FIG. 1 Obtaining check-in profiles of users of location-basedservice applications (LBS), i.e. Foursquare

Check - in profile:	Foursquare user_32	
I. Personal data	User ID	32
	First Name	Den
	Last Name	Crowley
	Photo	https://...jpg
	Contact Telephone	212 949 7945
	Contact email	den@foursquare.com
	Gender	male
	Home City	NewYork, NY
II. Check-in data	**Check - in_1ID**	**4bf58dd8d48988d111941735**
	Venue ID	4e954a0649015a078d51e67b
	Venue Name	Virgin Active Health Club
	Address	34 Langstone Way, London, UK
	Postcode	NW7 1GU
	Contact Telephone	020 8876 5436
	Latitude	51.607331
	Longitude	-0.210277
	Category ID	4bf58dd8d48988d175
	CategoryName	Gym or Fitness Centre
	Date/Time	22.09.2011/19.37 (GMT)
	...	...
	Check-in_2 ID	4bf58dd8d48988d15a941735
	...	...

	Foursquare user_ 2584	
	User ID	2584
	First Name	Alexei
	Last Name	Poliakov
	Photo	https://...jpg
	Contact Telephone	020 7672 2993
	Contact email	alexei@alexie.com
	Gender	male
	Home City	London, UK
	Check-in_1ID	**4acdd67ff964a52033cd20e3**
	Venue ID	4d8c572e2da46ea82173246d
	Venue Name	The Phoenix Cinema
	Address	52 High Road, London, UK
	Postcode	N2 9PJ
	Contact Telephone	020 8444 6789
	Latitude	51.588238
	Longitude	- 0.164094
	Category ID	4bf58dd8d48988d17f941735
	CategoryName	Movie Theatre
	Date/Time	17.10.2011/16.37 (GMT)
	...	...
	Check-in_2ID	**4b7ffcd1f964a520e94830e3**
	...	...

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FIG. 2 Creating user profiles in the locomizer check-in database

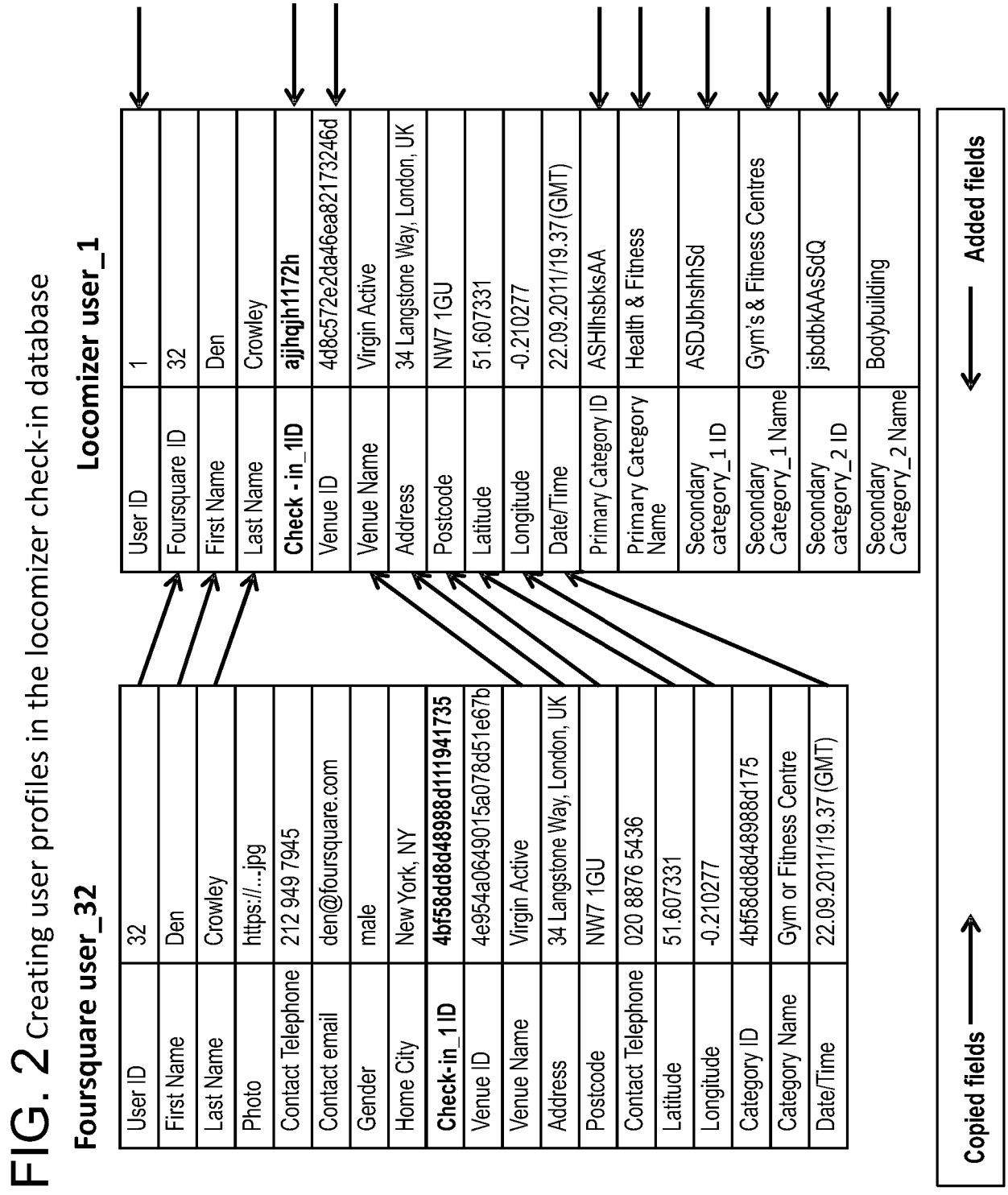
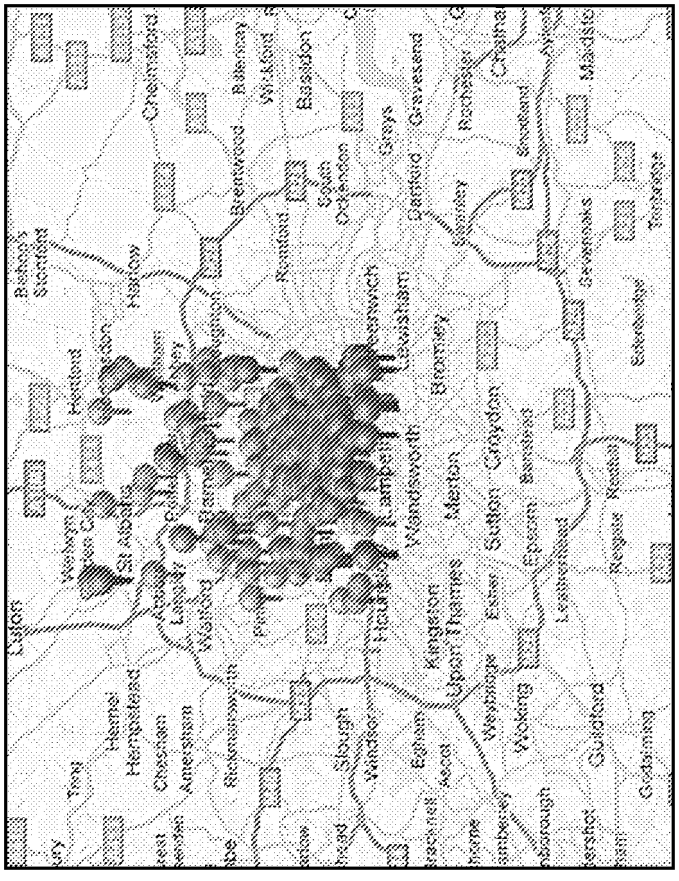


FIG. 3

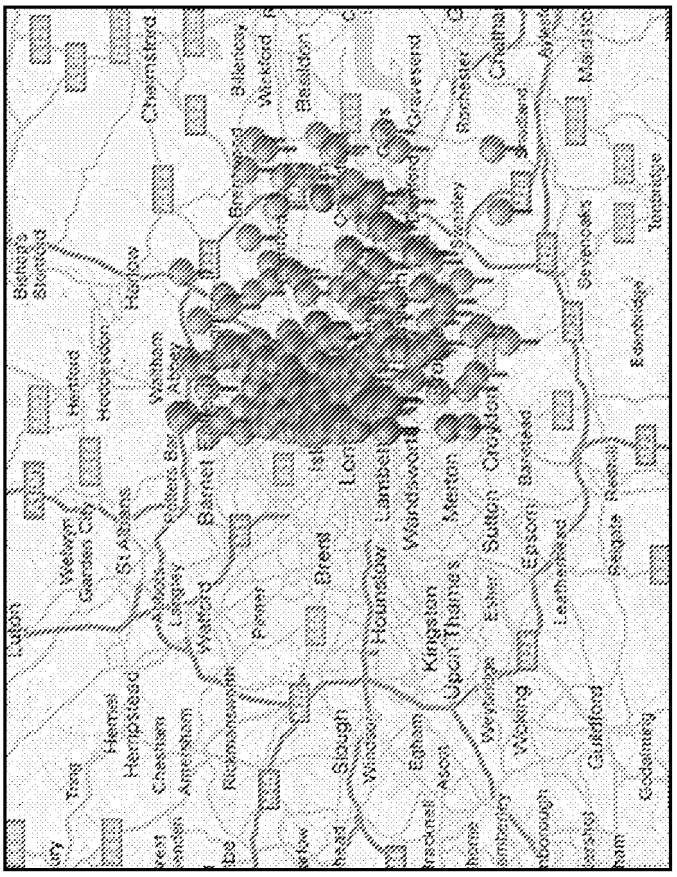
Mapping check-ins of locomizer user_1 and user_2

Locomizer user_1



TOTAL check-ins: **273**
Time between the first and last check-in: **158 days**

Locomizer user_2

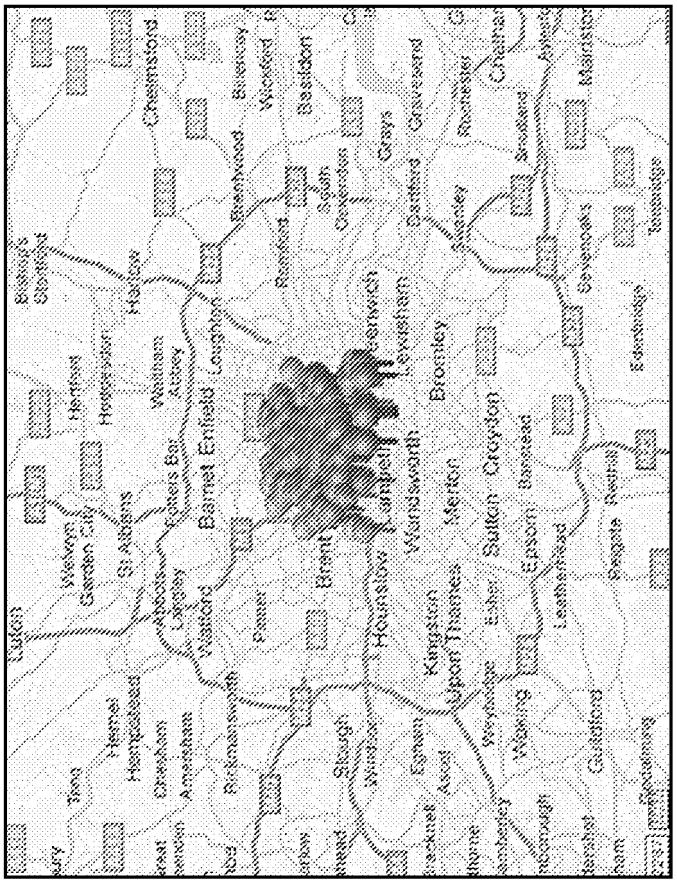


TOTAL check-ins: **272**
Time between the first and last check-in: **97 days**

FIG. 4

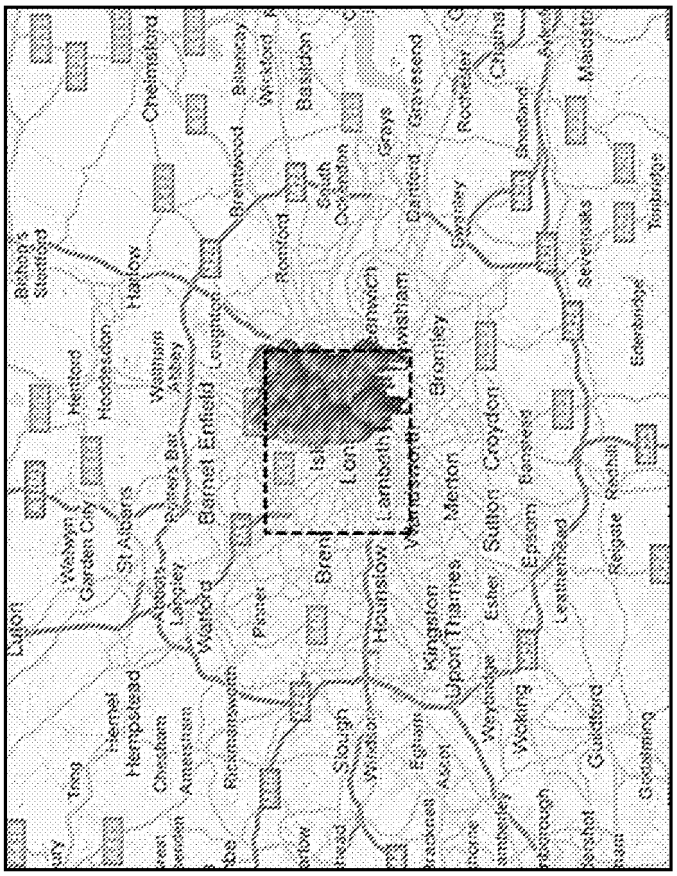
Extracting check-ins within the selected geographic area

