

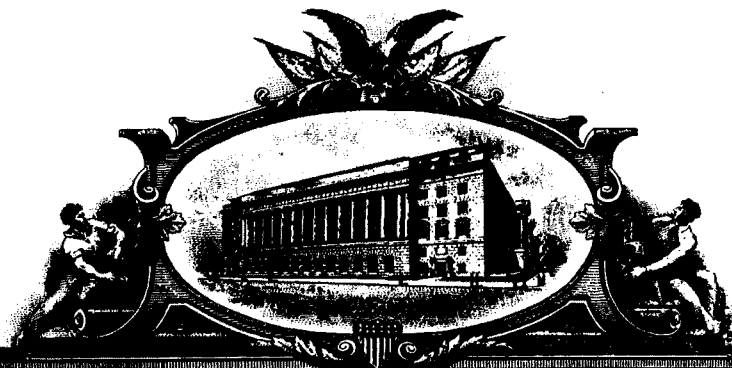


DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

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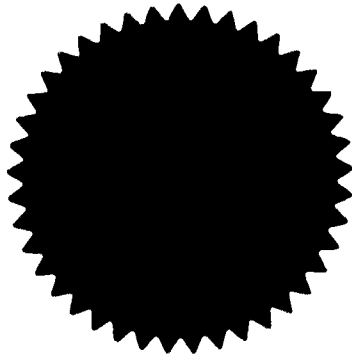
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APPLICATION NUMBER: 63/479,349

FILING DATE: *January 10, 2023*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY
APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS
CONVENTION, IS US 63/479,349

By Authority of the
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Paula Smith
Certifying Officer

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APPLICATION #
63/479,349

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Title of Invention

Efficient Geolocation

Application Information

APPLICATION TYPE
Utility - Provisional Application under
35 USC 111(b)

PATENT #
-

CONFIRMATION #
3198

FILED BY
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PATENT CENTER #
61417777

FILING DATE
-

CUSTOMER #
94289

FIRST NAMED INVENTOR
Duc Tri Tran

CORRESPONDENCE ADDRESS
-

AUTHORIZED BY
-

Documents

TOTAL DOCUMENTS: 4

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
ABS109PROV-CovSht.pdf	3	Provisional Cover Sheet (SB16)	306 KB
Warning: The attached file contains comments or annotations. Comments are not recommended and may cause processing problems with the document. This is not a USPTO supplied Provisional Cover Sheet fillable form. Data in the form cannot be automatically loaded to other USPTO systems.			
ABS109PROV-Spec02.pdf	4	-	50 KB
ABS109PROV-Spec02-SPEC.pdf	(1-3) 3	Specification	46 KB
ABS109PROV-Spec02-ABST.pdf	(4-4) 1	Abstract	27 KB

ABS109PROV-Figs02.pdf	1	Drawings-only black and white line drawings	196 KB
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Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
ABS109PROV-CovSht.pdf	57598CD1279DA772ACC1E0C0A2AA88595B59BBDA915425881 8B10437CA4112EB8A53F81C72F68501993D2AABB2E002EF448 87200292662117E206DB82AB86CC5
ABS109PROV-Spec02.pdf	B4E3687E2A0AA43AE0BAAC970C2024562F0BD7B09B763D523 E1563C040CBCFE321C129B7395CD51F63E9DC6ECB0605E5C CA053517E37BCB7EA6ED81D6BDDBF30
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PTO/SB/16 (10-20)

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 1 of 2

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

Priority Mail Express® Label No. _____

INVENTOR(S)		
Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Duc Tri	Tran	Ho Chi Minh City, Vietnam
Quoc Thai Duong	Nguyen	Ho Chi Minh City, Vietnam
Thi Tuyet Suong	Bui	Ho Chi Minh City, Vietnam

Additional inventors are being named on the _____ separately numbered sheets attached hereto.

TITLE OF THE INVENTION (500 characters max):

Efficient Geolocation

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

☒ The address corresponding to Customer Number: 94289

OR

☐ Firm or
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Address

City	State	Zip
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ENCLOSED APPLICATION PARTS (check all that apply)

☐ Application Data Sheet. See 37 CFR 1.76. ☐ CD(s), Number of CDs _____

☒ Drawing(s) Number of Sheets 1 ☐ Other (specify) _____

☒ Specification (e.g., description of the invention) Number of Pages 4

Fees Due: Filing Fee of \$300 (\$150 for small entity) (\$75 for micro entity). If the specification and drawings exceed 100 sheets of paper, an application size fee is also due, which is \$420 (\$210 for small entity) (\$105 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

METHOD OF PAYMENT OF THE FILING FEE AND APPLICATION SIZE FEE FOR THIS PROVISIONAL APPLICATION FOR PATENT

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Applicant must attach form PTO/SB/15A or Bor equivalent.

