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(54) **METHODS, SYSTEMS AND MEDIA FOR DETECTING NON-INTENDED TRAFFIC USING CO-VISITATION INFORMATION**

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H04L 29/06 (2006.01)

(52) **U.S. Cl.**
USPC **726/22**; 726/3

(58) **Field of Classification Search**
USPC 726/22, 3
See application file for complete search history.

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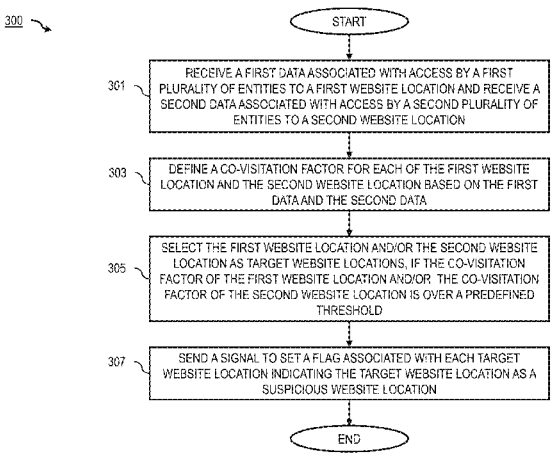
(57) **ABSTRACT**

A non-transitory processor-readable medium stores code representing instructions to be executed by a processor to receive data associated with access by a first plurality of entities to a first website location and to receive data associated with access by a second plurality of entities to a second website location. The processor is also caused to define a co-visitation factor for each of the first website location and the second website location based on the received data. The processor is also caused to, if the co-visitation factor of the first website location and/or the co-visitation factor of the second website location is over a predefined threshold, select the first website location and/or the second website location as target website locations. The processor is caused to send a signal to set a flag associated with each target website location indicating the target website location as a suspicious website location.

19 Claims, 6 Drawing Sheets



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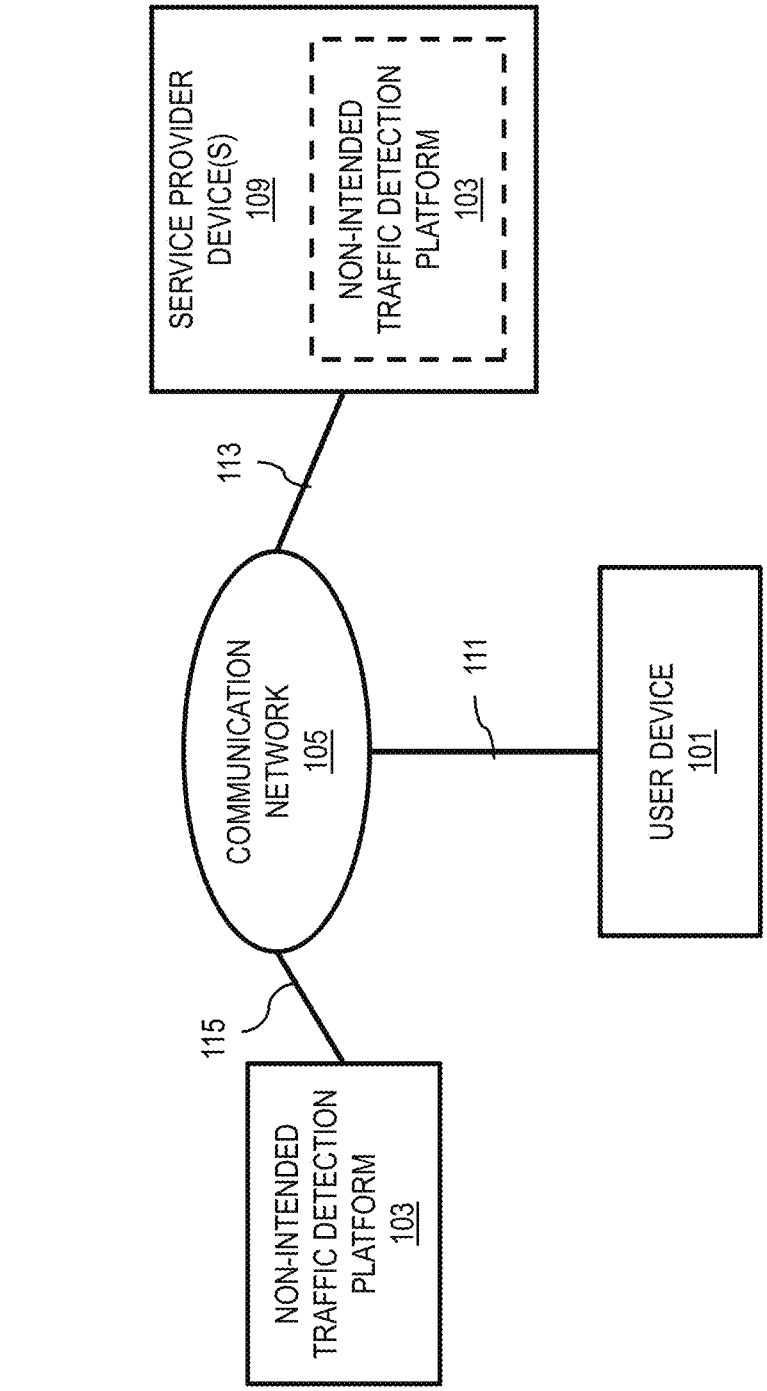
SERVICE PROVIDER DEVICE(S) 109
NON-INTENDED TRAFFIC DETECTION PLATFORM 103
113
COMMUNICATION NETWORK 105
111
USER DEVICE 101
115
NON-INTENDED TRAFFIC DETECTION PLATFORM 103
100

FIG. 1

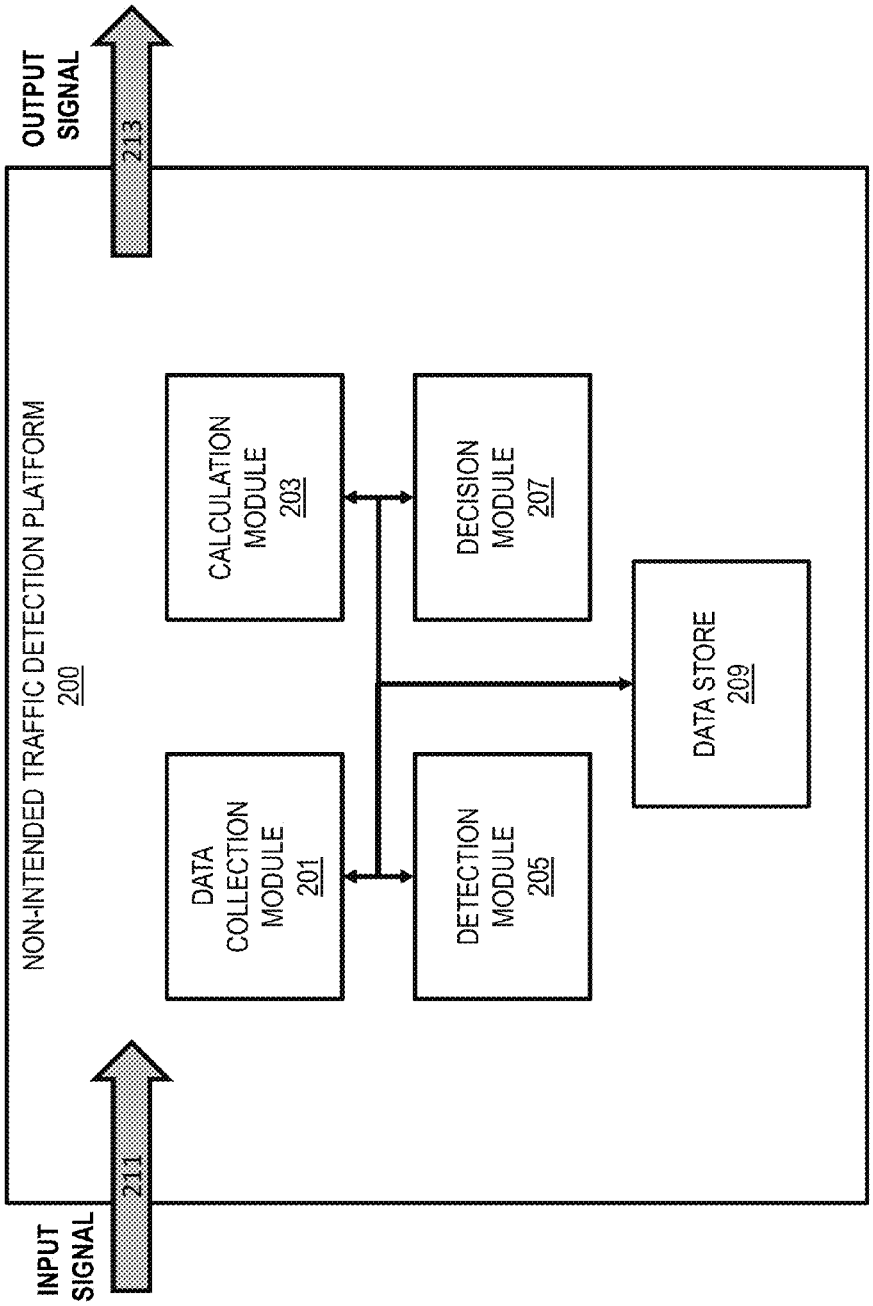
OUTPUT SIGNAL
213
NON-INTENDED TRAFFIC DETECTION PLATFORM
200
CALCULATION MODULE 203
DECISION MODULE 207
DATA STORE 209
DATA COLLECTION MODULE 201
DETECTION MODULE 205
INPUT SIGNAL
211