Locomizer user_1



TOTAL check-ins: **201**
Time between the first and last check-in: **158 days**

Locomizer user_2



TOTAL check-ins: 142
Time between the first and last check-in: **97 days**

FIG. 5 Extracting check-ins for the selected time period

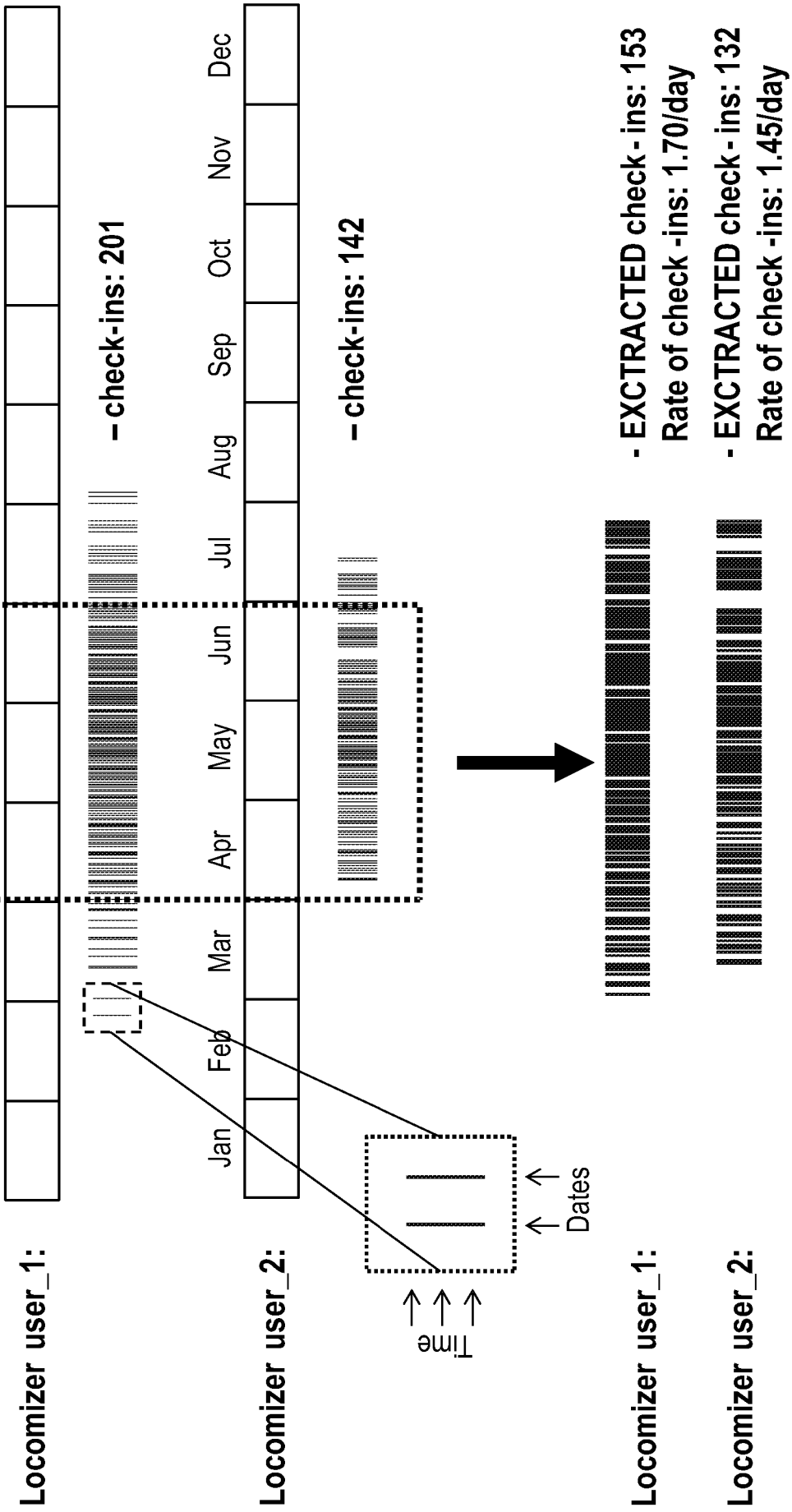


FIG. 6 Extracting check-ins for the selected day categories

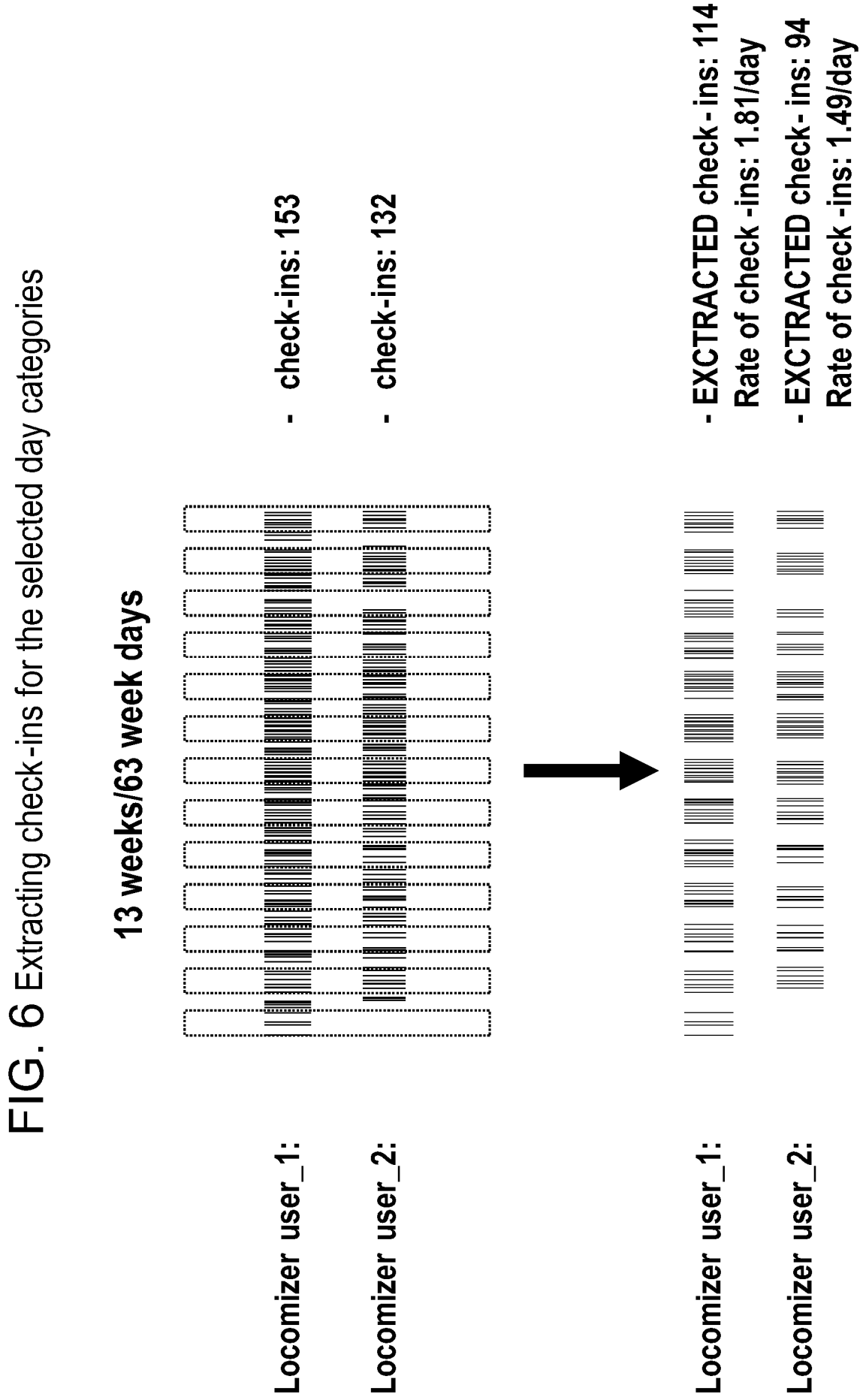


FIG. 7 Extracting check-ins for the selected time intervals

FIG. 8 Setting a size of the check-in neighbourhood area with public activities

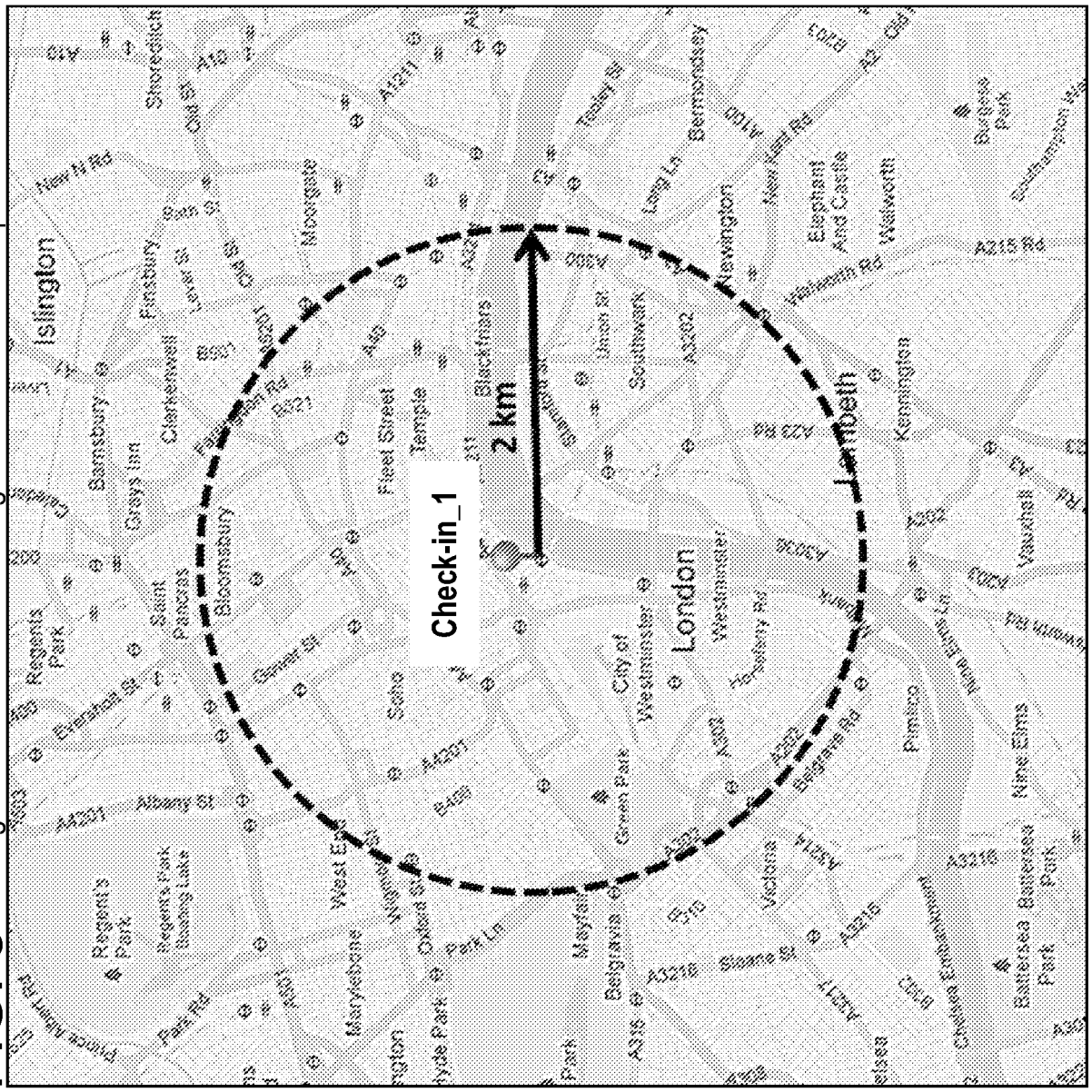
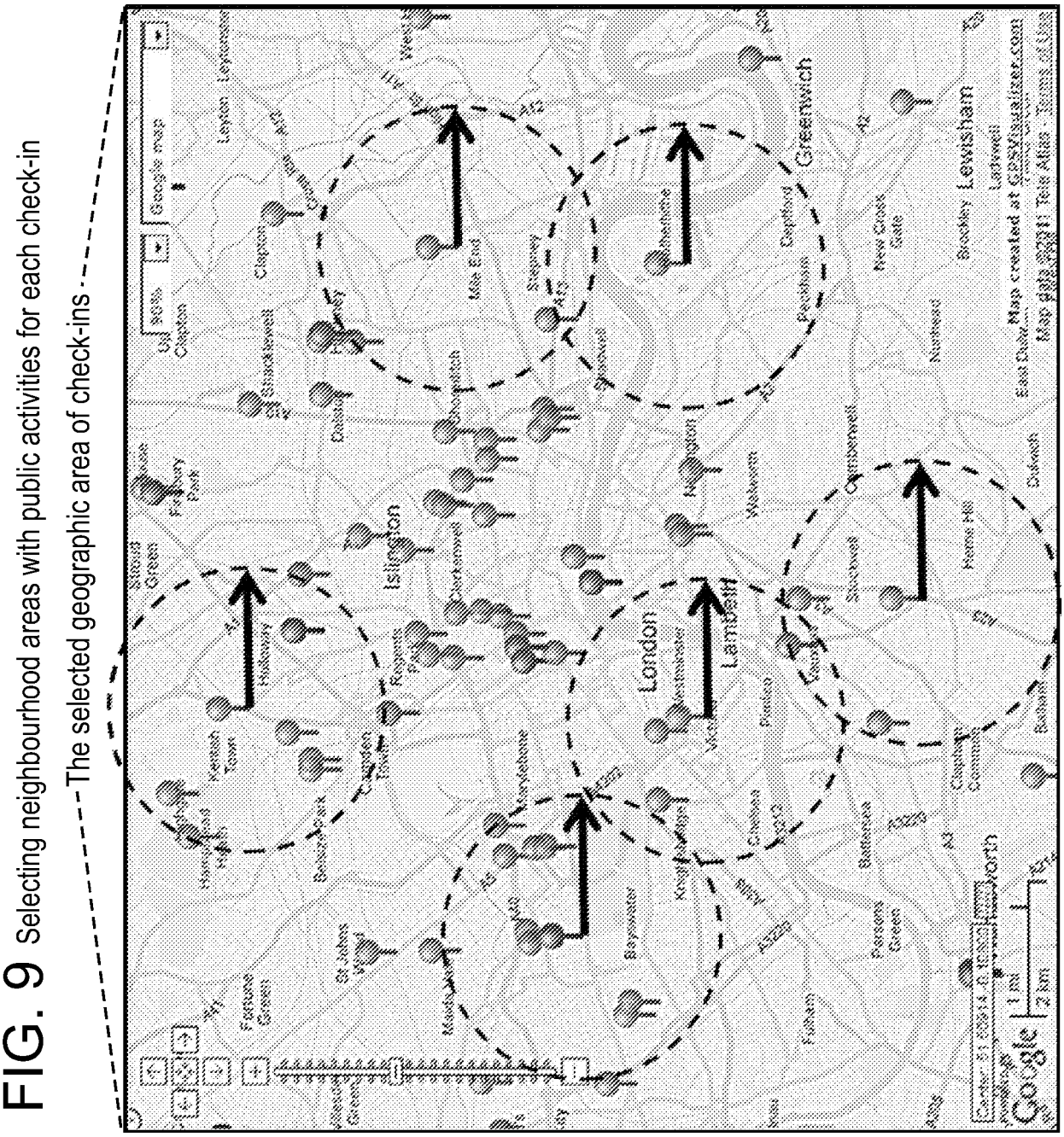


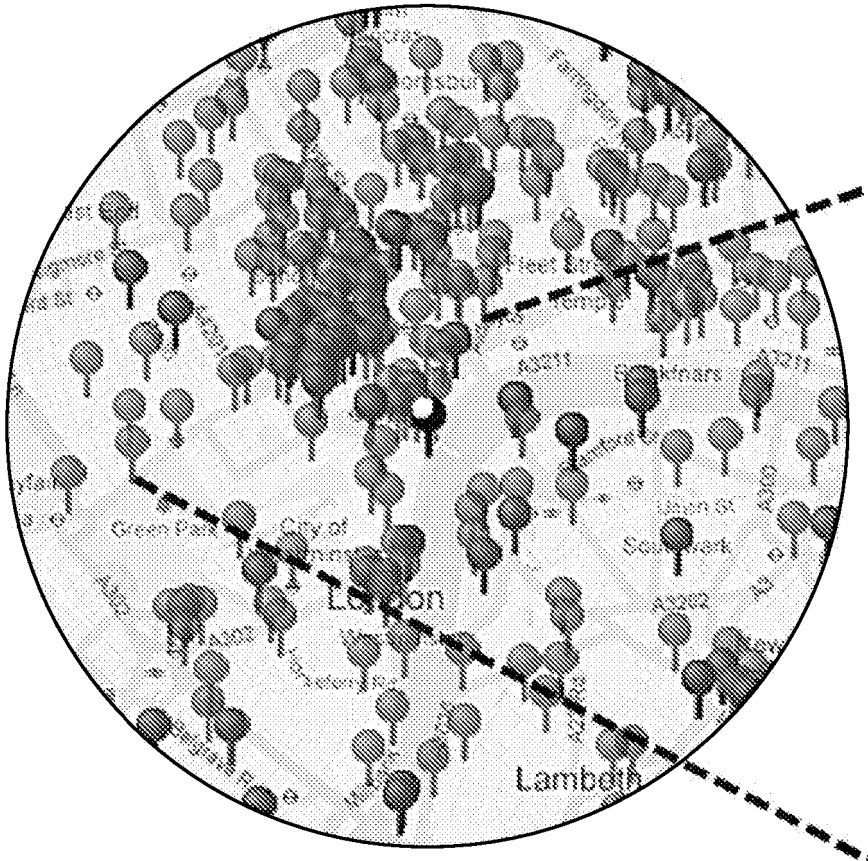
FIG. 9 Selecting neighbourhood areas with public activities for each check-in



