

PATENT COOPERATION TREATY

From the INTERNATIONAL PRELIMINARY EXAMINING
AUTHORITY

To:

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PCT

NOTIFICATION OF TRANSMITTAL OF
INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY (CHAPTER II OF
THE PATENT COOPERATION TREATY)

(PCT Rule 71.1)

Date of mailing
(day/month/year)

19 JUL 2019

Applicant's or agent's file reference

IMPORTANT NOTIFICATION

International application No.
PCT/US2018/031368

International filing date
(day/month/year) **07 May 2018
(07.05.2018)**

Priority date
(day/month/year)

Applicant

VERIDIUM IP LIMITED

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the *PCT Applicant's Guide*.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed invention is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the IPEA/US

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/US2018/031368	International filing date (day/month/year) 07 May 2018 (07.05.2018)	Priority date (day/month/year)	
International Patent Classification (IPC) or both national classification and IPC IPC: G06F 7/483, 21/32; G06K 9/62, 9/46, 9/00; G06N 3/04 CPC: G06F 7/483; G06K 9/6273; G06K 9/4628; G06K 9/00288; G06F 21/32; G06N 3/04; G06F 2221/2107			
Applicant VERIDIUM LIMITED			

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:

- a. ☒ (sent to the applicant and to the International Bureau) a total of _____ sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions).
 - ☐ sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4bis, 70.2(e), 70.16 and 91.2).
 - ☐ superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)).
- b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____ containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3ter of Annex C of the Administrative Instructions).

4. This report contains indications relating to the following items:

- ☒ Box No. I Basis of the report
- ☐ 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 Article 35(2) 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

Date of submission of the demand 11 March 2019 (11.03.2019)	Date of completion of this report 03 July 2019 (03.07.2019)
Name and mailing address of the IPEA/US COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: IPEA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA	Authorized officer BHAVESH MEHTA
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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/US2018/031368

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:
- ☒ 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))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a) and (b))
2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:
- ☐ the international application as originally filed/furnished, or
- ☒ the description:
- pages 1-20 as originally filed/furnished.
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☒ the claims:
- Nos. _____ as originally filed/furnished.
- Nos.* _____ as amended (together with any statement) under Article 19
- Nos.* 1-20 received by this Authority on 11 March 2019 (11.03.2019)
- ☒ the drawings:
- pages 1-8 as originally filed/furnished.
- pages* _____ received by this Authority on _____
- pages* _____ received by this Authority on _____
- ☐ a sequence listing - see Supplemental Box Relating to Sequence Listing.
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-bis)):
- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
5. ☐ This report has been established:
- ☐ taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-bis) and 70.2(e)).
- ☐ without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4bis and 70.2(e)).
6. With regard to top-up searches (Rules 66.1ter and 70.2(f)):
- ☒ A top-up search was carried out by this Authority on 03 July 2019 (03.07.2019)
- ☐ Additional relevant documents have been discovered during the top-up search.
- ☐ No top-up search was carried out by this Authority because it would serve no useful purpose.
7. ☐ Supplementary international search report(s) from Authority(ies) _____ has/ have been received and taken into account in establishing this report (Rule 45bis.8(b) and (c)).

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/US2018/031368

Box No. V

Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims		NO
Inventive step (IS)	Claims	1-20	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

----- NEW CITATIONS -----

US 20170104752 A1 (SAKEMI, YUMI) 13 April 2017 (13.04.2017) , paragraphs 29-44

----- EXPLANATION -----

Claims 1-20 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest: classifying the Euclidian measurable feature vector; and/or classifying the current Euclidian measurable feature vector, wherein the classifying is performed at least in part using one or more distance functions; and conducting a search of at least some of the stored Euclidian measurable feature vectors in a portion of the data storage using the current Euclidian measurable feature vector, wherein the encrypted biometric input record is matched with at least one encrypted biometric record in encrypted space as a function of an absolute distance computed between the current Euclidian measurable feature vector and a calculation of each of the respective Euclidian measurable feature vectors in the portion of the storage, wherein classifying the Euclidian measurable feature and/or the current Euclidian measurable feature vector returns floating point values, and a Frobenius algorithm is utilized to compute an absolute distance between each floating point and its average.

