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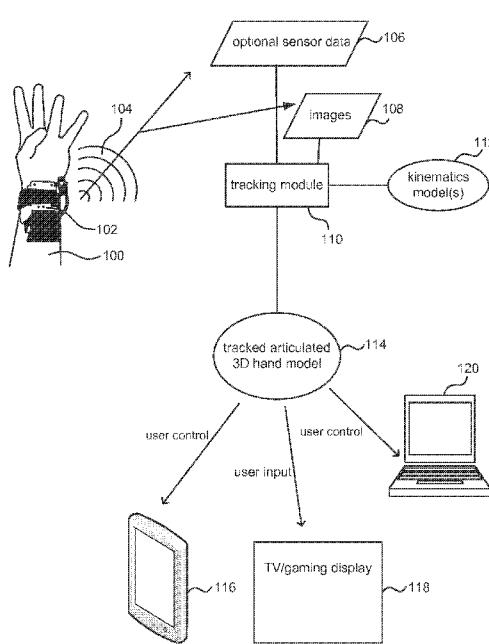
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(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, 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.

[Continued on nextpage]

(54) Title: WEARABLE SENSOR FOR TRACKING ARTICULATED BODY-PARTS



(57) **Abstract:** A wearable sensor for tracking articulated body parts is described such as a wrist-worn device which enables 3D tracking of fingers and optionally also the arm and hand without the need to wear a glove or markers on the hand. In an embodiment a camera captures images of an articulated part of a body of a wearer of the device and an articulated model of the body part is tracked in real time to enable gesture-based control of a separate computing device such as a smart phone, laptop computer or other computing device. In examples the device has a structured illumination source and a diffuse illumination source for illuminating the articulated body part. In some examples an inertial measurement unit is also included in the sensor to enable tracking of the arm and hand.

FIG. 1

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(Hi))

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

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- *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(Hi))

Published:

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- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
9 October 2014

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US20 13/06Q233

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.:

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.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2013/06Q233

A. CLASSIFICATION OF SUBJECT MATTER
 INV. G06F3/Q1 G06F3/03
 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)
 G06F

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	FAROOQ AHMAD ET AL: "Ubi Hand: A wearable input device for 3D Interaction", ACM SIGGRAPH 2006 COURSES ON, SIGGRAPH '06, 30 July 2006 (2006-07-30), page 159, XP055117833, New York, New York, USA DOI : 10.1145/1179622.1179805 ISBN : 978-1-59-593364-5	1,2,4,6, 8-10
Y	the whole document	3,5,7
Y	WO 2008/010024 AI (CHERRADI I [AT]) 24 January 2008 (2008-01-24) paragraph [0081] - paragraph [0115]	3,5,7
		-/-

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

12 August 2014

21/08/2014

Name and mailing address of the ISA/

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Tonet, Oliver

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/06Q233

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>Victor F Pamplona ET AL: "The Image-Based Data Glove" , Proceedings of 10th Symposium on Virtual Reality (SVR '2008) , 13 May 2008 (2008-05-13) , pages 204-211, XP055117974, Retrieved from the Internet: URL: http://vitorpamplona.com/deps/papers/2008_SVR_IBDG.pdf [retrieved on 2014-05-14] the whole document</p> <p>-----</p>	8-10
A	<p>Anonymous: "Ubi Hand: a wearable input device for 3D interaction (biological data)" , 12 June 2014 (2014-06-12) , XP055123029, Retrieved from the Internet: URL: http://dl.acm.org/citation.cfm?doi=1179522.1179805&pref1layout=tabs [retrieved on 2014-06-12] the whole document</p> <p>-----</p>	1-7
L	<p>Anonymous: "Ubi Hand: a wearable input device for 3D interaction (biological data)" , 12 June 2014 (2014-06-12) , XP055123029, Retrieved from the Internet: URL: http://dl.acm.org/citation.cfm?doi=1179522.1179805&pref1layout=tabs [retrieved on 2014-06-12] the whole document</p> <p>-----</p>	1-10
A	<p>US 8 228 315 B1 (STARNER THAD EUGENE [US] ET AL) 24 July 2012 (2012-07-24) column 1, paragraph 1 - column 8, paragraph 35</p> <p>-----</p>	8-10
T	<p>DAVID KIM ET AL: "Digits: Freehand 3D interactions anywhere using a wrist-worn gloveless sensor" , PROCEEDINGS OF THE 25TH ANNUAL ACM SYMPOSIUM ON USER INTERFACE SOFTWARE AND TECHNOLOGY, UIST '12, 7 October 2012 (2012-10-07) , pages 167-175, XP055114035 , New York, New York, USA DOI : 10.1145/2380116.2380139 ISBN : 978-1-45-031580-7</p> <p>-----</p>	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/06Q233

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008010024 A1	24-01-2008	AT 543132 T EP 2041640 A1 US 2009322673 A1 WO 2008010024 A1	15-02-2012 01-04-2009 31-12-2009 24-01-2008
US 8228315 B1	24-07-2012	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-7

wearable sensing device for markerless gesture-based control of a computing device

2. claims: 8-10

tracking a 3D articulated model of an articulated body part illuminated with structured and diffuse illumination