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FIG. 10 Obtaining all venues within the neighbourhood area for each check -in from geospatial databases, i.e. factual.com

Locomizer user_1:
Check-in_1
neighbourhood area



TOTAL venues: **314**

Check-in_1: venue_1

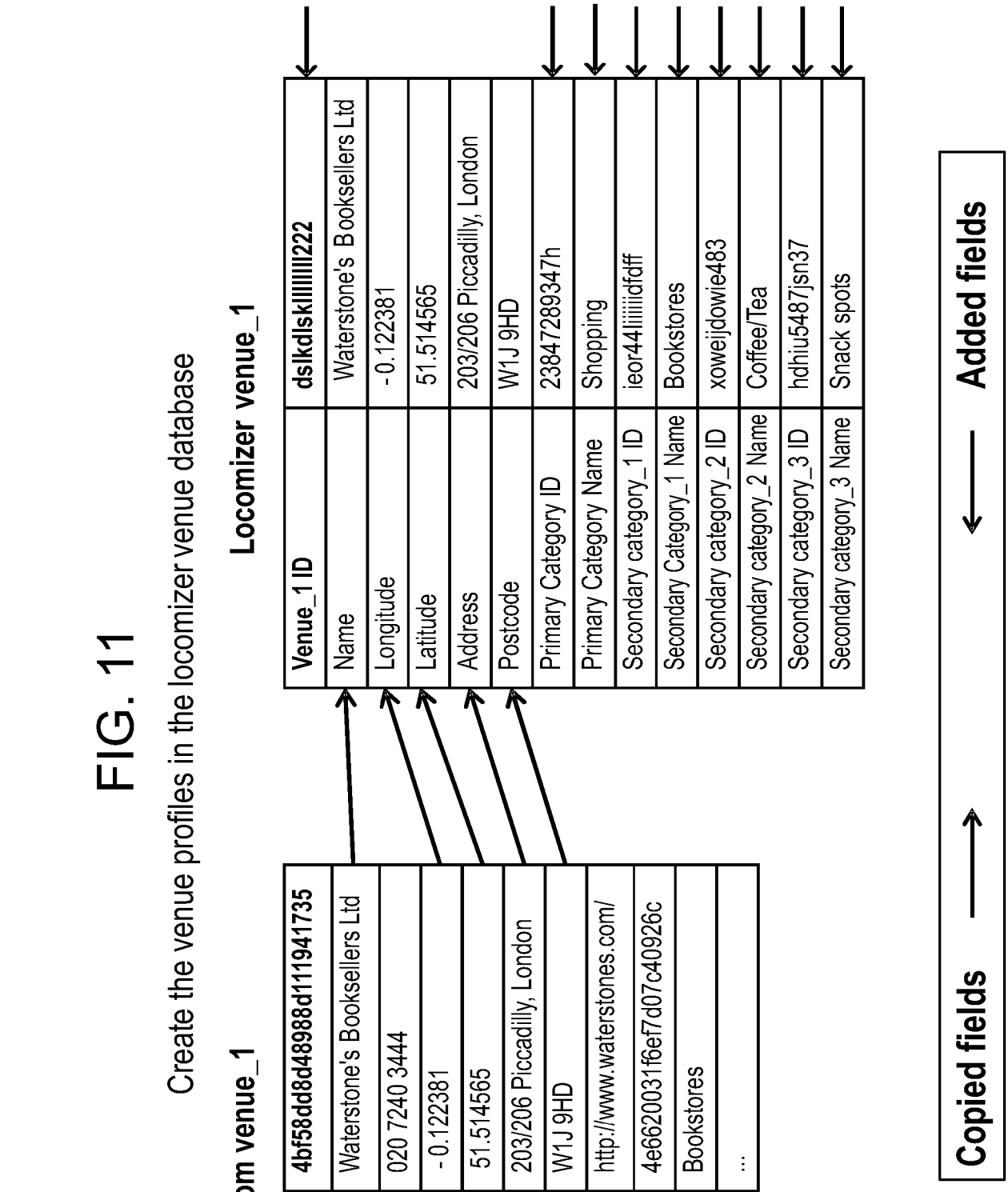
Venue_1 ID	**4bf58dd8d48988d111941735**
Name	Waterstone's Booksellers Ltd
Telephone	020 7240 3444
Longitude	-0.122381
Latitude	51.514565
Address	203/206 Piccadilly, London
Postcode	W1J 9HD
URL	http://www.waterstones.com/
Category ID	4e6620031f6ef7d07c40926c
Category Name	Bookstores
...	...

Check-in_1: venue_2

Venue_2 ID	**4bf58dd8d48988d111941735**
Name	Costa coffee
Telephone	020 7240 3423
Longitude	-0.122567
Latitude	51.507001
Address	13 New Row, City of London
Postcode	WC2N 4LF
URL	http://www. costa.co.uk/
Category ID	4bf58dd8d48988d163941735
Category Name	Coffee/Tea
...	...