Claims 1-20 the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

PCT/US18/31368 11 March 2019 (11.03.2019)

CLAIMS UNDER ARTICLE 34
REPLACEMENT SHEETDocket No.: 10141/005405-WO0
PCT/US18/31368

What is Claimed:

1. A computer implemented method for matching an encrypted biometric input record with at least one stored encrypted biometric record, without data decryption of the input and the at least one stored record, the method comprising:
 - providing an initial biometric vector to a neural network, wherein the neural network translates the initial biometric vector to a Euclidian measurable feature vector;
 - storing the Euclidian measurable feature vector in a storage with other Euclidian measurable feature vectors;
 - classifying the Euclidian measurable feature vector; and/or classifying the current Euclidian measurable feature vector, wherein the classifying is performed at least in part using one or more distance functions;
 - receiving, from a mobile computing device over a data communication network, a current biometric vector representing the encrypted biometric input record;
 - providing the current biometric vector to the neural network, wherein the neural network translates the current biometric vector to a current Euclidian measurable feature vector; and
 - conducting a search of at least some of the stored Euclidian measurable feature vectors in a portion of the data storage using the current Euclidian measurable feature vector, wherein the encrypted biometric input record is matched with at least one encrypted biometric record in encrypted space as a function of an absolute distance computed between the current Euclidian measurable feature vector and a calculation of each of the respective Euclidian measurable feature vectors in the portion of the storage, wherein classifying the Euclidian measurable feature and/or the current Euclidian measurable feature vector returns floating point values, and a Frobenius algorithm is utilized to compute an absolute distance between each floating point and its average.
2. The method of claim 1, wherein the search is conducted in Order $\log(n)$ time.
3. The method of claim 1, further comprising:
 - using a Frobenius algorithm to classify the Euclidian measurable biometric vectors;

PCT/US18/31368 11 March 2019 (11.03.2019)

CLAIMS UNDER ARTICLE 34
REPLACEMENT SHEETDocket No.: 10141/005405-WO0
PCT/US18/31368

traversing a hierarchy of the classified Euclidian measurable biometric vectors in
Order $\log(n)$ time; and

identifying that a respective Euclidian measurable biometric vector is the current
Euclidian measurable feature vector.

5

4. The method of claim 1, further comprising:

identifying, for each respective Euclidian measurable biometric vector, a plurality of
floating point values; and

using a bitmap to eliminate from an absolute distances calculation any of the plurality
10 of values that are not present in every vector.

5. The method of claim 1, further comprising:

identifying, for each respective Euclidian measurable biometric vector, a plurality of
floating point values; and

15 defining a sliding scale of importance based on the number of vectors a respective one
of the floating point value appears.

6. The method of claim 1, wherein the neural network is configured with a
variety of convolutional layers, together with a rectifier (ReLU) and pooling nodes.

20

7. The method of claim 1, wherein the neural network is configured to use
pooling as a form of non-linear down-sampling,

and further wherein one or more pooling nodes progressively reduce the spatial size
of a represented Euclidean-measurable feature vector to reduce the amount of parameters and
25 computation in the neural network.

8. The method of claim 6, further comprising:

computing, for each of a plurality of stored Euclidian measurable feature vectors, a
relative position difference between an average face vector and the respective Euclidian
30 measurable feature vector;

squaring the relative position difference;

PCT/US18/31368 11 March 2019 (11.03.2019)

CLAIMS UNDER ARTICLE 34
REPLACEMENT SHEETDocket No.: 10141/005405-WO0
PCT/US18/31368

summing the values; and
calculating the square root.

5 9. The method of claim 1, wherein performance of the neural network is determined as a function of a cost function, in which a number of layers given as a spatial size of an output volume is computed as a function of an input volume size W, a kernel field size of layer neurons K, a stride with which the layers are applied S, and an amount of zero padding P used on a border.

10 10. The method of claim 1, wherein the neural network translates the initial biometric vector and the current biometric vector as a function of matrix multiplications for each respective layer, and uses a Euclidean distance algorithm based on a Euclidean cost function.

15 11. A computer implemented system for matching an encrypted biometric input record with at least one stored encrypted biometric record, without data decryption of the input and the at least one stored record, the system comprising:

 one or more processors and a computer-readable medium, wherein the one or more processors are configured to interact with the computer-readable medium in
20 order to perform operations that include:

 providing an initial biometric vector to a neural network, wherein the neural network translates the initial biometric vector to a Euclidian measurable feature vector;

 storing the Euclidian measurable feature vector in a storage with other Euclidian measurable feature vectors;

25 receiving, from a mobile computing device over a data communication network, a current biometric vector representing the encrypted biometric input record;

 classifying the Euclidian measurable feature vector; and/or classifying the current Euclidian measurable feature vector, wherein the classifying is performed at least in part using one or more distance functions;