FIG. 2

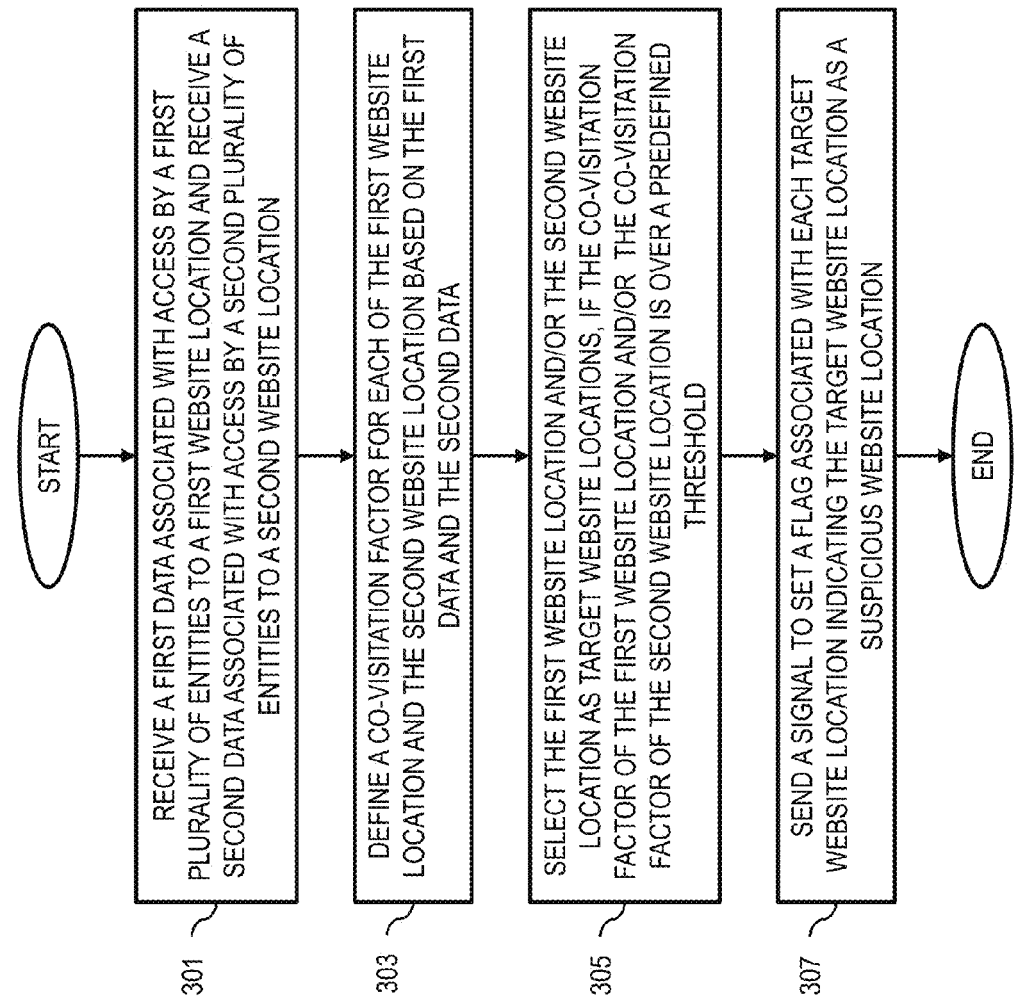
START
RECEIVE A FIRST DATA ASSOCIATED WITH ACCESS BY A FIRST PLURALITY OF ENTITIES TO A FIRST WEBSITE LOCATION AND RECEIVE A SECOND DATA ASSOCIATED WITH ACCESS BY A SECOND PLURALITY OF ENTITIES TO A SECOND WEBSITE LOCATION
301
DEFINE A CO-VISITATION FACTOR FOR EACH OF THE FIRST WEBSITE LOCATION AND THE SECOND WEBSITE LOCATION BASED ON THE FIRST DATA AND THE SECOND DATA
303
SELECT THE FIRST WEBSITE LOCATION AND/OR THE SECOND WEBSITE LOCATION AS TARGET WEBSITE LOCATIONS, IF THE CO-VISITATION FACTOR OF THE FIRST WEBSITE LOCATION AND/OR THE CO-VISITATION FACTOR OF THE SECOND WEBSITE LOCATION IS OVER A PREDEFINED THRESHOLD
305
SEND A SIGNAL TO SET A FLAG ASSOCIATED WITH EACH TARGET WEBSITE LOCATION INDICATING THE TARGET WEBSITE LOCATION AS A SUSPICIOUS WEBSITE LOCATION
307
END