FIG. 11

Create the venue profiles in the locomizer venue database



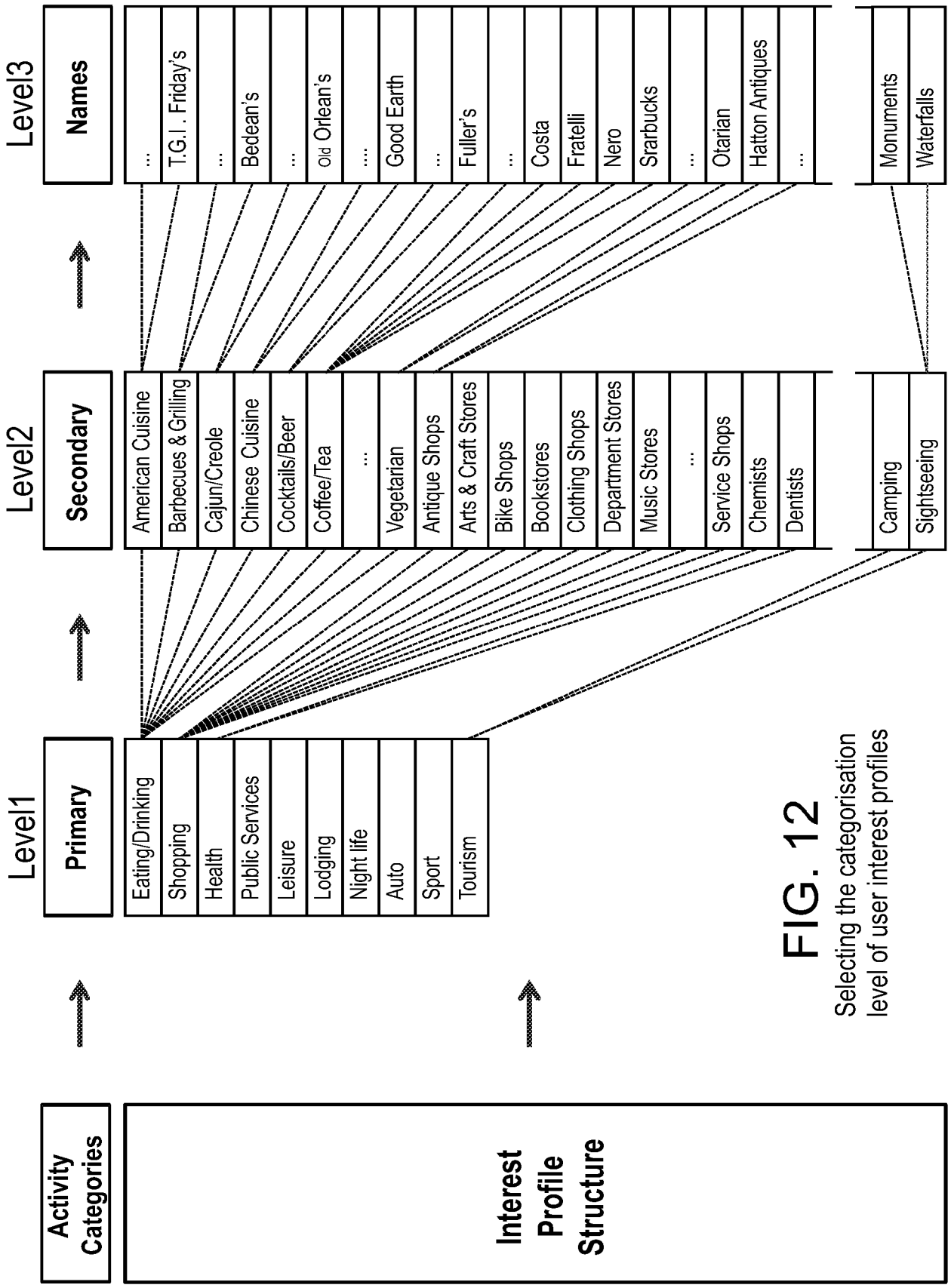


FIG. 12

Selecting the categorisation level of user interest profiles

FIG. 13 Sorting out activities at the level of **Primary** categories

Locomizer venue database

Name	Costa coffee
Longitude	-0.122567
Latitude	51.507001
Primary Category	Eating/Drinking
Secondary Category_1	Coffee/Tea
Secondary category_2	Snack spots

Name	Waterstone's
Longitude	-0.122381
Latitude	51.514565
Primary Category	Shopping
Secondary Category_1	Bookstores
Secondary category_2	Coffee/Tea
Secondary category_3	Snack spots

Name	Hatfield House
Longitude	-0.208835
Latitude	51.760582
Primary Category	Leisure
Secondary Category_1	Museum
Secondary category_2	Park
Secondary category_3	Garden

Name	Teapod
Longitude	-0.073815
Latitude	51.503296
Primary Category	Eating/Drinking
Secondary Category_1	Coffee/Tea

Locomizer activity database (10 primary categories of activities)*

Primary Categories	Eating/Drinking	Shopping	Auto	...	Leisure	...	Tourism

Venues

Costa coffee
-0.122567
51.507001

Waterstone's
-0.122381
51.514565

Hatfield House
-0.208835
51.760582

Teapod
-0.073815
51.503296

Full activity record in the database →

Activities within selected area around Check- in_1	
Category level	Primary
Category name	Eating/Drinking
Venue name	Teapod
Longitude	-0.073815
Latitude	51.503296

* - Fig. 34

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FIG. 14 Sorting out activities at the level of **Secondary** categories

Locomizer Venue database

Name	Costa coffee
Longitude	-0.122567
Latitude	51.507001
Primary Category	Eating/Drinking
Secondary Category_1	Coffee/Tea
Secondary category_2	Snack spots

Name	Waterstone's
Longitude	-0.122381
Latitude	51.514565
Primary Category	Shopping
Secondary Category_1	Bookstores
Secondary category_2	Coffee/Tea
Secondary category_3	Snack spots

Name	Hatfield House
Longitude	-0.208835
Latitude	51.760582
Primary Category	Leisure
Secondary Category_1	Museum
Secondary category_2	Park
Secondary category_3	Garden

Name	Teapod
Longitude	-0.073815
Latitude	51.503296
Primary Category	Eating/Drinking
Secondary Category_1	Coffee/Tea

Locomizer activity database (250 secondary categories of activities)*

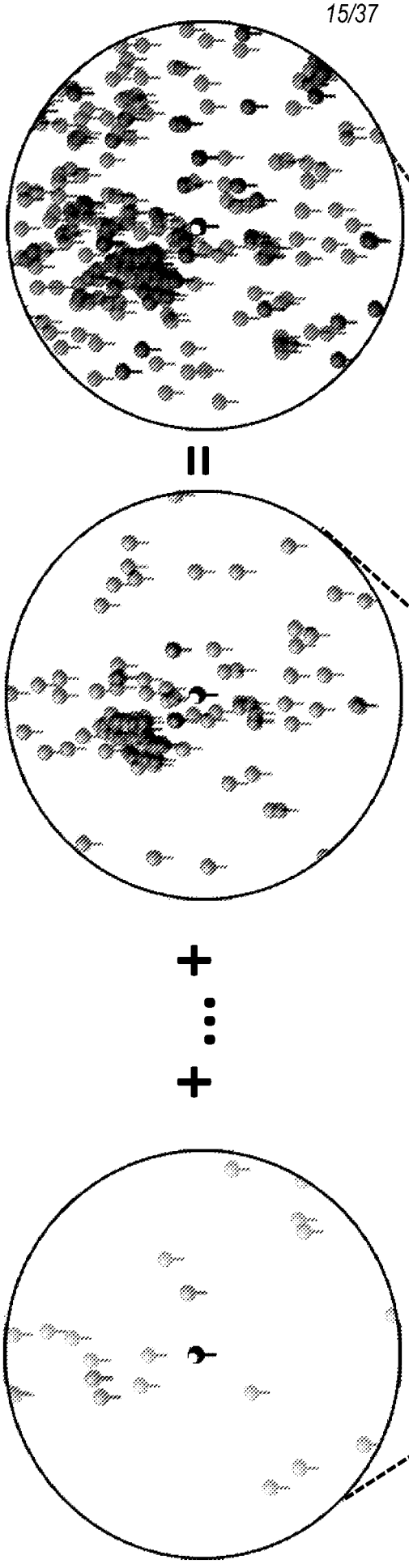
Secondary Categories	Coffee/Tea	Snack spots	Bookstores	Museum	Park	Garden	...	Sightseeing
Venues	Costa coffee -0.122567 51.507001	Costa coffee -0.122567 51.507001	Waterstone's -0.122381 51.514565	Hatfield House -0.208835 51.760582	Hatfield House -0.208835 51.760582	Hatfield House -0.208835 51.760582		
	Waterstone's -0.122381 51.514565	Waterstone's -0.122381 51.514565						
	Teapod -0.073815 51.503296							

Full activity record in the database →

Activities within selected area around Cheek in_1	
Category level	Secondary
Category name	Coffee/Tea
Venue name	Teapod
Longitude	-0.073815
Latitude	51.503296

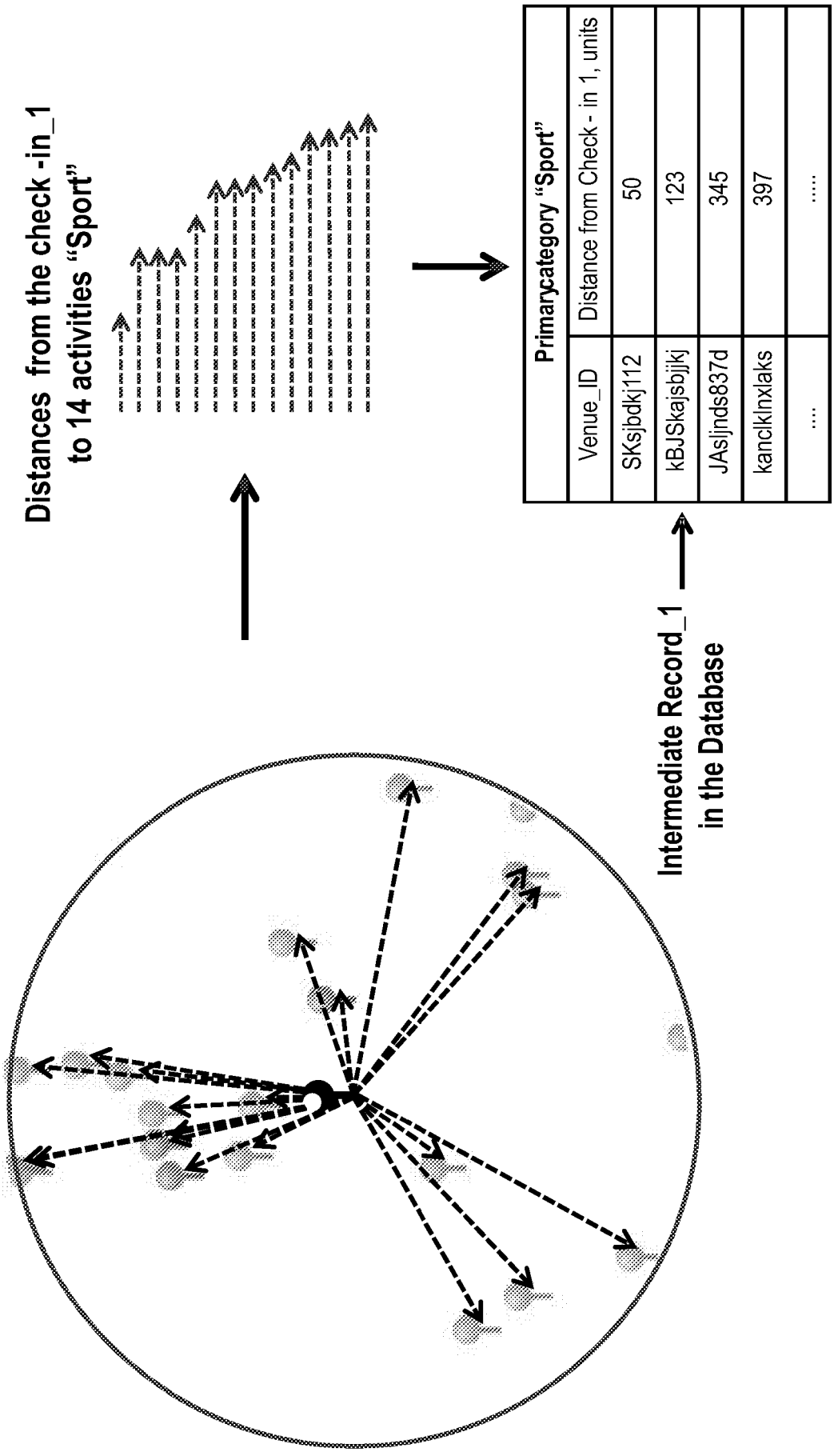
* - Fig. 34

FIG. 15 Categorising the activities in the check-in neighbourhood area into groups (**Primary** category level)