PCT/US18/31368 11 March 2019 (11.03.2019)

CLAIMS UNDER ARTICLE 34
REPLACEMENT SHEETDocket No.: 10141/005405-WO0
PCT/US18/31368

providing the current biometric vector to the neural network, wherein the neural network translates the current biometric vector to a current Euclidian measurable feature vector; and

- conducting a search of at least some of the stored Euclidian measurable feature vectors in a portion of the data storage using the current Euclidian measurable feature vector, wherein the encrypted biometric input record is matched with at least one encrypted biometric record in encrypted space as a function of an absolute distance computed between the current Euclidian measurable feature vector and a calculation of each of the respective Euclidian measurable feature vectors in the portion of the storage,
- wherein classifying the Euclidian measurable feature and/or the current Euclidian measurable feature vector returns floating point values, and a Frobenius algorithm is utilized to compute an absolute distance between each floating point and its average.

12. The system of claim 11, wherein the search is conducted in Order $\log(n)$ time.

13. The system of claim 11, wherein the one or more processors are configured to interact with the computer-readable medium in order to perform operations that include:

using a Frobenius algorithm to classify the Euclidian measurable biometric vectors;

traversing a hierarchy of the classified Euclidian measurable biometric vectors in Order $\log(n)$ time; and

identifying that a respective Euclidian measurable biometric vector is the current Euclidian measurable feature vector.

14. The system of claim 11, wherein the one or more processors are configured to interact with the computer-readable medium in order to perform operations that include:

identifying, for each respective Euclidian measurable biometric vector, a plurality of floating point values; and

using a bitmap to eliminate from an absolute distances calculation any of the plurality of values that are not present in every vector.

CLAIMS UNDER ARTICLE 34
REPLACEMENT SHEET

Docket No.: 10141/005405-WOO
PCT/US18/31368

15. The system of claim 11, wherein the one or more processors are configured to interact with the computer-readable medium in order to perform operations that include:

identifying, for each respective Euclidian measurable biometric vector, a plurality of floating point values; and

5 defining a sliding scale of importance based on the number of vectors a respective one of the floating point value appears.

16. The system of claim 11, wherein the neural network is configured with a variety of convolutional layers, together with a rectifier (ReLU) and pooling nodes.

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17. The system of claim 11, wherein the neural network is configured to use pooling as a form of non-linear down-sampling,

and further wherein one or more pooling nodes progressively reduce the spatial size of a represented Euclidean-measurable feature vector to reduce the amount of parameters and
15 computation in the neural network.

18. The system of claim 15, wherein the one or more processors are configured to interact with the computer-readable medium in order to perform operations that include:

20 computing, for each of a plurality of stored Euclidian measurable feature vectors, a relative position difference between an average face vector and the respective Euclidian measurable feature vector;

squaring the relative position difference;

summing the values; and

calculating the square root.

25

19. The system of claim 11, wherein performance of the neural network is determined as a function of a cost function, in which a number of layers given as a spatial size of an output volume is computed as a function of an input volume size W, a kernel field size of layer neurons K, a stride with which the layers are applied S, and an amount of zero
30 padding P used on a border.

PCT/US18/31368 11 March 2019 (11.03.2019)

**CLAIMS UNDER ARTICLE 34
REPLACEMENT SHEET**

Docket No.: 10141/005405-WO0
PCT/US18/31368

20. The system of claim 11, wherein the neural network translates the initial biometric vector and the current biometric vector as a function of matrix multiplications for each respective layer, and uses a Euclidean distance algorithm based on a Euclidean cost function.

5

11 March 2019 (11.03.2019)
LEASON ELLIS

March 11, 2019

Reference No.: 10141/005405-WO0

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RE: International Application No. PCT/US18/31368
International Filing Date: 07 May 2018
For: SYSTEM AND METHOD FOR BIOMETRIC IDENTIFICATION
Attorney Docket No. 10141/005405-WO0

COMMUNICATION UNDER PCT ARTICLE 34

Sir:

This is in response to the Written Opinion mailed 23 July 2018, in connection with the above-identified International Application. Submitted herewith is a Demand under Chapter II for further examination of this application, together with an Amendment under Article 34 and remarks in support of a favorable International Preliminary Report on Patentability Ch. II.

In accordance with PCT Article 34, certain remarks (with respect to the amended independent claims now pending) are provided in response to the Written Opinion, but no remarks are made in regard to the laws of patentability of any jurisdiction, including the United States.

