taken solely, or in combination, fail to provide the required limitations, and modification of any complementary combination of the references of record would be impermissible and not provide any advantages over the present application.

Although both autonomous vehicles and caching map tile data in navigation systems are well known in the art, the addition of predicting the route based on the vehicle velocity, improves upon prior art systems by adding both increased accuracy and prediction of a route in an automated mode, and therefore improving the speed and accuracy of predictively caching needed map tiles for navigation, and would require a complexity beyond the level of ordinary skill, and therefore this claim meets the PCT criteria for patentability.

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.