Primary category	Number of activities
Eating/Drinking	1
Shopping	108
Health	21
Public Services	79
Leisure	96
Lodging	39
Night life	123
Auto	36
Sport	14
Tourism	57
All	574

FIG. 16 Measuring the distances between the **check-in_1** of locomizer user_1 and each activity in the category **"Sport"**



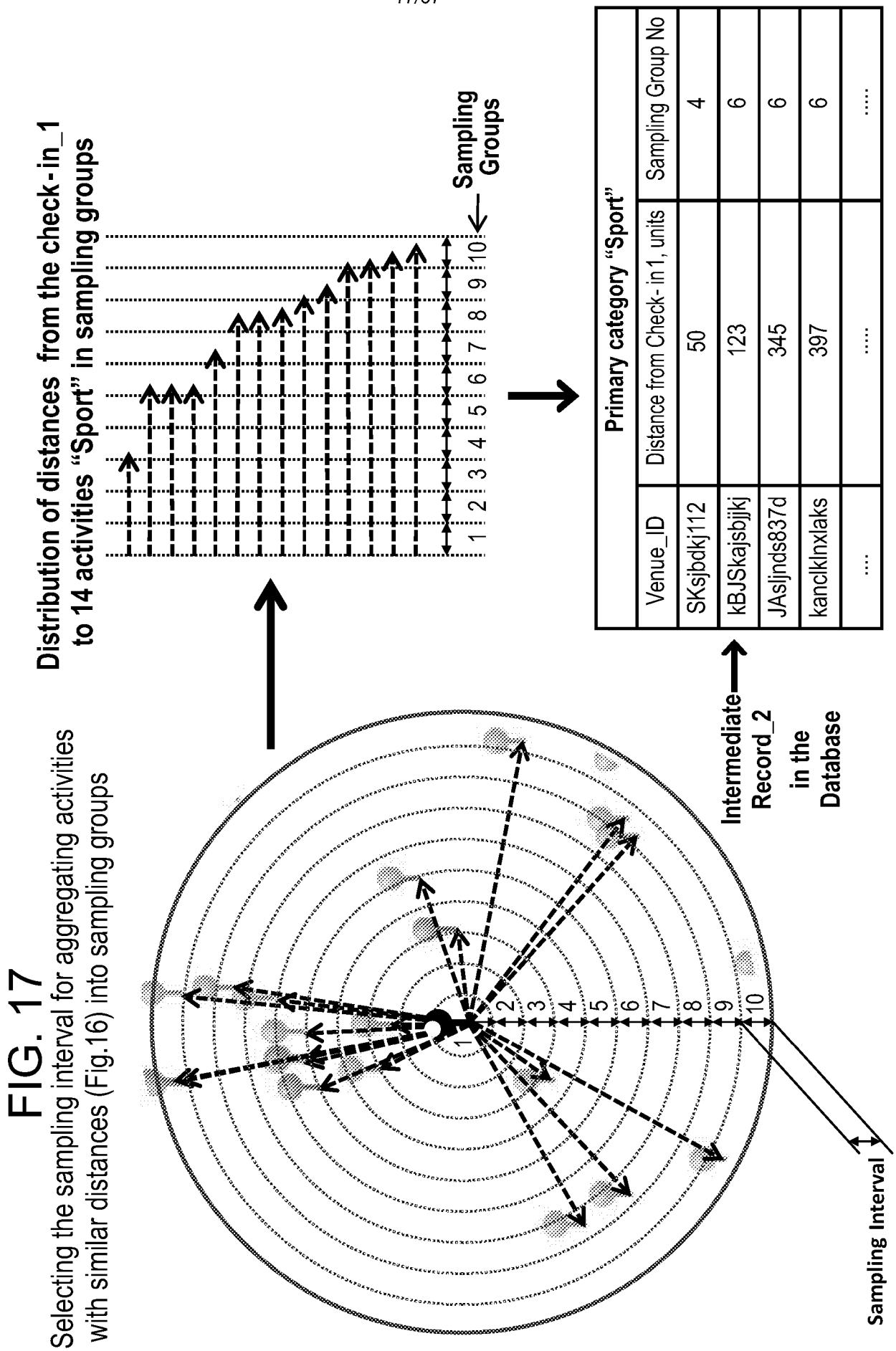


FIG. 17

Selecting the sampling interval for aggregating activities with similar distances (Fig.16) into sampling groups

FIG. 18 Calculating the area of each sampling group in the check -in neighbourhood area

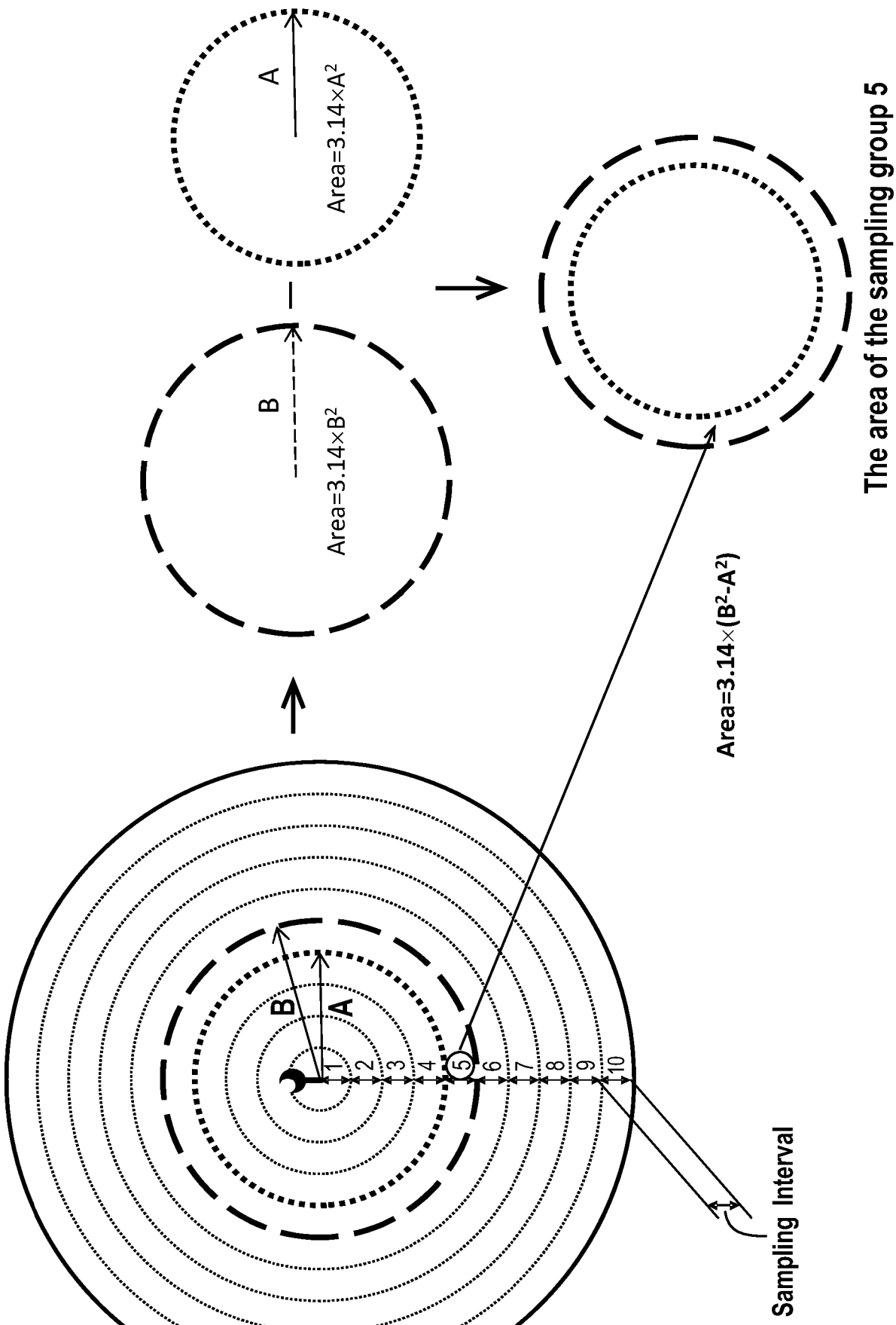


FIG. 19 Calculating the probability of finding the activity **"Sport"** in each sampling group for the **check-in_1**

Check-in1	Sampling Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Minimum distance from the check-in **(A)**, units	0	1	2	3	4	5	6	7	8	9
	Maximum distance from the check-in **(B),** units	1	2	3	4	5	6	7	8	9	10
	Size of each sampling group **(C)**, units	1	3	5	7	9	11	13	15	17	19
	Number of activities "Sport" per each sampling group **(D)**	0	0	1	0	0	3	1	4	2	3
	Density of activities "Sport" in each sampling group **(E=D/C)**, units	0.0	0.0	0.2	0	0	0.3	0.1	0.3	0.1	0.2
	Total size of all sampling groups **(F)**, units	100									
	Total number of activities "Sport" in all sampling groups **(G)**	14									
	Average density of activities in the check-in area **(H=G/F)**, units	0.14									
	Probability to find an activity "Sport" in each sampling group (L=E/H)	**0.0**	**0.0**	**1.4**	**0.0**	**0.0**	**2.1**	**0.7**	**2.1**	**0.7**	**1.4**
	Natural logarithm of probability to find an activity "Sport" in each sampling group (P=lnL)	**-**	**-**	**0.3**	**-**	**-**	**0.7**	**-0.4**	**0.7**	**-0.4**	**0.3**

↑

Intermediate Record_3 in the Database

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FIG. 20 Calculating the average probability of finding the activity "**Sport**" in each sampling group for N selected **check-ins** of locomizer user_1

Check-in_1										
Sampling group Nº	1	2	3	4	5	6	7	8	9	10
Natural logarithm of probability to find an activity "Sport" (P)	-	-	0.3	-	-	0.7	-0.4	0.7	-0.4	0.3

+

Check-in_2										
Sampling group Nº	1	2	3	4	5	6	7	8	9	10
Natural logarithm of probability to find an activity "Sport" (P)	2.0	0.3	-1.6	3.9	1.5	-1.9	-0.8	-1.6	0	0.3

+

Check-in_N										
Sampling group Nº	1	2	3	4	5	6	7	8	9	10
Natural logarithm of probability to find an activity "Sport" (P)	0.1	2.7	5.8	0	-1.8	-0.9	0	0.3	0.1	-0.9

→ Sum of P divide by N (P/N)

Average Check-in										
Sampling group Nº	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Average natural logarithm of probability to find an activity "Sport", or interest score (I)	**0.7**	**1.0**	**1.5**	**1.3**	**-0.1**	**-0.7**	**-0.4**	**-0.2**	**-0.1**	**-0.1**

FIG. 21 Calculating the Total **interest score** of the locomizer user_1 for the activity "**Sport**" within the selected **interest area**

Average check-in	Sampling group Nº	1	2	3	4	5	6	7	8	9	10
	Average natural logarithm of probability to find an activity "Sport", or interest score (I)	0.7	1.0	1.5	1.3	-0.1	-0.7	-0.4	-0.2	-0.1	-0.1

1 Select the interest area (range of the sampling groups)

2 Sum up the interest scores for the sampling groups 1-4

Intermediate Record_4 in the Database

Primary category	"Sport"
Interest area	Sampling group 1-10
Total Interest score	3.9