☐ A check or money order made payable to the *Director of the United States Patent and Trademark Office* is enclosed to cover the filing fee and application size fee (if applicable).

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☐ The Director is hereby authorized to charge the filing fee and application size fee (if applicable) or credit any overpayment to Deposit Account Number: _____

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET – Page 2 of 2

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government. (NOTE: Providing this information on a provisional cover sheet, such as this Provisional Application for Patent Cover Sheet (Form PTO/SB/16), does not satisfy the requirement of 35 U.S.C. 202(c)(6), which requires that the *specification* contain a statement specifying that the invention was made with Government support and that the Government has certain rights in the invention.)

☒ No.

☐ Yes, the invention was made by an agency of the U.S. Government. The U.S. Government agency name is:

☐ Yes, the invention was made under a contract with an agency of the U.S. Government.

The contract number is: _____

The U.S. Government agency name is: _____

In accordance with 35 U.S.C. 202(c)(6) and 37 CFR 401.14(f)(4), the specifications of any United States patent applications and any patent issuing thereon covering the invention, including the enclosed provisional application, must state the following:

“This invention was made with government support under [IDENTIFY THE CONTRACT] awarded by [IDENTIFY THE FEDERAL AGENCY]. The government has certain rights in the invention.”

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SIGNATURE /DGLoveland/ DATE Jan 10, 2023
TYPED OR PRINTED NAME DAMIEN G LOVELAND REGISTRATION NO. 75635
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EFFICIENT GEOLOCATION

TECHNICAL FIELD

[0001] The present disclosure relates to geolocation of an electronic device. In particular, it relates to the use of BSSID (Basic Service Set Identifier) data.

BACKGROUND

[0002] Geolocation services may use a third party API (Application Programming Interface) to resolve a mobile device's location using detected BSSIDs or MAC (Media Access Control) addresses. Fleets of mobile devices may need to make hundreds of millions or even billions of API requests annually. The number of API requests increases as the fleets grow and as more location-sensitive features are added to services that manage the devices.

[0003] Typically, a device's locations are stored in a database. The locations are only used for single device itself.

SUMMARY

[0004] The inventors have recognized a way of using the geolocation data more efficiently. Device location histories are queried efficiently, in a collection that has a large number of documents. A query is made in the database location history of the device to see if there is any location that satisfies some criteria, such as: are there a certain number of access points that overlap with a current list of access points, same public IP, and so on. A potential benefit of embodiments of the invention is that they may reduce the cost of resolving locations.

DESCRIPTION

Glossary

[0005] Access point: a device that creates a wireless local area network, or WLAN, usually in an office or large building.

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[0006] API - application programming interface

[0007] BSSID: Basic Service Set Identifier. Basically, BSSID and MAC address are the same thing, and both refer to a device's identity on a network. BSSID is used more regarding devices that provide a connection to a network. So, in the context of this document, it is preferable to use BSSID instead of MAC address.

[0008] MAC address: A Media Access Control address is a unique ID of an access point or a device, e.g. 00:0C:E6:02:37:F8

[0009] WLAN: Wireless local area network.

Exemplary Embodiment

[0010] One embodiment involves looking up and finding one document in the location history database that has an Access Point list that overlaps with at least 3 items (that is, 3 access points that are currently detected by the device). If found, then we reuse the location recorded in that document without calling a geolocation API. However, as the size of the geolocation history collection is usually huge, we have a way to return the result in a minimum response time.

[0011] One approach involves storing the geolocation history records in a new collection with an identification (`_id`) that is the combination of 3 BSSIDs. In order to make sure that the identification is unique among 3 BSSIDs, we have to sort the BSSIDs into a list first.

[0012] FIG. 1 shows a group of BSSIDs detected for a given longitude and latitude. The BSSIDs are then sorted into numerical order. Combinations of them are made, where there are 3 BSSIDs in each combination. Each combination is related to the specific longitude and latitude and stored in the database, each combination in a separate document. Later, when the same device, or another device, detects three BSSIDs that have a combined document entry in the database, the corresponding longitude and latitude can be retrieved from the document without having to call a geolocation API.

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[0013] TABLE 1 shows results of an exemplary database, e.g. in Collection:

LocationByWifiMacAddress

Number of documents	490,510,900
Size	45.1GB
Number of combinations	1140 (for 20 BSSIDs)
Query time	0.879s

TABLE 1

This shows that for 20 BSSIDs that are detected, there are 1140 combinations of three BSSIDs that can be selected from those 20. It also shows that a typical query time is below a second.