FIG. 3

300

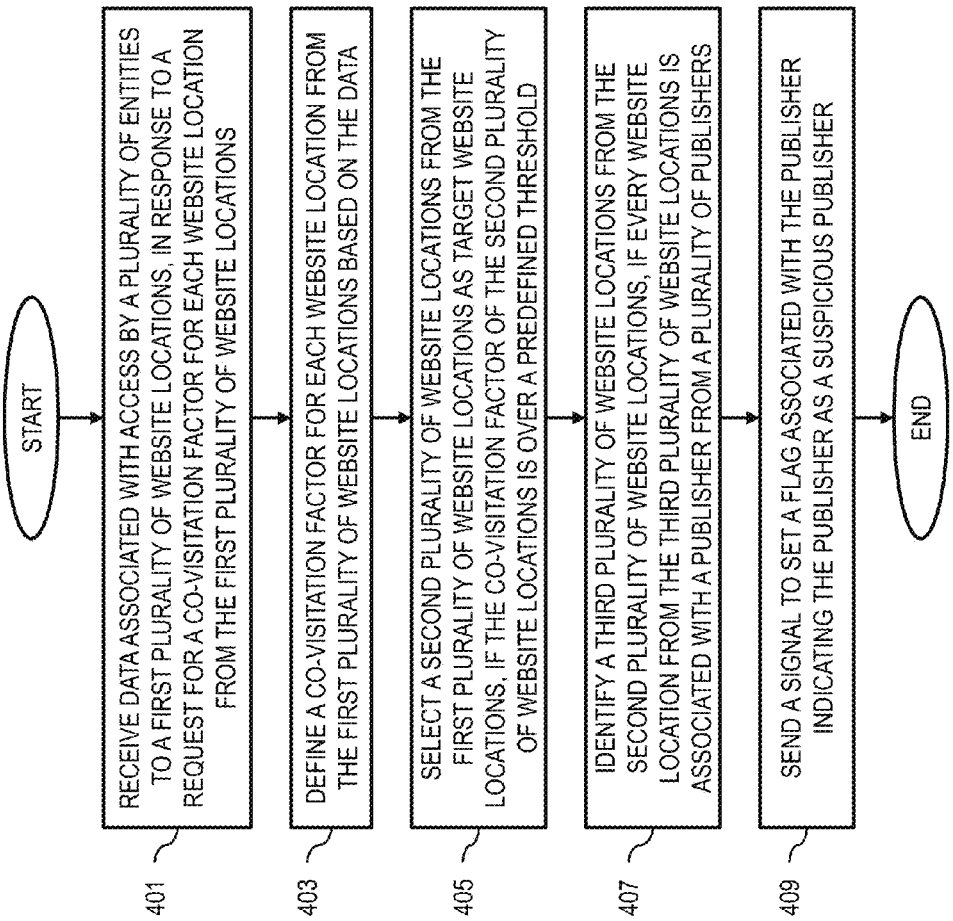
START
RECEIVE DATA ASSOCIATED WITH ACCESS BY A PLURALITY OF ENTITIES TO A FIRST PLURALITY OF WEBSITE LOCATIONS, IN RESPONSE TO A REQUEST FOR A CO-VISITATION FACTOR FOR EACH WEBSITE LOCATION FROM THE FIRST PLURALITY OF WEBSITE LOCATIONS
401
DEFINE A CO-VISITATION FACTOR FOR EACH WEBSITE LOCATION FROM THE FIRST PLURALITY OF WEBSITE LOCATIONS BASED ON THE DATA
403
SELECT A SECOND PLURALITY OF WEBSITE LOCATIONS FROM THE FIRST PLURALITY OF WEBSITE LOCATIONS AS TARGET WEBSITE LOCATIONS, IF THE CO-VISITATION FACTOR OF THE SECOND PLURALITY OF WEBSITE LOCATIONS IS OVER A PREDEFINED THRESHOLD
405
IDENTIFY A THIRD PLURALITY OF WEBSITE LOCATIONS FROM THE SECOND PLURALITY OF WEBSITE LOCATIONS, IF EVERY WEBSITE LOCATION FROM THE THIRD PLURALITY OF WEBSITE LOCATIONS IS ASSOCIATED WITH A PUBLISHER FROM A PLURALITY OF PUBLISHERS
407
SEND A SIGNAL TO SET A FLAG ASSOCIATED WITH THE PUBLISHER INDICATING THE PUBLISHER AS A SUSPICIOUS PUBLISHER
409
END