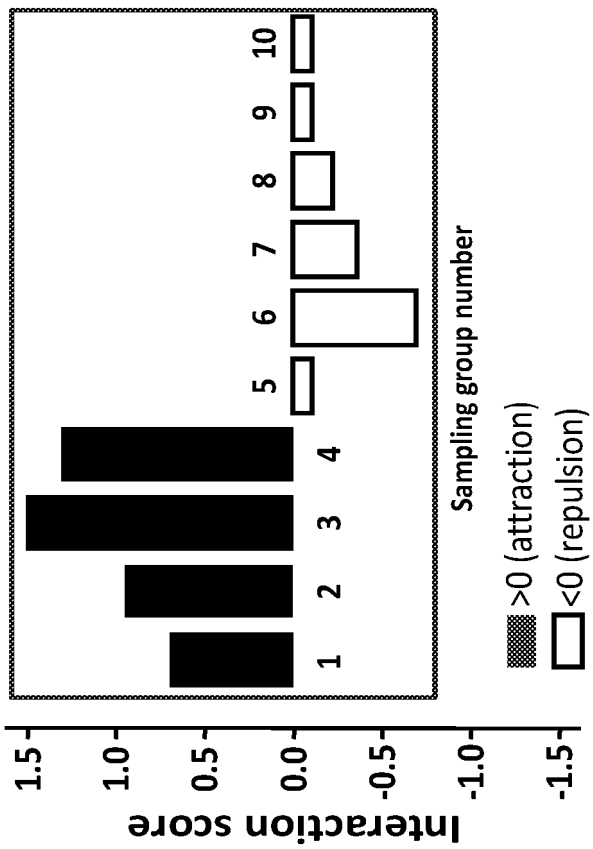


FIG. 22 Calculating the final normalized Interest Profile of locomizer user_1

Primary category	Total Interest Score
Eating/Drinking	+2.3
Shopping	+3.1
Health	-2.9
Public Services	-10.2
Leisure	+2.7
Lodging	-3.9
Night life	+5.3
Auto	+1.1
Sport	+2.9
Tourism	-4.7

[redacted]ate of check-ins/day)/area size =

Interest Profile ID	34
User ID	1
Category level	Primary
Interest profile scores	+10,2, +20.0 ....-10.7,-30.6
Geographic area: max.latitude, min. latitude, max. longitude, min. longitude	51.5747
	51.4429
	-0.2548
	0.0185
Check- in Neighbourhood area	2 km
Time period	01/04/11 - 01/07/11
Day categories	Week days
Time interval	6.00 -18.00
Rate of check - ins/day	1.7
Sampling group size	10 units
Interest Area	Sampling groups 1-8

Interest Profile
+10.2
+20.0
-40.0
-110.3
+10.6
-50.0
+40.2
+0.0
+10.7
-30.6

Final Record in the Database

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FIG. 23 Interest Profiles of users with different check-in patterns

Primary Category	Group1	Group2	Group3
Eating/Drinking	10	92	0
Auto	10	0	0
Public Services	10	0	0
Health	10	0	0
Leisure	10	0	0
Lodging	10	0	0
Night life	10	0	0
Shopping	2	0	0
Sport	10	0	92
Tourism	10	0	0
Total check-ins	**92**	**92**	**92**

Check-in patterns ⇧

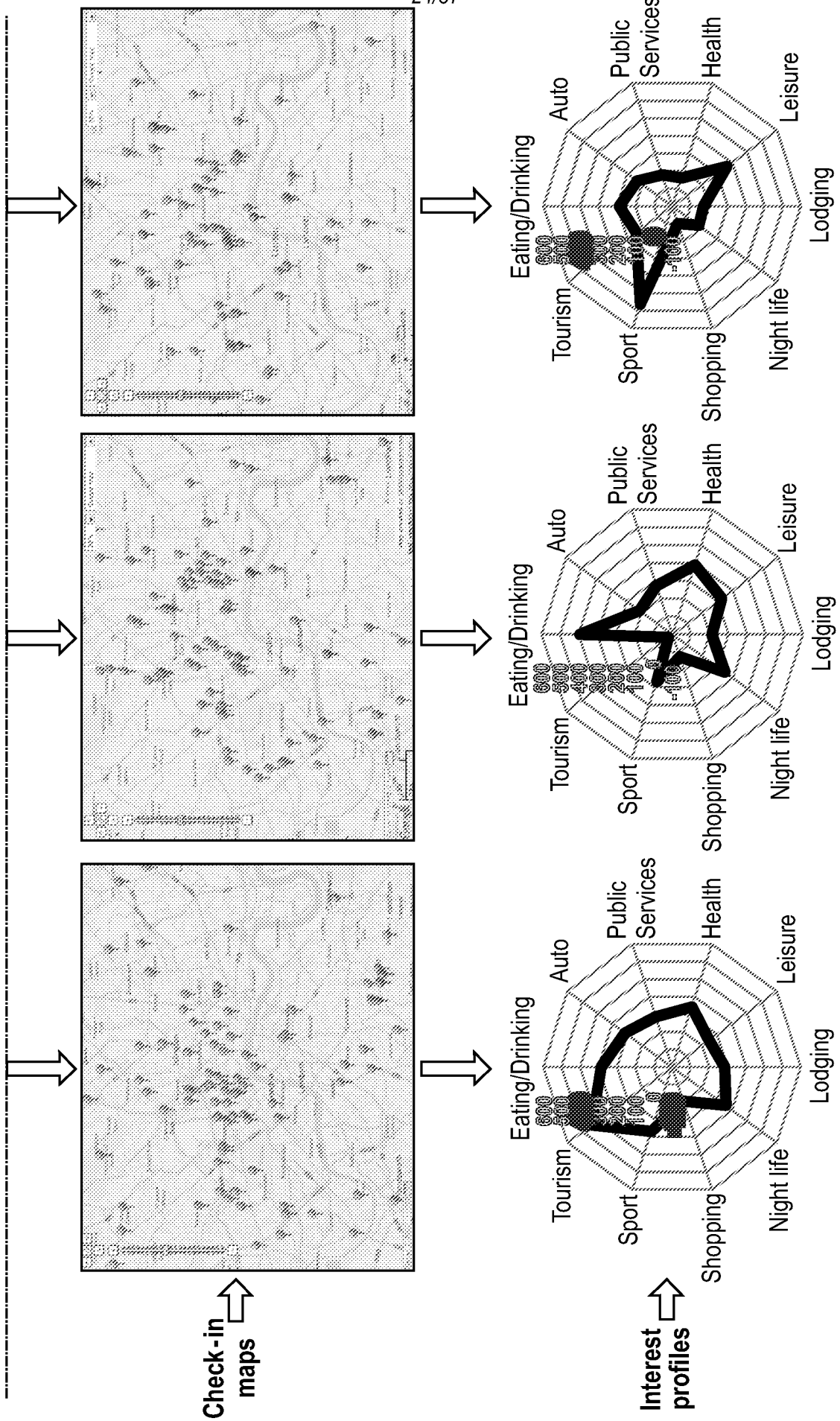

Check-in maps
Interest profiles
Eating/Drinking
Auto
Public Services
Health
Leisure
Lodging
Night life
Shopping
Sport
Tourism
600
500
400
300
200
100

FIG. 23(contd)

FIG. 24 Sample Interest Profiles from the Groups 1 and 2 (Figure 23)

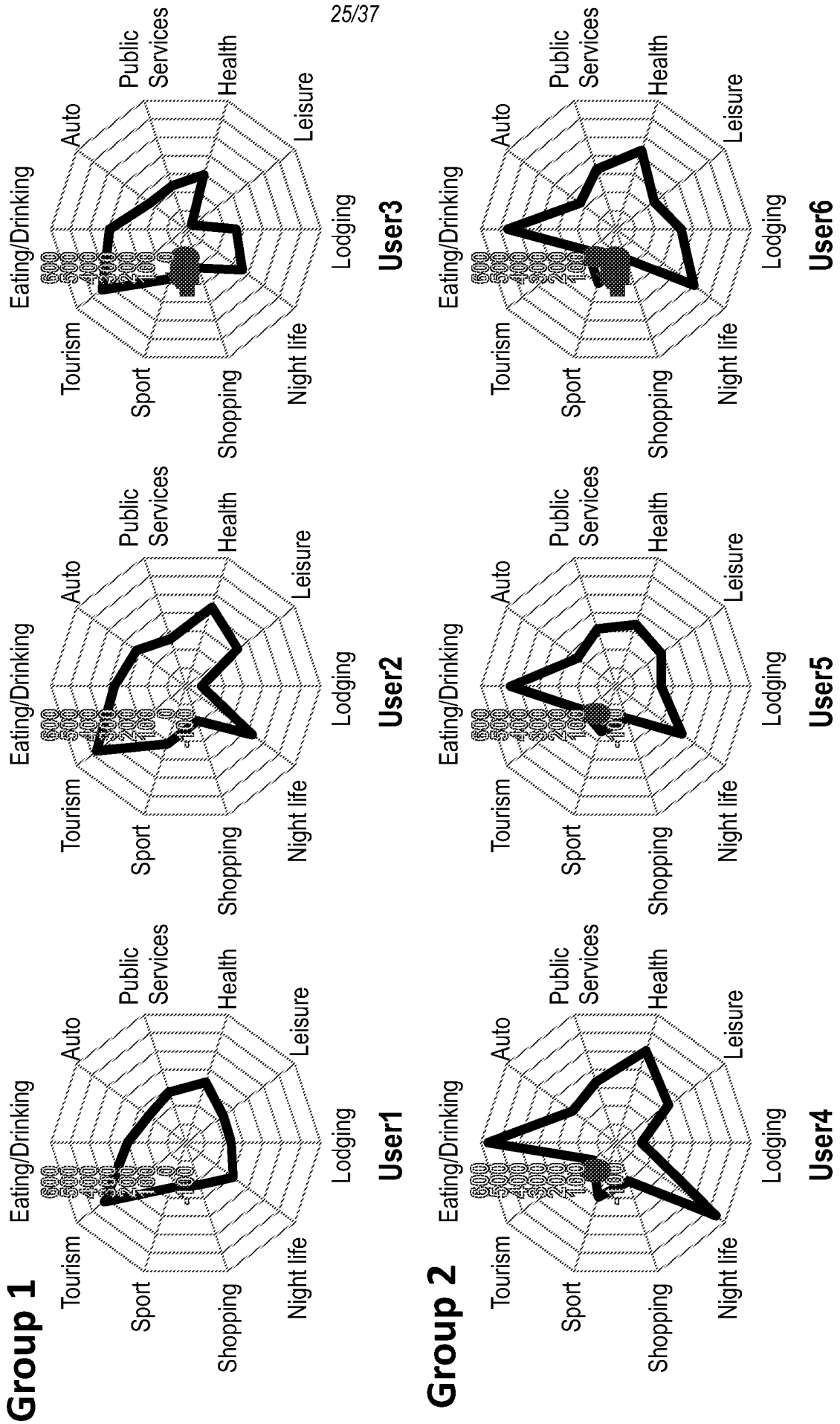
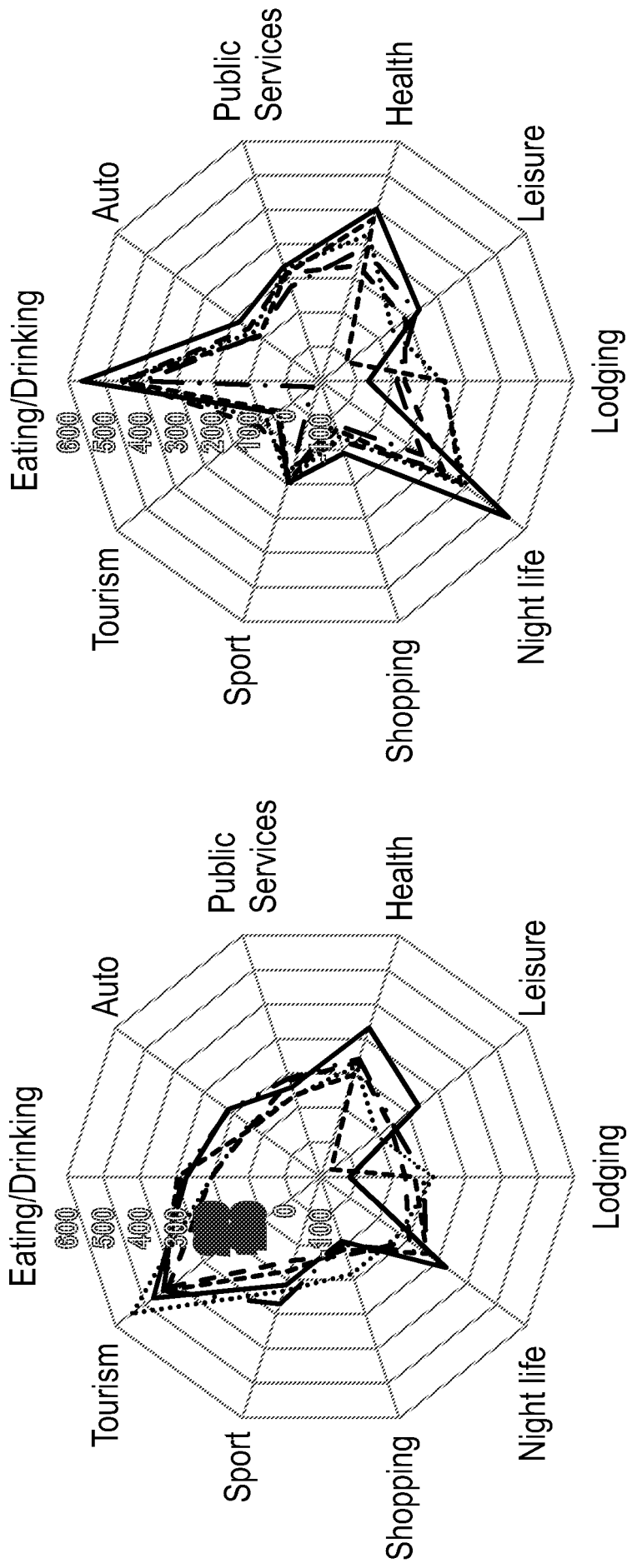