International Application No. PCT/US18/31368
Date: March 11, 2019

Remarks

Status of Claims

Claims 1-24 were originally filed.

Claims 1-24 stand as possessing novelty.

Claims 1-24 stand as having industrial applicability.

Claims 1-3, 6, 8-10, 12-15, 18, 20-22, and 24 stand as lacking inventive step.

“Vein Patterns as Bio-Metric Identifier using Euclidean Distance” by Aeri et al. (hereinafter “Aeri”), U.S. 2016/0373440 to Hoyos Labs IP Ltd., U.S. 5,161,204 to Hutcheson et al., U.S. 2015/0278642 to Superfish Ltd., and U.S. 2012/0314974 to Yang are cited in the International Search Report and Written Opinion.

Identification of Claim Amendments

Claim 1 has been amended and replaces original claim 1, as filed.

Claims 2-3 are canceled.

Claim 4-5 have been amended and renumbered as claims 2-3.

Claims 6-9 are unchanged and have been renumbered as claims 4-7.

Claim 10 has been amended and renumbered as claim 8.

Claims 11-12 are unchanged and have been renumbered as claims 9-10.

Claim 13 has been amended and renumbered as claim 11 and replaces original claim 13.

Claims 14-15 are canceled.

Claims 16-24 have been amended and renumbered as claims 12-20.

Basis of Claim Amendments

The basis for the amendment to claim 1 can be found in originally filed claims 2 and 3, as well as paragraphs [0005], [0006], [0007], [0065], [0071], and [0074].

Claims 2-3 have been canceled.

Claims 4-5 have been renumbered as claims 2-3.

Claims 6-9 have been renumbered as claims 4-7.

Claim 10 has been renumbered as claim 8.

Claims 11-12 have been renumbered as claims 9-10.

The basis for the amendment to originally filed claim 13 (now claim 11) can be found in originally filed claims 14 and 15, as well as paragraphs [0005], [0006], [0007], [0065], [0071], and [0074].

International Application No. PCT/US18/31368
Date: March 11, 2019

Claims 14-15 have been canceled.

Claims 16-24 have been renumbered as claims 12-20.

No new matter has been added.

Lack of Inventive Step

In the Written Opinion of the International Searching Authority, originally filed claims 1-3, 6, 8-10, 12-15, 18, 20-22, and 24 stand as lacking Inventive Step under PCT Article 33(3).

Independent claims 1 and 13, now claims 1 and 11, have been amended to include features of originally filed dependent claims 2 and 3, and 14 and 15, respectively. Applicant respectfully submits that claims 1 and 11, as amended herein, recite a combination of features that define inventive step (as well as novelty and industrial applicability), including in view of the cited prior art. Moreover, each of claims 2-10 and 12-20, which depends directly or indirectly from independent claim 1 or 11, respectively, similarly have inventive step for at least the same reasons, including in connection with the combination of features set forth in each of the claims with the features set forth in the base claim(s) from which it depends.

More particularly, features that were set forth in originally filed claims 3 and 15 are included in amended independent claims 1 and 11, which contribute to a determination that claims 1 and 11 possess inventive step. Applicant respectfully submits that U.S. 2012/0314974 to Yang, which is cited in the Search Report against originally filed claims 3 and 15, does not teach or suggest the features included in claims 1 and 11, including classifying the “Euclidian measurable feature vector” and/or the “current Euclidian measurable feature vector,” which returns “floating point values”, and that a Frobenius algorithm is used to compute “an absolute distance between each floating point and its average.” Accordingly, since features of applicant’s amended independent claims 1 and 11 are missing from the cited prior art, applicant’s amended independent claims 1 and 11 possess inventive step, as well as novelty and industrial applicability.

Furthermore, each of claims 2-10 and 12-20, which depends directly or indirectly from independent claim 1 or 11 respectively, similarly have inventive step (and novelty and industrial applicability) for at least the same reasons, including in connection with the combination of features set forth in each of the claims with the features set forth in the base claim(s) from which it depends.

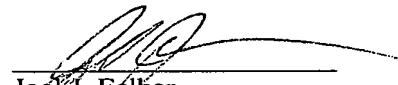
International Application No. PCT/US18/31368
Date: March 11, 2019

Reconsideration is respectfully requested.

Conclusion

Therefore, and in view of the amendments and remarks set forth herein, Applicant submits that all claims possess novelty and inventive step over the art of record, and further request reconsideration in view of the accompanying Demand.

Respectfully submitted,



Joel J. Felber
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Attorney for Applicant