FIG. 4

400

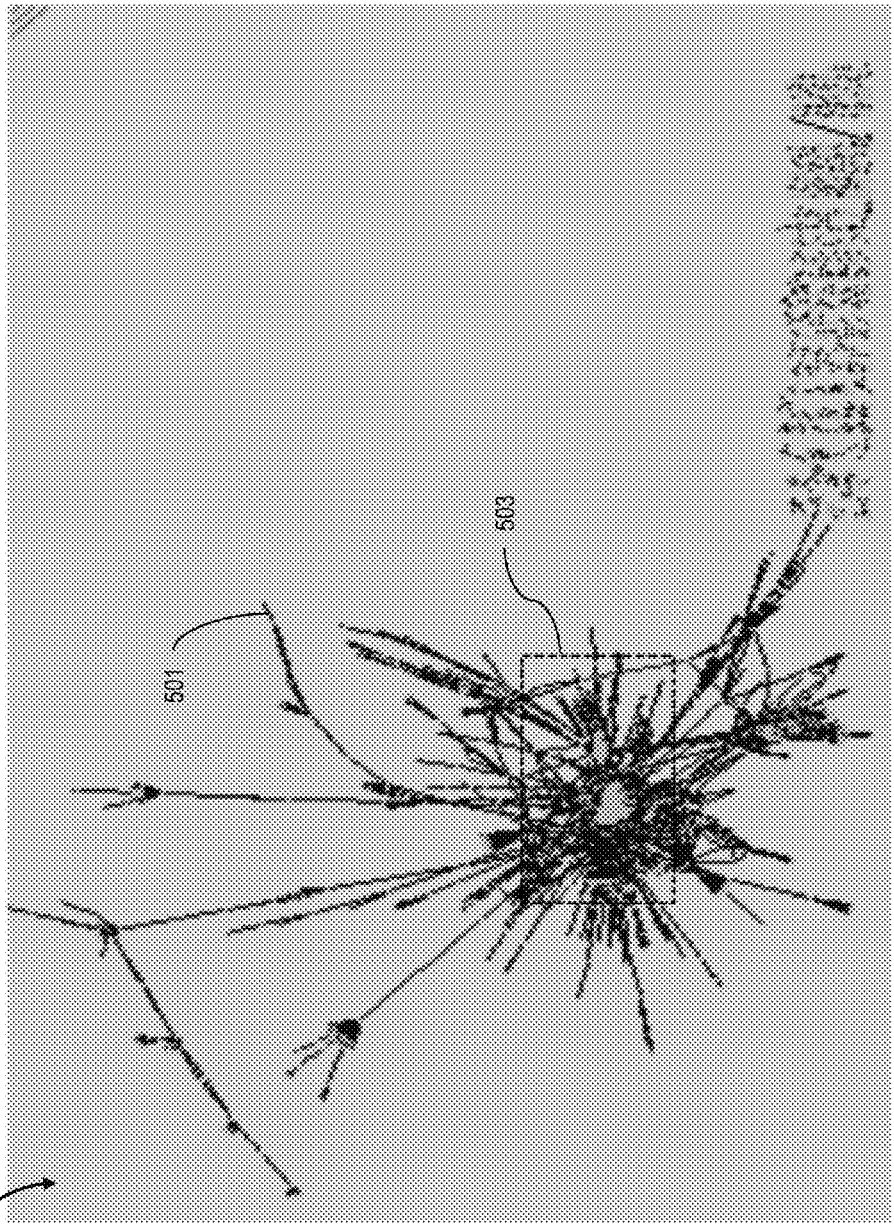

FIG. 5A

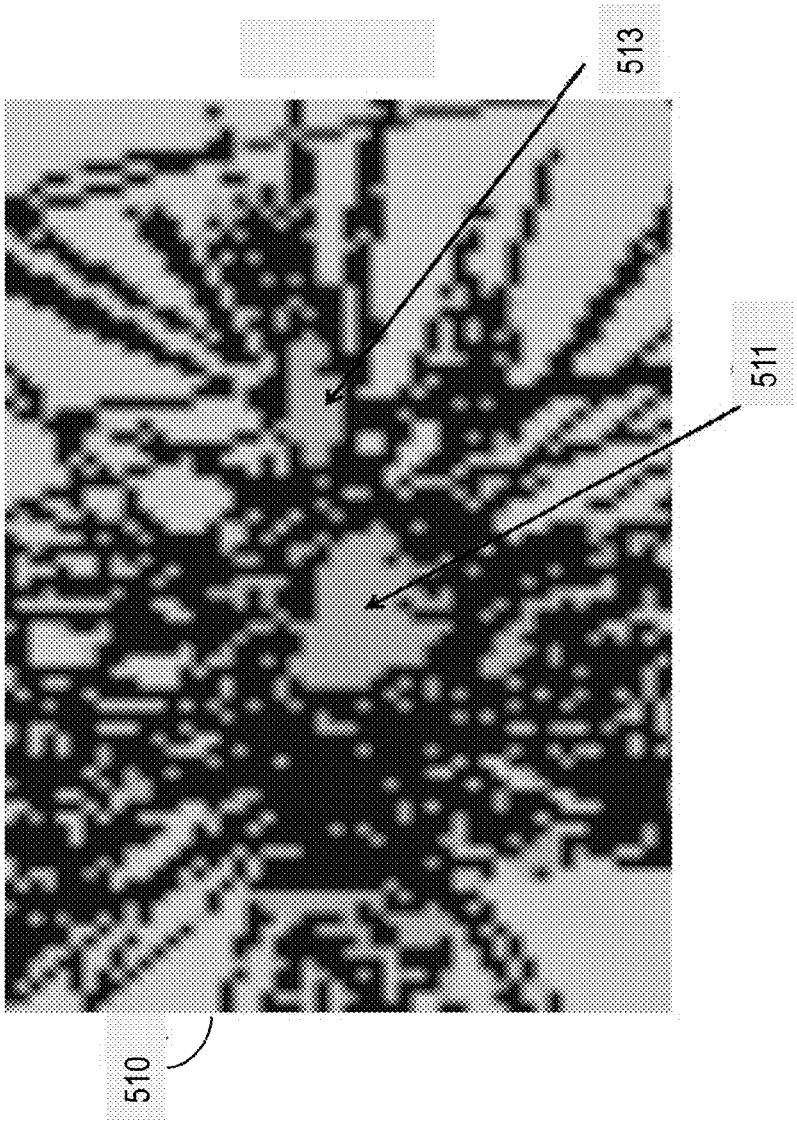

FIG. 5B

METHODS, SYSTEMS AND MEDIA FOR DETECTING NON-INTENDED TRAFFIC USING CO-VISITATION INFORMATION

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application No. 61/697,482, entitled "Methods, Systems and Media for Detecting Non-Intended Traffic Using Co-Visitation Networks", filed on Sep. 6, 2012, which is incorporated herein by reference in its entirety.

BACKGROUND

Some embodiments described herein relate generally to detecting non-intended network traffic using network visitation information.

Network service providers such as, for example, advertisers or online markets use streams of network data to understand user behavior, relying on the fact that the observed actions represent the intentions of real network users. The service providers typically reply on understanding users' intentions to determine when and to whom to provide a service (e.g., an advertisement). Some service providers, however, use approaches for inflating traffic that does not coincide with real users' intentions, for example, by automatically redirecting a user to a network location after the user selects a different network location (e.g., a website), or by loading a website in the background while the user is viewing other content. This can artificially increase the amount of traffic for certain network locations by increasing the number of non-intended visits by users, thereby allowing these network locations to charge more for certain services such as advertisements.

Known methods have been developed to explicitly observe mechanisms that produce non-intended user visits to network locations and identify network locations with non-intended traffic. These known methods, however, are inadequate because the mechanisms that a network location uses for producing non-intended traffic have to be individually identified for each network location.

Therefore, a need exists to overcome the shortcomings of the known methods by detecting non-intended traffic using co-visitation information.

SUMMARY

In some embodiments, a non-transitory processor-readable medium stores code representing instructions to be executed by a processor, the code comprising code to cause the processor to receive a first data associated with access by a first set of entities to a first website location. The processor is also caused to receive a second data associated with access by a second set of entities to a second website location. The processor is also caused to define a co-visitation factor for each of the first website location and the second website location based on the first data and the second data. The processor is also caused to, if the co-visitation factor of the first website location and/or the co-visitation factor of the second website location is over a predefined threshold, select the first website location and/or the second website location as target website location(s). The processor is also caused to send a signal to set a flag associated with each target website location indicating the target website location as a suspicious website location.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram of a computer system in which detecting non-intended traffic using co-visitation information can be performed, according to an embodiment.

FIG. **2** is a schematic illustration of a non-intended traffic detection platform, according to an embodiment.

FIGS. **3-4** are flowcharts of processes for detecting non-intended traffic using co-visitation information, according to an embodiment.

FIGS. **5A-5B** are graph illustrations of a sample network of co-visitation information, according to an embodiment.

DETAILED DESCRIPTION

Known network traffic analysis systems observe various actions over networks, collect data associated with those actions, analyze the collected data, and provide analysis results to a variety of applications such as, for example, bid request analysis and selection from online real-time bidding auctions, display advertising, etc. Some service providers, however, direct unaware network users from network location to network location to monetize those network locations by increasing their traffic.

Various network services such as, for example, targeted advertising rely on understanding network users' intentions and using those intentions to decide on presenting advertisements to the users. Countless methods exist, however that network service providers can use to direct users to their network locations even if not intended by the user. Some of these methods guide a user to a non-intended network location while the user is visiting an intended network location. For example, when a user searches for "tap shoes" on a search engine, the method redirects the user to a website that sells tap shoes rather than just provide the search results. Meanwhile, other methods for directing users to non-intended network locations may be the result of artificial technical mechanisms and can even happen without the users' knowledge. For example, a user may be automatically redirected to a website after closing another website. For another example, a website can load in the background while the user is viewing other content. For the purpose of display advertising, distinguishing between the intended and the non-intended traffic is desirable because targeted advertising often relies on modeling the users' future intentions based on their past (intentional) actions.

Known methods have been developed to explicitly observe mechanisms that produce non-intended user visits to network locations and identify network locations with non-intended traffic. These known methods, however, are inadequate because the mechanisms that a network location uses for producing non-intended traffic typically have to be individually identified for each network location.

Methods and apparatus are described herein to identify website locations with a relatively large number of non-intended users irrespective of the source of the non-intended users. In some embodiments, a non-transitory processor-readable medium stores code representing instructions to be executed by a processor, the code comprising code to cause the processor to receive a first data associated with access by a first set of entities to a first website location. The processor is also caused to receive a second data associated with access by a second set of entities to a second website location. The processor is also caused to define a co-visitation factor for each of the first website location and the second website location based on the first data and the second data. The processor is also caused to select, if the co-visitation factor of

the first website location and/or the co-visitation factor of the second website location is over a predefined threshold, the first website location and/or the second website location as target website location(s). The processor is also caused to send a signal to set a flag associated with each target website location indicating the target website location as a suspicious website location.

In some embodiments, an apparatus includes a calculation module implemented in at least one of a memory or a processing device. The calculation module is configured to, for each website location from a set of website locations, receive data representing a percentage of entities from a set of entities that accessed that website location based, at least in part, on the data. The calculation module is also configured to, for each website location from the set of website locations, define a normalization of the percentage based, at least in part, on a number of entities in the set of entities. The calculation module is further configured to, for each two website locations from the set of website locations, define a co-visitation factor based, at least in part, on the normalization of the percentage of entities. The apparatus also includes a detection module implemented in at least one of a memory or a processing device. The detection module is configured to receive data associated with access by the set of entities to the set of website locations. The detection module is also configured to receive the co-visitation factor for each website location from the set of website locations from the calculation module. The detection module is further configured to select at least one target website location from the set of website locations based, at least in part, on the co-visitation factor of the at least one website location. The apparatus further includes a decision module implemented in at least one of a memory or a processing device. The decision module is configured to send a signal to set a flag associated with the at least one target website location from the set of website locations indicating the at least one target website location as a suspicious website location.

In some embodiments, a non-transitory processor-readable medium stores code representing instructions to be executed by a processor, the code comprising code to cause the processor to receive data associated with access by a set of entities to a first set of website locations, in response to a request for a co-visitation factor for each website location from the first set of website locations. The processor is also caused to define a co-visitation factor for each website location from the first set of website locations based, at least in part, on the data. The processor is further caused to select a second set of website locations from the first set of website locations as target website locations, if the co-visitation factor of the second set of website locations is over a predefined threshold. The processor is also caused to identify a third set of website locations from the second set of website locations, if every website location from the third set of website locations is associated with a publisher from a set of publishers. The processor is further caused to send a signal to set a flag associated with the publisher indicating the publisher as a suspicious publisher.

As used herein, "user" can be a person, a module, a device, an application, or any entity that accesses a network location. In some of the embodiments discussed, a user is referred to as a person using a user device via one or more user interfaces. Additionally/alternatively, a user can be a device, a module of a device, or an application such as, for example, a bidding application, an advertisement engine, etc., that can cause network traffic that can be managed by the described methods and apparatus.

As used herein, the singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, the term "an "entity" is intended to mean a single entity or multiple entities (e.g., entities with similar access history or similar models of behavior, etc.).