FIG. 25 Comparison of the Interest Profiles of users with different check-in patterns



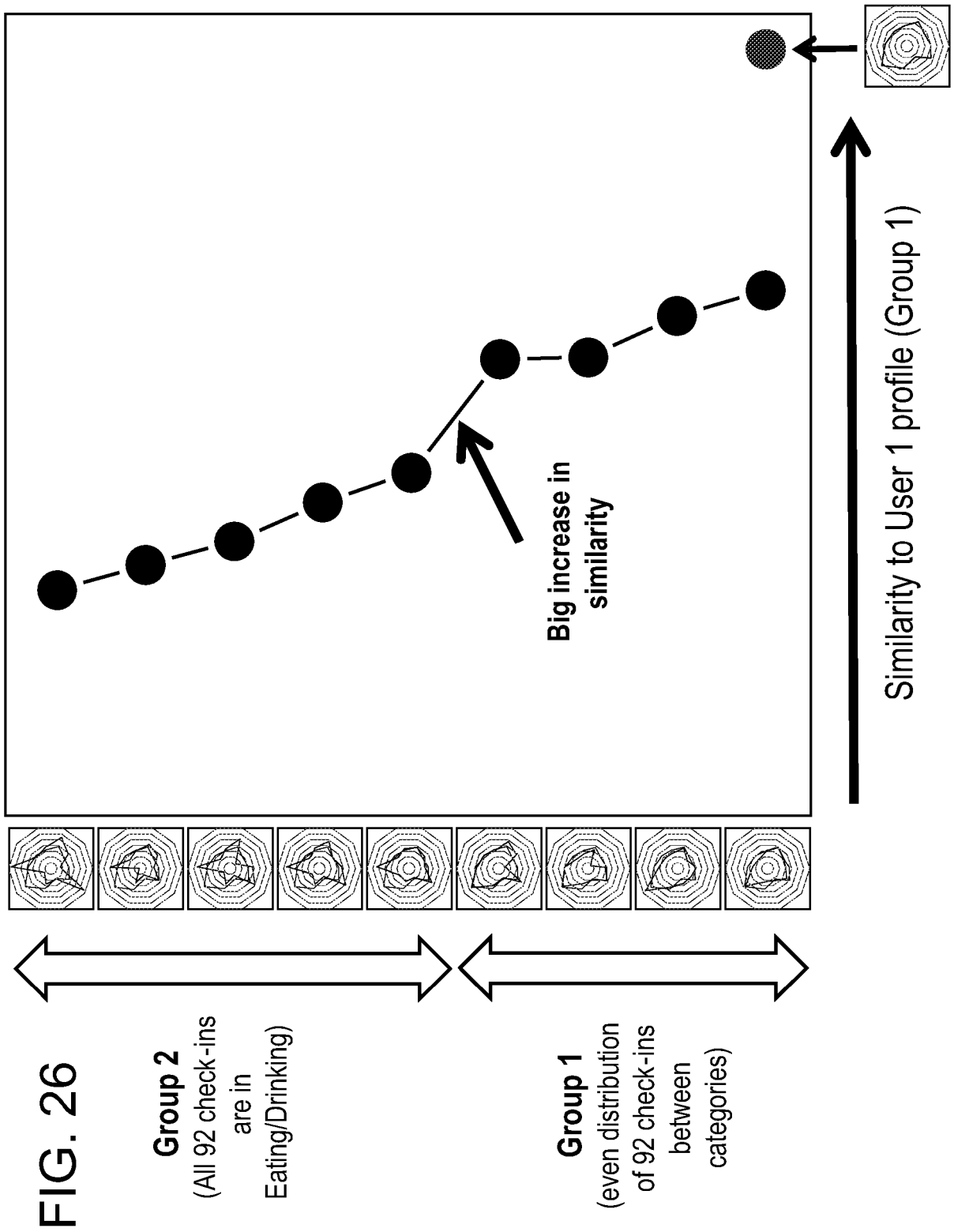

Similarity to User 1 profile (Group 1)
Big increase in similarity
Group 2
(All 92 check-ins are in Eating/Drinking)
Group 1
(even distribution of 92 check-ins between categories)

FIG. 26

FIG. 27 Selecting the geographic area and type of places

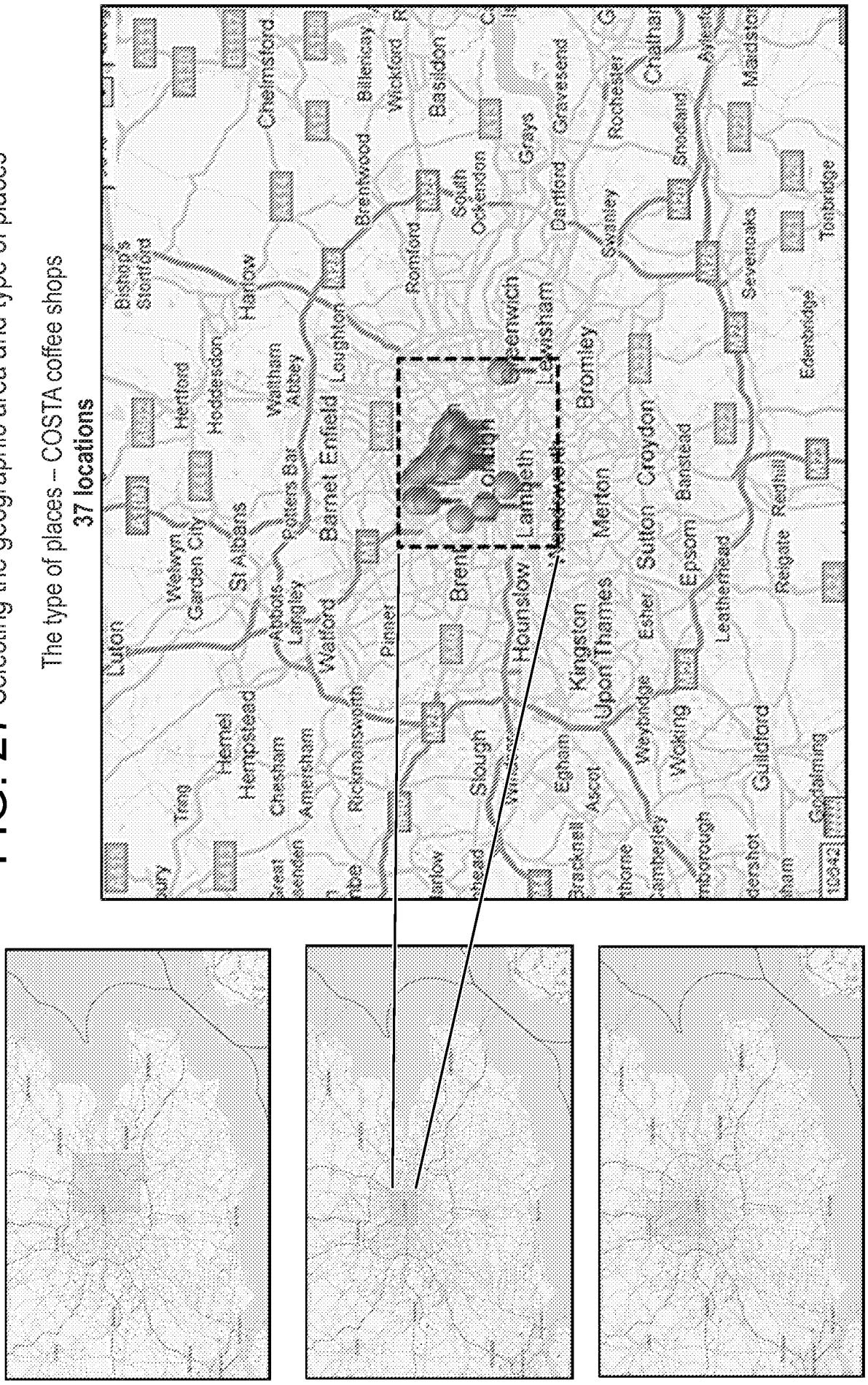
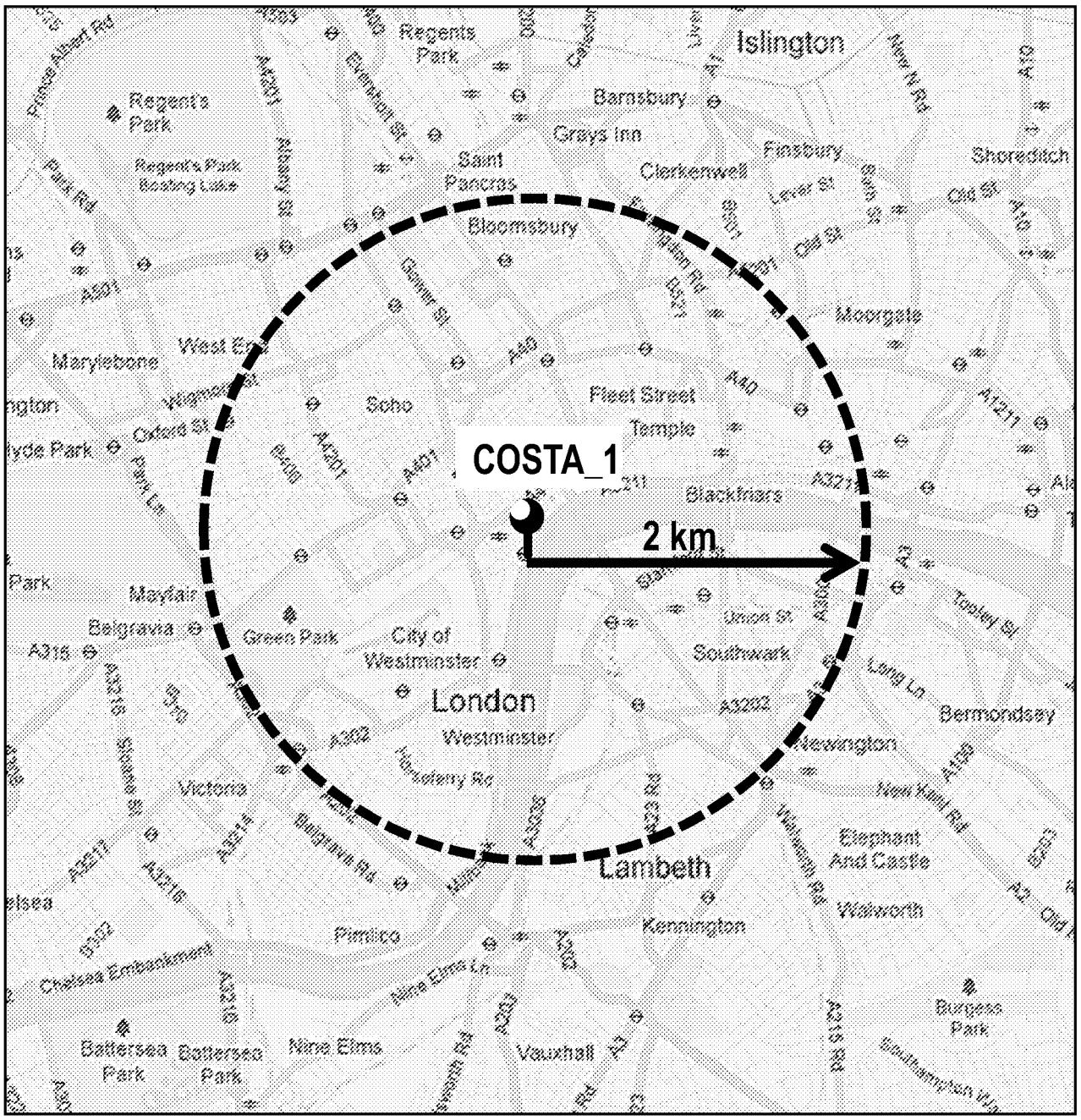