Variations

[0014] In other embodiments, groups of four or more access points may be used instead of three. By increasing the number of access points, the database size may be reduced, the query time may be reduced and the accuracy maybe increased.

[0015] The three access point identifiers may be combined in another way for storage in the database.

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ABSTRACT

Access point identifiers that are associated with a common location are grouped into sets of three and stored in a document in a database. When the location of a device is required, the access points that it detects are searched for in the database. If a matching set of three access points are found in the database, then the corresponding location is retrieved from the document in which the three access points are found.

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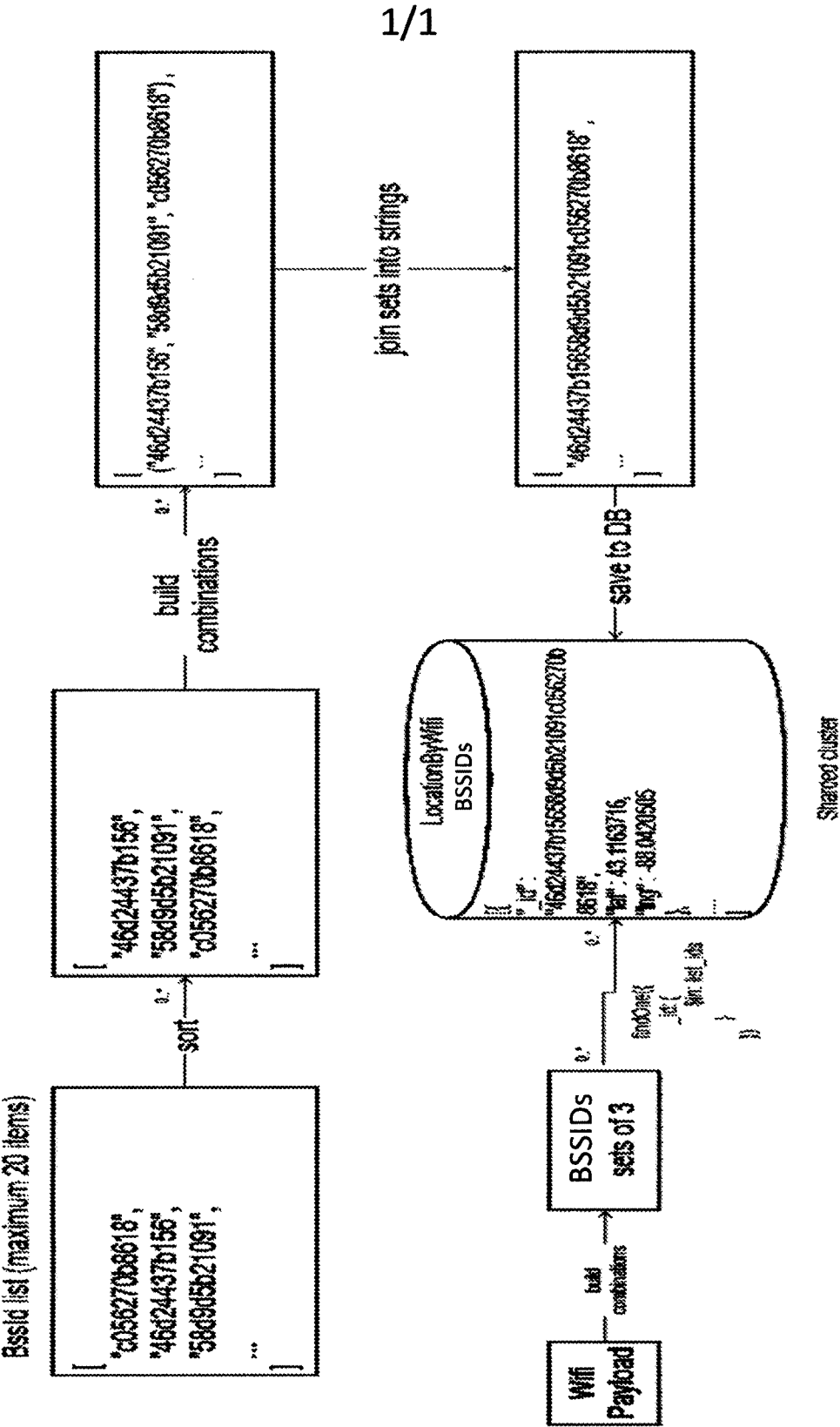


FIG. 1