FIG. **1** is a schematic block diagram of a computer system in which detecting non-intended traffic can be performed, according to an embodiment. The computer network system **100** includes at least one user device **101**, a non-intended traffic detection platform **103**, a communication network **105**, and at least one service provider device(s) **109**, which can be operatively coupled to one or more user device **101** or other service provider device(s) **109** via the communication network **105**. Note that the non-intended traffic detection platform **103** or some of its components can be embedded within the service provider device(s) **109**, or be external to the service provider device(s) **109**, and operatively coupled to one or more user device **101** or one or more service provider device(s) **109** via the communication network **105**. Any of the devices or platforms of the computer network system **100** can be equipped with local memory/storage spaces (not shown in FIG. **1**). Furthermore, the devices and platforms of the computer network system **100** can have access to centralized or distributed memory/storage spaces (not shown in FIG. **1**) for example through the communication network **105**. Additionally, a user device **101**, a non-intended traffic detection platform **103**, and a service provider device(s) **109** each can include one or more processors, performing processes associated with the services provided to the user device **101** (each not shown in FIG. **1**). Thus, FIG. **1** is merely an example illustrating the types of devices and platforms that can be included within a computer network system **100**.

Communication network **105** can for example be any communication network, such as the Internet, configurable to allow the user device **101**, the non-intended traffic detection platform **103**, and the service provider device(s) **109** to communicate with communication network **105** and/or to each other through communication network **105**. Communication network **105** can be any network or combination of networks capable of transmitting information (e.g., data and/or signals) and can include, for example, a telephone network, an Ethernet network, a fiber-optic network, a wireless network, and/or a cellular network.

In some instances, communication network **105** can include multiple networks operatively coupled to one another by, for example, network bridges, routers, switches and/or gateways. For example, the user device **101** can be operatively coupled to a cellular network; the service provider device(s) **109** and/or the non-intended traffic detection platform **103** can be operatively coupled to a fiber-optic network. The cellular network and fiber-optic network can each be operatively coupled to one another via one or more network bridges, routers, switches, and/or gateways such that the cellular network and the fiber-optic network are operatively coupled to collectively form a communication network. Alternatively, the cellular network and the fiber-optic network can each be operatively coupled to one another via one or more additional networks. For example, the cellular network and the fiber-optic network can each be operatively coupled to the Internet such that the cellular network, the fiber-optic network and the Internet are operatively coupled to form a communication network.

As illustrated in FIG. **1**, the user device **101** is operatively coupled to communication network **105** via network connection(s) **111**; service provider device(s) **109** is operatively coupled to communication network **105** via network connec-

tion(s) **113**; and the non-intended traffic detection platform **103** is operatively coupled to communication network **105** via network connection(s) **115**. Network connections **111**, **113**, and **115** can be any appropriate network connection for operatively coupling user device **101**, service provider device(s) **109**, and the non-intended traffic detection platform **103**.

A network connection **111**, **113**, and **115** each can be a wireless network connection such as, for example, a wireless fidelity ("Wi-Fi") or wireless local area network ("WLAN") connection, a wireless wide area network ("WWAN") connection, and/or a cellular connection. A network connection **111**, **113**, and **115** each can be a wired connection such as, for example, an Ethernet connection, a digital subscription line ("DSL") connection, a broadband coaxial connection, and/or a fiber-optic connection.

As mentioned above, in some instances, a computer network system **100** can include more than one user device **101**, more than one non-intended traffic detection platform **103**, and more than one service provider device(s) **109**. A user device **101**, a non-intended traffic detection platform **103**, and/or a service provider device(s) **109**, can be operatively coupled to the communication network **105** by heterogeneous network connections. For example, a first user device **101** can be operatively coupled to the communication network **105** by a WWAN network connection, another user device **101** can be operatively coupled to the communication network **105** by a DSL network connection, and a non-intended traffic detection platform **103** can be operatively coupled to the communication network **105** by a fiber-optic network connection. The service provider device(s) **109** can be, for example, a web server configured to provide various applications to electronic devices, such as user device **101**.

The user device **101** can be any of a variety of electronic devices that can be operatively coupled to communication network **105**. A user device **101** can be for example a personal computer, a tablet computer, a personal digital assistant (PDA), a cellular telephone, a smart phone, a TV, a portable/mobile Internet device and/or some other electronic communication device. The user device **101** can include a web browser configured to access a webpage or website location hosted on or accessible via the service provider device(s) **109** over communication network **105**. A service provider **109** can be a server provided by an organization that provides access to the Internet. A service provider **109** can be organized in various categories such as, for example, commercial, community owned, non-profit, privately-owned, etc. The user device **101** can be configured to support, for example, HyperText Markup Language (HTML) using JavaScript. The user device **101** can include a web browser such as, for example, Internet Explorer®, Firefox®, Safari®, Dolphin®, Opera® and Chrome®. An Internet page or website location can be accessed by a user of a web browser at a user device **101** by providing the web browser with a reference such as a uniform resource locator (URL), for example, of a webpage. For example, a user of a user device **101** can access a service provider device(s) **109** via a URL designated for or assigned to the service provider device(s) **109**. In some instances, user device **101** can include specialized software for accessing a web server other than a browser, such as, for example, a specialized network-enabled application or program. In some instances, portions of a website location accessible via a web server can be located in a local or remote memory space/data store accessible to the web server. The portions of the website location can be stored in the memory/data store in a database, a data warehouse, a file, etc. A user device **101** can also include a display, monitor or user interface (not shown in FIG. **1**), a keyboard, various communication or input/output (I/O) ports (e.g., a USB port), and other user interface features, such as, for example, digital pens, mice, touch screen controls, audio components, and/or video components (each not shown). A user device **101** can be operatively coupled to communication network **105** via a user interface and a network connection **111**.

FIG. **2** is a schematic illustration of a non-intended traffic detection platform, according to an embodiment. Non-intended traffic detection platform **200** can be similar to the non-intended traffic detection platform **103** of FIG. **1**. As shown in FIG. **2**, a non-intended traffic detection platform **200** can include a data collection module **201**, a calculation module **203**, a detection module **205**, a decision module **207** and a data store **209**. In various instances, the non-intended traffic detection platform **200** and its components can be located anywhere within a communication network system **100** such as that shown in FIG. **1** including, but not limited to, within the service provider device(s) **109**, or in separate network locations within the communication network system **100** of FIG. **1**.

As used herein, a module can be, for example, any assembly and/or set of operatively-coupled electrical components, and can include, for example, a memory, a processor, electrical traces, optical connectors, software (executing or to be executed in hardware) and/or the like. Furthermore, a module can be capable of performing one or more specific functions associated with the module, as discussed further below.

The non-intended traffic detection platform **200** can provide non-intended traffic detection for service provider device(s) **109**. In some embodiments, the non-intended traffic detection platform **200** can receive a request from a service provider device **109** of FIG. **1** via an input signal **211**, for identifying network locations (e.g., website locations) with undesirably large (e.g., higher than a pre-defined threshold) amount of non-intended users and for information related to the identified network locations. The data collection module **201** can collect data associated with network locations, the traffic on those network locations including number of visitors, identity of visitors, etc. The data collection module **201** can store the collected data in data store **209**.

The data store **209** can include various repositories of network locations with non-intended traffic, co-visitation data, non-intended users' data, etc. (each not shown), as well as any data used and/or stored by the modules of the non-intended traffic detection platform **200**. Furthermore, the non-intended traffic detection platform **200** can communicate with other components of a computer network system (e.g., computer network system **100** of FIG. **1**) via input signals **211** and output signals **213**.

In some embodiments, the calculation module **203** can identify non-intended network traffic (e.g., non-intended users) by identifying the website locations that a specific user or group of users visit repeatedly over time. The calculation module **203** can aggregate information associated with the identified website locations across multiple users. For example, the calculation module **203** can determined which website locations a user visits over an hour, a day, a week, etc. The visitation data can then be aggregated with visitation data associated with other users to determine which website locations have a number of users in common. For example, if w website locations have a number of users in common, a greater likelihood exists that the users' visits to one or more of the w website locations are non-intended. Additionally or alternatively, if the w website locations have different contents, this can be an indication that users' visits to one or more of the w website locations can be non-intended. A user(s) visiting common website locations can be referred to as "co-

visitation". For example, if a user u_1 is monitored by the calculation module **203** during a predetermined time period t and the user u_1 accesses website locations x and y during the time period t, this can constitute a co-visitation by user u_1 of website locations x and y. In some embodiments, the calculation module **203** calculates a co-visitation factor for each network location based on co-visitation of the network locations by various users. The calculation module **203** can store the co-visitation factors in data store **209**.

