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(54) Title: AUTONOMOUS MAP TRAVERSAL WITH WAYPOINT MATCHING

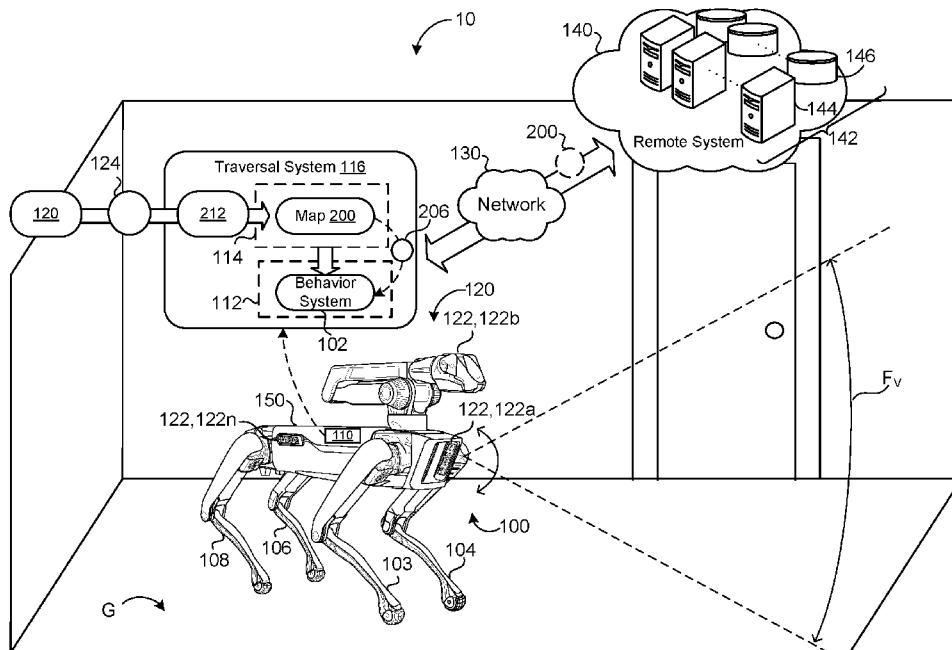


FIG. 1

(57) Abstract: A robot (100) includes a drive system configured to maneuver the robot about an environment (10) and data processing hardware (112) in communication with memory hardware (114) and the drive system. The memory hardware stores instructions that when executed on the data processing hardware cause the data processing hardware to perform operations. The operations include receiving image data (124) of the robot maneuvering in the environment and executing at least one waypoint heuristic (212). The at least one waypoint heuristic is configured to trigger a waypoint placement on a waypoint map (200). In response to triggering the waypoint placement, the operations include recording a waypoint (210) on the waypoint map where the waypoint is associated with at least one waypoint edge (220) and includes sensor data obtained by the robot. The at least one waypoint edge includes a pose transform expressing how to move between two waypoints.



SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
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INTERNATIONAL SEARCH REPORT

International application No PCT/US2019/047804
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A. CLASSIFICATION OF SUBJECT MATTER INV. G05D1/02 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) G05D		
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, 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	US 9 717 387 B1 (SZATMARY BOTOND [US] ET AL) 1 August 2017 (2017-08-01)	1,4,6-9, 11,14, 16-19
Y	column 30, line 50 - column 31, line 42; figure 1b	2,3,5, 12,13,15
Y	----- WO 2007/051972 A1 (QINETIQ LTD [GB]; KAUSHAL TEJ PAUL [GB] ET AL.) 10 May 2007 (2007-05-10) page 14, line 33 - page 15, line 15; figure 1	2,3,5, 12,13,15
A	----- US 8 930 058 B1 (QUIST DONALD G [US] ET AL) 6 January 2015 (2015-01-06) column 4, lines 51-67	1-9, 11-19
A	----- US 2013/231779 A1 (PURKAYASTHA INDRAJIT [US] ET AL) 5 September 2013 (2013-09-05) paragraph [0082]; figures 2-6	1-9, 11-19
<input type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> 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	"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	
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"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)	"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	
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	
"P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search	Date of mailing of the international search report	
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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 Groen, Fokke	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/047804

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.:
1-9, 11-19

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: 1-9, 11-19

method and robot placing waypoint heuristic on a map in memory

2. claims: 10, 20-30

method and robot using ICP algorithm to execute a traversal path from a first way point to a second way point.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/047804

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 9717387	B1	01-08-2017	US 9717387 B1 01-08-2017
			US 2018125319 A1 10-05-2018
			US 2019380551 A1 19-12-2019

WO 2007051972	A1	10-05-2007	NONE

US 8930058	B1	06-01-2015	NONE

US 2013231779	A1	05-09-2013	NONE
