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(71) Applicant: **NORTHEASTERN UNIVERSITY** [US/US]; 360 Huntington Avenue, Boston, MA 021 15 (US).

(72) Inventors: **SRINIVAS, Sridhar;** 41 Esty Farm Road, Newton, MA 02459 (US). **YURY, Petrov;** 7 Orchard Avenue, Wakefield, MA 01880 (US). **OZGUR, Yavuzcetin;** 338 Grove Street, Fort Atkinson, WI 53538 (US). **KAUSHIK, Chowdhury;** 65 E. India Row, Apt. 22h, Boston, MA 021 10 (US).

(74) Agents: **HJORTH, Beverly, E.** et al; Mclane, Graf, Raulerson & Middleton, PA, 300 Tradecenter, Suite 7000, Woburn, MA 01801 (US).

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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(in))*

— *of inventorship (Rule 4.17(iv))*

[Continued on next page]

(54) Title: SENSOR SYSTEM FOR MEASURING BRAIN ELECTRIC ACTIVITY

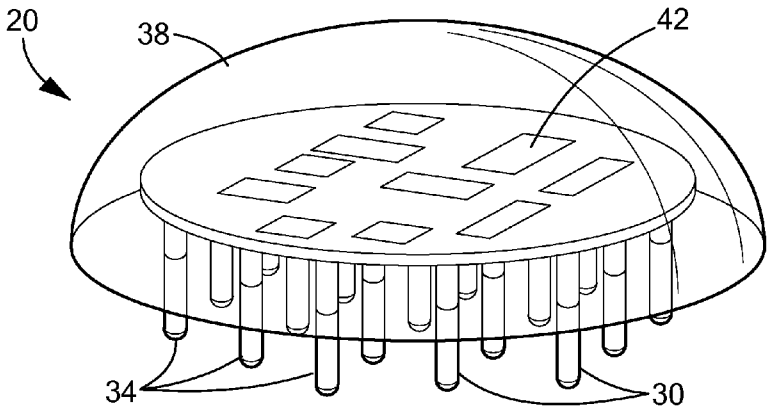

FIG. 1

(57) Abstract: A sensor system and process for measuring electromagnetic activity of a brain are provided. The system and process employ a sensor assembly having a plurality of electrodes arranged in a closely spaced arrangement and a processor to determine a weighted average of the signals indicative of an electric field generated by electromagnetic activity of the brain. The system provides a medical body area network of a subject including one or more of the sensor assemblies and one or more additional sensors, which may be within a smartphone or other wearable device.

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— *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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19 February 2015

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 14/43425

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 5/048 (2014.01)
CPC - A61B 5/0478
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)
IPC(8): 5/0408, 5/048, 18/14; G01R 29/08; G06F 3/01, 7/70 (2014.01); CPC: A61B 4/04008, 5/0408, 5/0478, 18/14, 2018/167; G01R 29/0814; G06F 3/015, 7/70; H03F 1/10; USPC: 324/348, 688; 370/234; 600/383, 545

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)
MicroPatent (US-G, US-A, EP-A, EP-B, WO, JP-bib, DE-C,B, DE-A, DE-T, DE-U, GB-A, FR-A); Google Scholar; ProQuest; IP.com; Google; brain, scalp, cranial, electromagnetic, electroencephalography, eeg, reference, ground, electrode, amplifier, signal, weight, arithmetic, average, mean, array, arrangement, set, pattern, microcontroller, processor, sense, measure, electric field, plate, cap

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2003/0204148 A1 (LANGE, DH et al.) 30 October 2003; figures 5-6, 9; paragraphs [0020], [0028], [0033], [0035], [0067], [0071]-[0073], [0081], [0091], [0095], [0099], [0148], [0197]	1-3, 5-16, 33-50
Y	US 3,565,060 A (SIPPLE, WC) 23 February 1971; column 1, lines 42-48; column 2, lines 5-6; claim 1	1-3, 5-16, 33-50
Y	KAHANE, LH et al. 'Regression Basics Chapter 2: The Least-Squares Estimation Method.' Second Edition. Sage Publications, Inc. 2008; page 17, first paragraph; page 19, equation 2.3a [Retrieved on 16.10.2014] Retrieved from the Internet: <URL: http://www.sagepub.com/upm-data/17668_Chapter2.pdf>	2
Y	US 2011/0190625 A1 (HARLEV, D et al.) 4 August 2011; paragraphs [0005], [0017], [0020], [0098], (0260]	3
Y	US 4,791,593 A (HENNION, B) 13 December 1988; column 1, lines 50-56; column 3, lines 6-11; column 4, lines 45-49; column 5, lines 43-47	5
Y	US 2010/0145176 A1 (HIMES, DM) 10 June 2010; paragraphs [0005], [0014], [0056]	8, 10
Y	US 2012/0316459 A1 (ABREU, MM) 13 December 2012; paragraphs [0004], [0013], [02591, [0261], [0265], [0273], [0429], [0449]	11, 13
Y	US 5,613,495 A (MILLS, GN et al.) 25 March 1997; figure 2; column 2, lines 7-8, lines 17-19, lines 24-25; column 3, lines 12-16; column 4, lines 39-40; column 8, lines 33-36; claim 1	12
Y	US 2013/0009783 A1 (TRAN, B) 10 January 2013; paragraphs [0004], [0021], [0042], [0077] [0146H0147]	37/33-44