In some embodiments, after information on co-visitation is collected by the data collection module **201**, and after a co-visitation factor is calculated by the calculation module **203**, the detection module **205** can use the co-visitation factor to identify network locations with co-visitation factors over a predefined threshold as target network locations. The predefined threshold can represent a highest co-visitation factor acceptable by a service provider(s) device **109** to consider as intended traffic. The threshold can be defined based on historical data. For example, the calculation module **203** can use the data collected by the data collection module **201**, results from previous data analysis, etc., (for example from data store **209**) to calculate a common threshold the co-visitation factors over which show a higher probability of resulting from non-intended traffic. The detection module **205** can store the information associated with target location in data store **209**.

In some embodiments, the decision module **207** can use the information associated with co-visitation factors, target network locations, etc., for making decisions on whether to provide a service (e.g., a bidding offer provided by a real-time bidding exchange "RTB", an advertisement, etc.) to a network location on a real-time bidding exchange. The decision module **207** can flag the website locations with a relatively large or unacceptable number of non-intended users (e.g., with co-visitation factors over a predefined threshold) as suspicious website locations to identify as website locations that are not desirable for providing services by the service provider(s) **109** (e.g., for placing an advertisement). For example, the non-intended traffic detection platform **200** can provide the detected information to a service provider device(s) **109** (e.g., an RTB provider) and the RTB provider can use the information to manage sale of advertisement slots on behalf of network locations (e.g., website locations) for displaying advertisements tailored for a particular visitor or a group of visitors of those website locations using user devices **101**.

In some instances, advertisers (or third parties representing the advertisers) each interested in displaying an advertisement to a particular visitor or a type of visitors can place a bid in an auction for an associated advertisement slot, where the highest bidder is generally awarded with the opportunity to place their advertisement in the advertisement slot to be displayed to the particular visitor or a type of visitors. In some instances, these real-time bidding auctions can be performed in the short time between the start of loading website data on a user device **101** and the completion of loading the website data on the user device **101**. One example of a metric in which an advertiser can be interested when determining how much to bid on an advertisement slot, is the traffic information of the associated website provided by the non-intended traffic detection platform **200**. Another example of a metric in which an advertiser can be interested when determining how much to bid on an advertisement slot, is previous website locations that a particular visitor has visited in the past, provided by the non-intended traffic detection platform **200**. Non-intended traffic information provided by the non-intended traffic detection platform **200** can be used by the service provider device(s) **109** for determining a price to charge an advertiser for an advertisement slot on a website.

In some embodiments, the flags set by the decision module **207** on website locations can be used, for example, for training service provider device(s) **109**, for example, to be able to provide targeted services (e.g., targeted advertisements). For example, a flag can be used to exclude events (e.g., website traffic events) when training targeting model for a service provider(s) **109**.

FIGS. **3-4** are flowcharts of processes for detecting non-intended traffic using co-visitation information, according to an embodiment. FIG. **3** is a flowchart for flagging website locations as suspicious, according to an embodiment. At **301**, a first data associated with access by a first set s_1 of user devices **101** to a first website location x is received, for example, by the data collection module **201** via an input signal **211**. Similarly, a second data associated with access by a second set s_2 of user devices **101** to a second website location y is also received. The first and the second data can be stored in a data storage such as, for example, the data store **209**.

At **303**, a co-visitation factor for each of the first website location x and the second website location y is defined, for example, by the calculation module **203**. The co-visitation factor can be defined for every pair of a first website location and a second website location based on the first data and the second data. In other words, although FIG. **3** is described in reference to two website locations, it should be understood that the process can be repeated for a very large number of websites.

In some instances, definition of the co-visitation factor can identify website locations that share a relatively large number of the same users (e.g., user devices **101**). For example, if K users, where K is greater than a threshold value m, visit both website locations x and y during a predetermined time period (for example, one hour, one day, one week, etc.), this can be an indication that website locations x and y share K users.

In some instances, the calculation module **203** can identify website locations that share a large percentage of the same users as website locations having a large number of non-intended users. For example, if 90% of visitors to website location x also visit website location y during a predetermined time period, this can be an indication that the visits to website locations x, y, or both are non-intended. The calculation can be performed, for example, by determining the number of visitors to website location x that also visit website location y and then dividing the number by the total number of visitors to website location x or the total number of visitors to website location y.

In some instances, for a pair of website locations x and y, multiple co-visitation factors can be calculated, where the total number of visitors to each website location can be used as a denominator when finding the co-visitation factor. For example, among the two website locations, x and y, if website location x has 100 and website location y has 1000 visitors during a monitored time period and 95% of the visitors to website location x also visit website location y, then if traffic for website location x, 100 is used in the denominator, the co-visitation factor is 95%. However, if the traffic for site y, 1000 is used in the denominator, then the co-visitation factor is 9.5%. In some instances, the number of visitors for the website location with the higher number of visitors can be used when calculating the co-visitation factor. Alternatively, the number of visitors for the website location with the lower number of visitors can be used when calculating the co-visitation factor. In another alternative, the co-visitation factor can be calculated using the number of visitors for both website locations in the denominator, and the co-visitation factor can be found using a weighted average of the co-

visitation factors calculated using each number, where the weights can be determined based on total traffic, content, trends in traffic, presence of links, type of website locations (e.g., commercial, blog, .com, .org, .edu, search engine, etc.), and/or any other suitable factors.

In some instances, the co-visitation information can be represented graphically, where each website location (e.g., x and y) visited by a user of a user device **101** can be represented as a point (e.g., a graph node) and website locations that share a co-visitation number or percentage of shared users can be connected by a line (e.g., a graph edge) connecting the nodes. For example, if two website locations x and y, have a percentage (e.g., 85%) of the same users over a monitored period of time, then the two website locations can be plotted as nodes on the graph connected by a graph edge.

For example, a bi-partite graph, G=<U, W,E> can be defined with a set U of user nodes (user devices **101**), a set W of website location nodes (e.g., x and y) visited by users from set U, and a set E of edges, where edges of set E connect user nodes U with website location nodes W. The users U are identified, for example, by the calculation module **203**, visiting website locations W over a predetermined time period.

In some instances, a unimodal graph of the website locations W can be constructed from the bi-partite graph by projecting the bi-partite graph on the W nodes. Such projection can be shown as equation (1):

$$G_W^m=\langle V_{W\subseteq W},E=\{(x,y):x,y\in W,\Gamma_G(x)\cap\Gamma_G(y)\geq m\}\rangle \quad (1)$$

where V_W, a subset of website locations W, is the set of nodes of graph G, and $\Gamma_G(x)$ is the set of neighbors of a graph node x in the original bi-partite graph. The nodes x and y represent website locations. In this example, m is a threshold value on the number of users that visit both website locations x and y.

In some instances, a threshold value n can be defined, for example by the calculation module **203**, based on co-visitation factors (e.g., the percentage of users U that visit both website locations x and y). A projection of such example can be shown as equation (2):

$$G_W^m = \left\langle V_W \subseteq W, E=\left\{(x,y):x,y\in W,\frac{[\Gamma_G(x)\cap\Gamma_G(y)]}{(\Gamma_G(x))}\geq n:n\in[0,1]\right\}\right\rangle \quad (2)$$

In some instances, using the projection represented in equation (2), networks of co-visitation information can be established where each edge E represents a link between two website locations x and y, when at least n*100 percent of the users of website location x are also users of website location y.

At **305**, the first website location x and/or the second website location y are selected as target website locations, for example by the detection module **205**, if the co-visitation factor of the first website location x and/or the co-visitation factor of the second website location y is higher than the predefined threshold value n.

At **307**, a signal is sent, for example by the decision module **207** via an out put signal **213**, to set a flag associated with each target website location (e.g., the first website location x and/or the second website location y) indicating the target website location as a suspicious website location. The flag can be used, for example by a service provider device **109**, to determine whether to provide services such as, for example, placing advertisements to a particular website. For example, the flagged or un-flagged status of a website location x or y can be used in determining whether to place advertisements on the flagged or un-flagged website location. The signal can prevent the suspicious website location from being designated to receive advertisements. Additionally or alternatively, a flagged website location and information derived from a flagged website location can be ignored or disregarded when training display advertising targeting models. This can allow such display advertising targeting models to be trained with information associated with legitimate website locations and information associated with suspicious website locations. Accordingly, the display advertising targeting models can more accurately model user intentions and not be influenced (or be less influenced) by non-intended user activities.

In some instances the first data or the second data can include bid requests received in an online real-time bidding auction. In such instances, the flagged status of a website location can be shared with real-time bidding exchanges, or can be used in determining whether to buy an advertisement on a flagged website location based on a price of the advertisement.

In some instances, the non-intended traffic detection platform **200** can detect website locations with a particular co-visitation factor (or range of co-visitation factors) and make decisions about whether to place an advertisement on such website locations. In other instances, the non-intended traffic detection platform **200** can add website locations with a particular co-visitation factor (or range of co-visitation factors) to a black list of website locations to be blocked from being accessed by a browser running on a user device **101**. The black list of suspicious website locations can be stored, for example, in the data store **209**.

In some instances, the co-visitation factor can be defined based on an intersection of users (e.g., user devices **101**) in the first set s_1 of user devices **101** and the second set s_2 of user devices **101**, that access both of the first website location x and the second website location y based on the first data and the second data, as previously discussed with regards to step **301** of FIG. **3**. A normalization of the percentage of user devices **101** accessing the first website location x and the second website location y can be defined based on a number of user devices **101** in the first set s_1 and a number of user devices **101** in the second set s_2. In some instances, the co-visitation factor for each of the first website location x and the second website location y can be defined based, at least in part, on the normalization of the percentage of user devices **101**. In some instances, a user from a set s_1 or s_2 can be associated with at least one of a spyware, a botnet, or a virus.

FIG. **4** is a flowchart for flagging publishers as suspicious, according to an embodiment. A publisher (not shown in FIG. **1**) can define or maintain multiple suspicious website locations to collect or be associated with (or credited with) as much user traffic as possible, seemingly legitimate user traffic. In some instances, the number of suspicious website locations associated with a particular publisher may be higher than a predefined threshold (e.g., an acceptable level). In such instances, the non-intended traffic detection platform **200** can flag that particular publisher as a suspicious publisher. The non-intended traffic detection platform **200** can then flag each website location associated with that particular publisher as suspicious website locations.

At **401**, data associated with access by a first set s_1 of user devices **101** to a first set w_1 of website locations is received, for example, by the data collection module **201**, in response to a request for a co-visitation factor for each website location from the first set w_1 of website locations. The received data can be stored in a data storage such as, for example, the data store **209**.

At **403**, a co-visitation factor for each website location from the first set w_1 of website locations is defined, for example, by the calculation module **203**. The co-visitation factor can be defined based, at least in part, on the received data.

At **405**, a second set w_2 of website locations from the first set w_1 of website locations is selected, for example by the detection module **205**, as target website locations ($w_2 \subset w_1$), if the co-visitation factor of the second set w_2 of website locations is higher than a predefined threshold value. The target website locations of set w_2 can represent website locations with relatively large numbers of non-intended users.

At **407**, a third set w_3 of website locations from the second set w_2 of website locations is identified, for example by the detection module **205** ($w_3 \subset w_2$), if every website location from the third set w_3 of website locations is associated with a specific publisher p from a set of publishers. A publisher can be a distributor of electronic resources such as, for example, website locations, blogs, video games, etc. The non-intended traffic detection platform **200** can use various resources such as, for example, domain registration databases to find website locations from common owners (e.g., publishers).

At **409**, a signal is sent, for example, by the decision module **207** via an output signal **213**, to set a flag associated with publisher p indicating the publisher p as a suspicious publisher. The decision module **207** can store information associated with suspicious publishers, website locations published by the suspicious publishers, and flags associated with suspicious publishers in data store **209** or in other locations in the communication network system **100** of FIG. **1** being accessible by the service provider device(s) **109** via the communication network **105**. The flag can be used to determine whether to provide services by the service provider device(s) **109** to website locations such as, for example, placing advertisements to a particular website location published by publisher p. For example, the flagged or un-flagged status of a publisher p can be used in determining whether to place advertisements on websites associated with the flagged or un-flagged publisher p. The signal can prevent website locations associated with publisher p from being designated to receive advertisements. Additionally or alternatively, a website location and information derived from a website location associated with a flagged publisher p can be ignored when training display advertising targeting models. This can allow display advertising targeting models to be trained with information associated with legitimate website locations (from legitimate publishers) and not with information associated with suspicious website locations (from suspicious publishers). Accordingly, the display advertising targeting models can more accurately model user intentions and not be influenced (or be less influenced) by non-intended user activities.

In some instances, the received data can include bid requests received in an online real-time bidding auction. In such instances, the flagged status of a publisher p can be shared with real-time bidding exchanges, or can be used in determining whether to buy an advertisement on a website location associated with a flagged publisher p based on a price of the advertisement.

In some instances, the non-intended traffic detection platform **200** can add publishers of website locations with a relatively high co-visitation factor to a black list of publishers. A website location associated with a black-listed publisher can be considered suspicious regardless of suspicious activity by the website. The website locations associated with a publisher from the black list can be blocked from being accessed by a browser running on a user device **101**. The black list of suspicious publishers can be stored in the data store **209**.

In some instances, at step **407**, the detection module **207** can identify multiple sets of website locations (similar to the third set w_3), each set being associated with a different publisher from a set of publishers. In such instances, the non-intended traffic detection platform **200** can repeat the processes of steps **407** and **409** multiple times for each set of website locations such that the different publishers associated with each set of website locations can be flagged as suspicious publishers.

FIGS. **5**A-**5**B are graph illustrations of a sample co-visitation network, according to an embodiment. FIG. **5**A is an example of a graph **500** associated with equation (2). In FIG. **5**A, each node **501** represents a website location and each line represents a link between website locations identifying co-visitation between the websites represented by the nodes. In the example of FIG. **5**A, the threshold value n is set at 0.9, such that only website locations with a co-visitation factor higher than 90% are included in graph **500**.

In some instances, position of nodes **501** (e.g., website locations) in graph **500** can represent the domain names of website locations, the Internet Protocol (IP) addresses of website locations, etc.

FIG. **5**B is an illustrative example showing an expansion **510** of a portion of graph **500** of FIG. **5**A shown as **503**. The cluster of nodes identified as **511** in graph **510** of FIG. **5**B is an example of a cluster about 700 website locations identified as having a co-visitation factor higher than a threshold n. For example, each of the website locations in the cluster **511** can have a co-visitation factor higher than 90% during a monitored period of time. The cluster identified as **513** is an example of a different cluster of about 200 website locations having a co-visitation factor higher than 90% during the monitored period of time. In some instances, a scale of the color of a cluster such as **511** or **513** can be defined based on the value of co-visitation factor for the cluster. For example, a darker gray scale may represent a higher co-visitation factor.

The website locations in graph **510** can range, for example, in content from cooking to video games, Las Vegas, news sites, etc. Many similar clusters with their own characteristics can be learned, for example, by the non-intended traffic detection platform **200** from focusing on certain neighborhoods in graph **500** of FIG. **5**A.