☒ 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	Date of mailing of the international search report
16 October 2014 (16.10.2014)	22 DEC 2014

Name and mailing address of the ISA/US	Authorized officer.
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,148,149 A (CAMPBELL, DJ et al.) 15 September 1992; column 1, lines 34-36; column 2, lines 36-42; column 4, lines 33-34, lines 53-57, lines 61-63	46
Y	US 6,449,461 B 1 (OTTEN, DDS) 10 September 2002; column 1, lines 38-39; column 2, lines 11-17; column 3, lines 13-18, lines 28-30, lines 36-40; column 7, lines 8-9	48
A	US 2010/0100153 A 1 (CARLSON, D et al.) 22 April 2010; paragraph [0038], [0068], [0076], [0127]	4
A	US 2010/01 13961 A 1 (OHLANDER, M et al.) 6 May 2010; paragraphs [001 1], [0017], [0040]	4
A	US 2003/0093129 A 1 (N!COLEUS, MAL et al.) 15 May 2003; entire document	1
A	US 2007/0250134 A 1 (MIESEL, KA et al.) 25 October 2007; entire document	1
A	US 2004/01581 19 A 1 (OSORIO, I et al.) 12 August 2004; entire document	1
A	US 2013/0138010 A 1 (PERSYST DEVELOPMENT CORPORATION) 30 May 2013; entire document	1

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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.: 30
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. Ill 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:

Group I: Claims 1-16 and 33-50 are directed toward a sensor assembly for measuring electromagnetic activity of a brain of a subject with a plurality of amplifiers arranged on the second side of the support plate.

Group II: Claims 17-29 and 31-32 are directed toward a method for measuring electric activity with a further reference electrode spaced remotely from the plurality of electrodes.

-*" - Continued on 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.:
1-16, 33-50

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/US14/43425

-"'-Continued from Box III - Observations where unity of invention is lacking-" *-

The inventions listed as Groups I-II 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 features of Group I include a support plate having first and second sides; a plurality of electrodes protruding from the first side of the support plate; a plurality of amplifiers arranged on the second side of the support plate; each amplifier to receive signals from the associated ones of the electrodes indicative of electric field activity of the brain; and a microcontroller in communication with the amplifiers to receive signals from the amplifiers, which are not present in Group II; the special technical features of Group II include defining a further reference electrode spaced remotely from the plurality of electrodes; switching between measuring a potential difference between active electrodes of the plurality of electrodes and the first reference electrode and measuring a potential difference between each of the plurality of electrodes and the further electrode, which are not present in Group I.

The common technical features of Groups I and II are a plurality of electrodes in an arrangement on a scalp; each of the electrodes in electrical communication with an associated amplifier; one of the plurality of electrodes comprising a reference electrode; determining a weighted average of the potential differences, the weighted average indicative of electrical activity of the brain.

These common technical features are disclosed by US 2003/0204148 A1 to Lange, et al. (hereinafter 'Lange'). Lange discloses a plurality of electrodes in an arrangement on a scalp (sensor strip 30 has three electrodes 32, 34, 36 that contact the subject's forehead skin surface (scalp); figures 5-6, 9; paragraphs [0072], [0095]); each of the electrodes in electrical communication with an associated amplifier (a preamplifier proximal to each electrode amplifies an electrical activity signal from the electrode on the subject's forehead; paragraphs [0020], [0035], [0081]); one of the plurality of electrodes comprising a reference electrode (a reference electrode; paragraph [0072]); determining a weighted average of the potential differences, the weighted average indicative of electrical activity of the brain (the integrated circuit processor calculates a weighted average of the signal; analyzing bioelectrical signals to generate a set of electrical or electromagnetic activity measurements of a subject's forehead (brain); paragraphs [0067], [0072], [0081], [0099], [0148], [0197]).

Since the common technical features are previously disclosed by the Lange reference, the common features are not special and so Groups I and II lack unity.