In some instances, co-visitation patterns observed in graph **500** of FIG. **5**A can suggest that many website locations are passing users around, sometimes at alarming rates, to, for example, monetize the users in real-time bidding exchanges. In some instances, a comparison between a co-visitation graph of a website location (e.g., an unknown website location) to co-visitation graph of known legitimate website locations can suggest that a high fraction of the traffic of the unknown website location can be non-intended. In such instances, the non-intended traffic detection platform **200** can perform the processes as described in FIG. **3** or **4** to determine whether the unknown website location is a suspicious website location

It is intended that the methods and apparatus described herein can be performed by software (executed on hardware), hardware, or a combination thereof Hardware modules may include, for example, a general-purpose processor, a field programmable gate array (FPGA), and/or an application specific integrated circuit (ASIC). Software modules (executed on hardware) can be expressed in a variety of software languages (e.g., computer code), including C, C++, Java™, Ruby, Visual Basic™, and other object-oriented, procedural, or other programming language and development tools. Examples of computer code include, but are not limited to,

micro-code or micro-instructions, machine instructions, such as produced by a compiler, code used to produce a web service, and files containing higher-level instructions that are executed by a computer using an interpreter. Additional examples of computer code include, but are not limited to, control signals, encrypted code, and compressed code.

Some embodiments described herein relate to a computer storage product with a non-transitory computer-readable medium (also can be referred to as a non-transitory processor-readable medium) having instructions or computer code thereon for performing various computer-implemented operations. The computer-readable medium (or processor-readable medium) is non-transitory in the sense that it does not include transitory propagating signals per se (e.g., a propagating electromagnetic wave carrying information on a transmission medium such as space or a cable). The media and computer code (also can be referred to as code) may be those designed and constructed for the specific purpose or purposes. Examples of non-transitory computer-readable media include, but are not limited to, magnetic storage media such as hard disks, floppy disks, and magnetic tape; optical storage media such as Compact Disc/Digital Video Discs (CD/DVDs), Compact Disc-Read Only Memories (CD-ROMs), and holographic devices; magneto-optical storage media such as optical disks; carrier wave signal processing modules; and hardware devices that are specially configured to store and execute program code, such as Application-Specific Integrated Circuits (ASICs), Programmable Logic Devices (PLDs), Read-Only Memory (ROM) and Random-Access Memory (RAM) devices.

While various embodiments have been described above, it should be understood that they have been presented by way of example only, and not limitation. Where methods and steps described above indicate certain events occurring in certain order, the ordering of certain steps may be modified. Additionally, certain of the steps may be performed concurrently in a parallel process when possible, as well as performed sequentially as described above. Although various embodiments have been described as having particular features and/or combinations of components, other embodiments are possible having any combination or sub-combination of any features and/or components from any of the embodiments described herein.

What is claimed is:

1. A non-transitory processor-readable medium storing code representing instructions to be executed by a processor, the code comprising code to cause the processor to:

receive a first data associated with access by a first plurality of entities to a first website location;

receive a second data associated with access by a second plurality of entities to a second website location;

define a percentage of total entities in the first plurality of entities and the second plurality of entities that accessed both of the first website location and the second website location based, at least in part on the first data and the second data;

define a normalization of the percentage of total entities for each of the first website location and the second website location based, at least in part, on a number of entities in the first plurality of entities and a number of entities in the second plurality of entities;

define a co-visitation factor for each of the first website location and the second website location based, at least in part, on the normalization of the percentage of total entities;

select at least one of the first website location or the second website location as target website locations, if the at least one of the co-visitation factor of the first website location or the co-visitation factor of the second website location is over a predefined threshold; and

send a signal to set a flag associated with each target website location indicating the target website location as a suspicious website location.

2. The non-transitory processor-readable medium of claim **1**, wherein at least one entity from the first plurality of entities is associated with at least one of a spyware, a botnet, or a virus.

3. The non-transitory processor-readable medium of claim **1**, wherein the access by each entity from the first plurality of entities is by a browser running on that entity.

4. The non-transitory processor-readable medium of claim **1**, wherein the first data or the second data include bid requests received in an online real-time bidding auction.

5. The non-transitory processor-readable medium of claim **1**, the code to send the signal includes code to cause the processor to:

send a signal to perform at least one of (1) prevent the suspicious website location from being designated to receive advertisements, or (2) block a bid request from the suspicious website location.

6. The non-transitory processor-readable medium of claim **1**, wherein the first data or the second data is received within a predefined period of time.

7. An apparatus comprising:

a calculation module implemented in at least one of a memory or a processing device, the calculation module configured to, for each website location from a plurality of website locations, receive data representing a percentage of entities from a plurality of entities that accessed that website location based, at least in part, on the data,

the calculation module configured to, for each website location from the plurality of website locations, define a normalization of the percentage based, at least in part, on a number of entities in the plurality of entities, the calculation module configured to, for each two website locations from the plurality of website locations, define a co-visitation factor based, at least in part, on the normalization of the percentage of entities;

a detection module implemented in at least one of a memory or a processing device, the detection module configured to receive data associated with access by the plurality of entities to the plurality of website locations, the detection module configured to receive the co-visitation factor for each website location from the plurality of website locations from the calculation module, the detection module configured to select at least one target website location from the plurality of website locations based, at least in part, on the co-visitation factor of the at least one website location; and

a decision module implemented in at least one of a memory or a processing device, the decision module configured to send a signal to set a flag associated with the at least one target website location from the plurality of website locations indicating the at least one target website location as a suspicious website location.

8. The apparatus of claim **7**, wherein at least one entity from the plurality of entities is associated with at least one of a spyware, a botnet, or a virus.

9. The apparatus of claim **7**, wherein the access by each entity from the plurality of entities is via a browser running on that entity.

10. The apparatus of claim **7**, wherein the data includes bid requests received in an online real-time bidding auction.

11. The apparatus of claim 7, wherein the decision module is further configured to send a signal to perform at least one of (1) prevent the suspicious website location from being designated to receive advertisements, or (2) block a bid request from the suspicious website location.

12. The apparatus of claim 7, wherein the data is received within a predefined period of time.

13. The apparatus of claim 7, wherein the co-visitation factor is defined for every pair of website locations from the plurality of website locations.

14. A non-transitory processor-readable medium storing code representing instructions to be executed by a processor, the code comprising code to cause the processor to:

receive data associated with access by a plurality of entities to a first plurality of website locations, in response to a request for a co-visitation factor for each website location from the first plurality of website locations;

define a co-visitation factor for each website location from the first plurality of website locations based, at least in part, on the data;

select a second plurality of website locations from the first plurality of website locations as target website locations, if the co-visitation factor of the second plurality of website locations is over a predefined threshold;

identify a third plurality of website locations from the second plurality of website locations, if every website location from the third plurality of website locations is associated with a publisher from a plurality of publishers; and

send a signal to set a flag associated with the publisher indicating the publisher as a suspicious publisher.

15. The non-transitory processor-readable medium of claim 14, wherein the co-visitation factor is defined based, at least in part, on a graph.

16. The non-transitory processor-readable medium of claim 15, wherein the graph is a bi-partite graph, the code further comprising code to cause the processor to:

transform the bi-partite graph to a unimodal graph by projection of the bi-partite graph on a subset of the first plurality of website locations as the second plurality of website locations, the unimodal graph having a plurality of unimodal graph edges,

each unimodal graph edge from the plurality of unimodal graph edges connecting a first website location from the second plurality of website locations with a second website location from the second plurality of website locations if a number of times the first website location and the second website location accessed by a common entity from the plurality of entities exceeds a predefined threshold.

17. The non-transitory processor-readable medium of claim 16, wherein:

for each unimodal graph edge from the plurality of unimodal graph edges, the predefined threshold is based, at least in part, on a percentage, of entities from the plurality of entities that access a first website location and a second website location connected by that unimodal graph edge.

18. The non-transitory processor-readable medium of claim 14, wherein the co-visitation factor for each website location from the first plurality of website locations is defined based, at least in part, on a total number of entities accessing each website location from the first plurality of website locations.

19. The non-transitory processor-readable medium of claim 14, the code to send the signal includes code to cause the processor to:

send a signal to perform at least one of (1) prevent a website location associated with a suspicious publisher from being designated to receive advertisements, or (2) block a bid request from the suspicious website location.

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