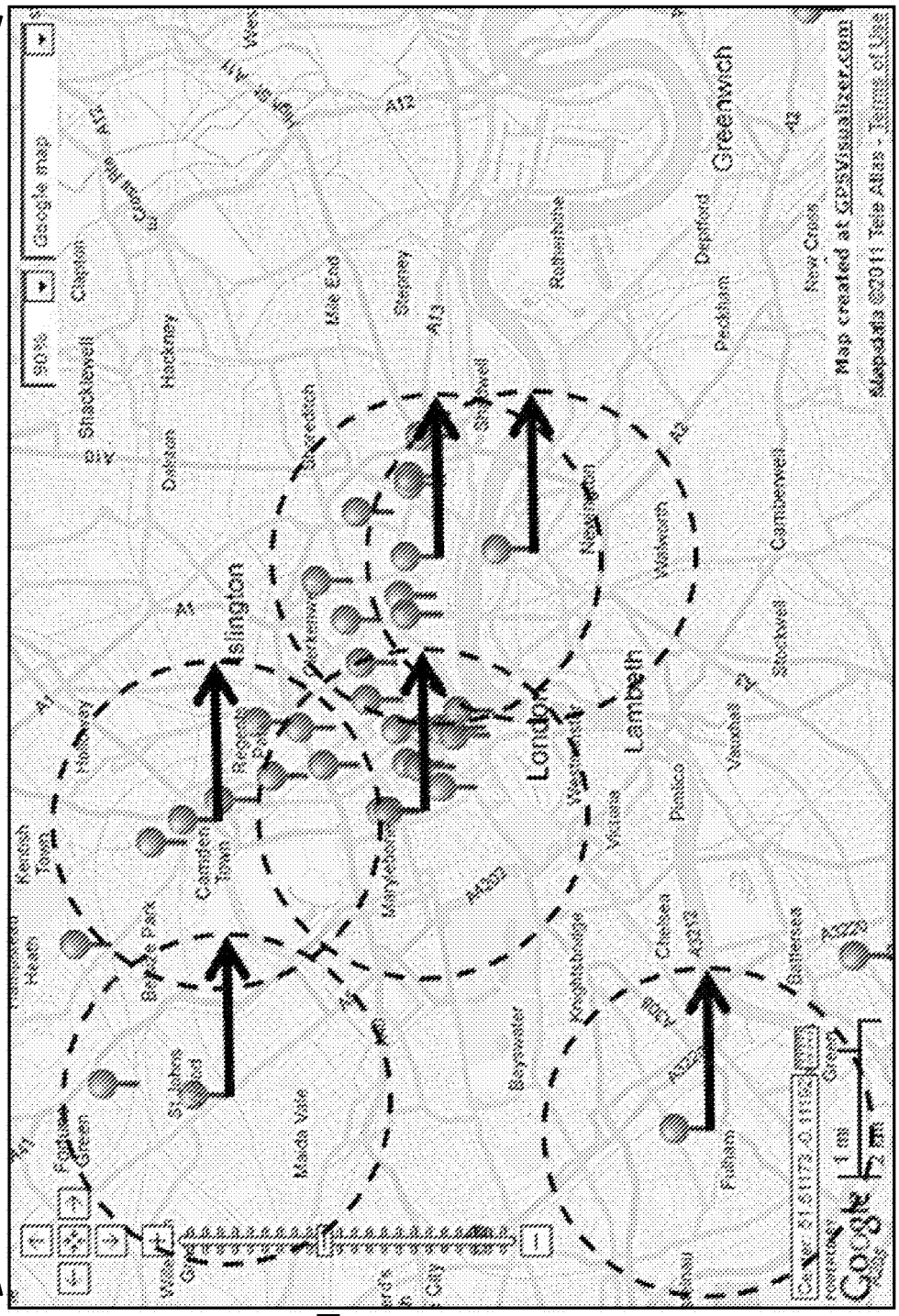
FIG. 28

Defining the size of neighbourhood area with public activities



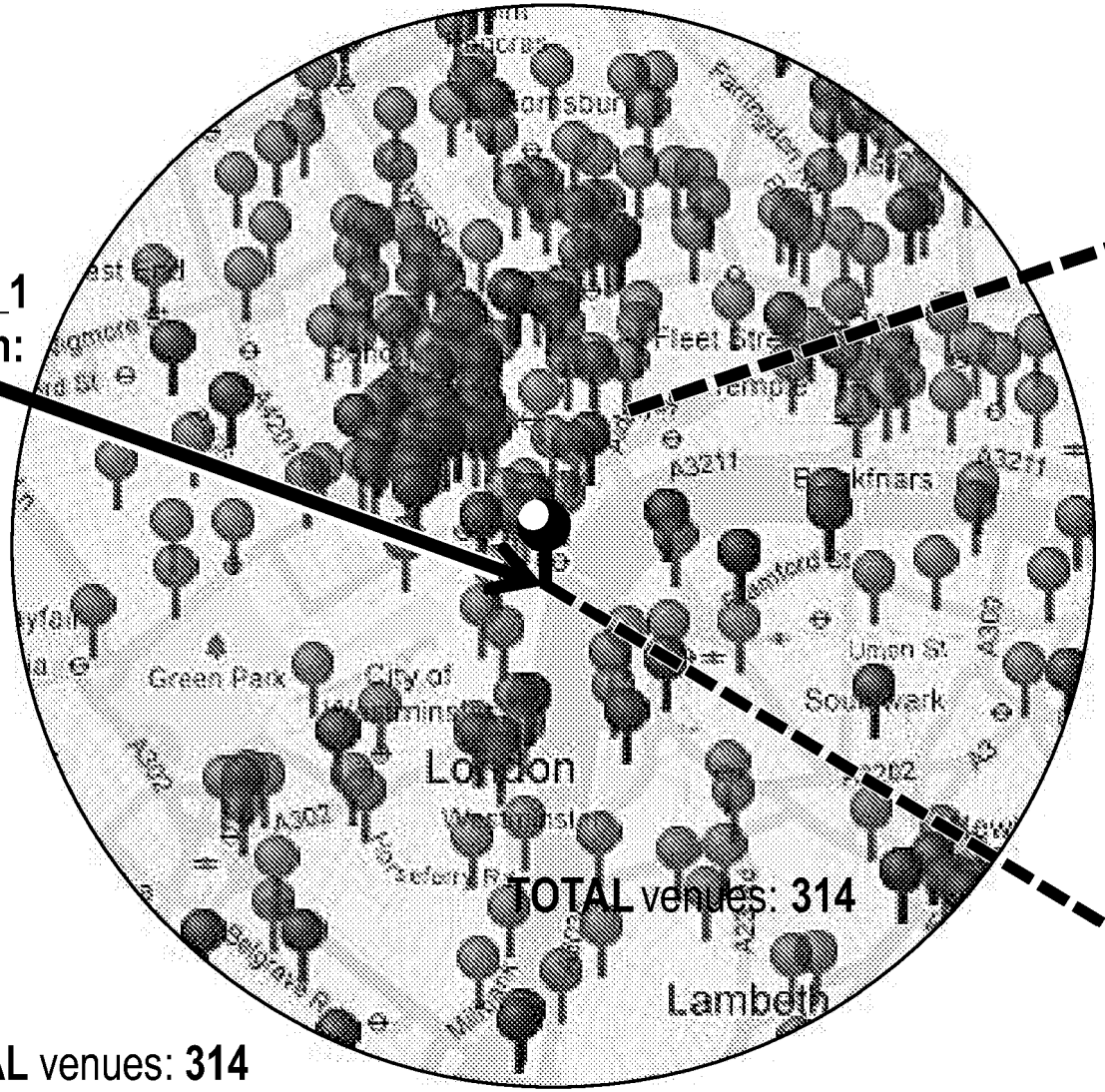
COSTA_1 location

FIG. 29 Selecting the neighbourhood areas with public activities for each place



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FIG. 30 Obtaining all venues within the neighbourhood area of each place from geospatial databases, i.e. factual.com



COSTA_1: venue_1

Venue_1ID	**4bf58dd8d48988d111941735**
Name	Waterstones Booksellers Ltd
Telephone	020 7240 3444
Longitude	-0.122381
Latitude	51.514565
Address	203/206 Piccadilly, London
Postcode	W1J 9HD
URL	http://www.waterstones.com/
Category ID	4e6620031f6ef7d07c40926c
Category Name	Bookstores
...	...

COSTA_1: venue_2

Venue_2 ID	**4bf58dd8d48988d111941735**
Name	Costa coffee
Telephone	020 7240 3423
Longitude	-0.122567
Latitude	51.507001
Address	13 New Row, City of London
Postcode	WC2N 4LF
URL	http://www. costa.co.uk/
Category ID	4bf58dd8d48988d163941735
Category Name	Coffee/Tea
...	...

TOTAL venues: **314**

FIG. 31 Creating the Interest Profile of Costa

Creating the Interest Profiles of Individual Costa locations (Fig. 15 - 21)

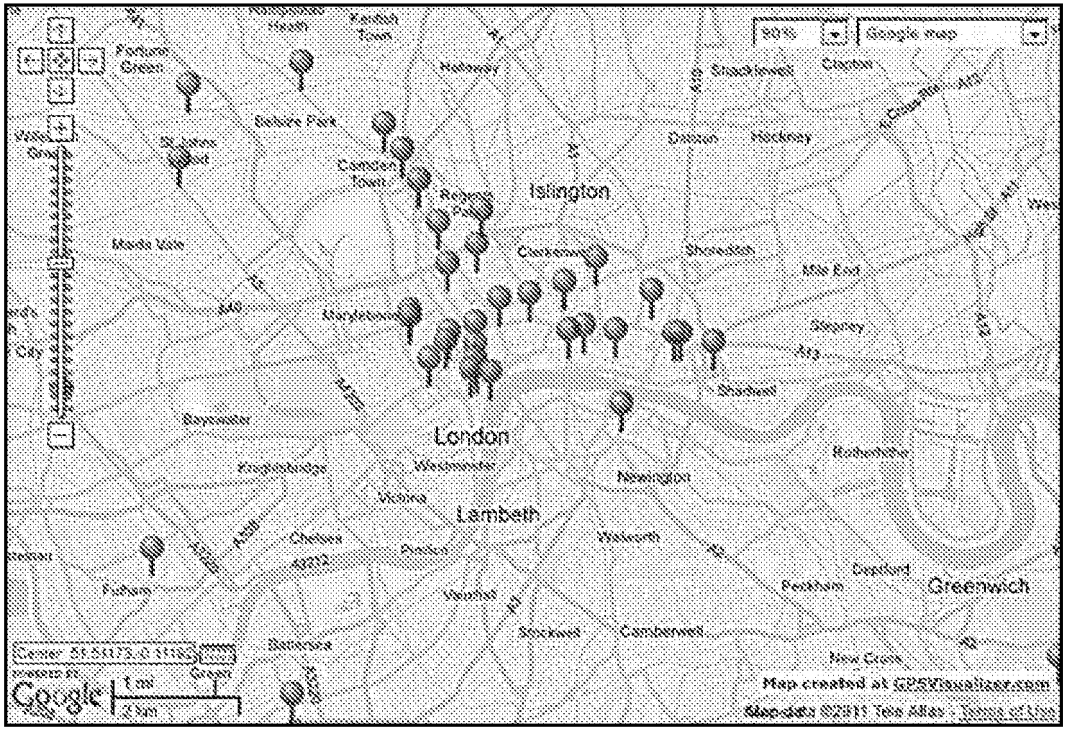
↓

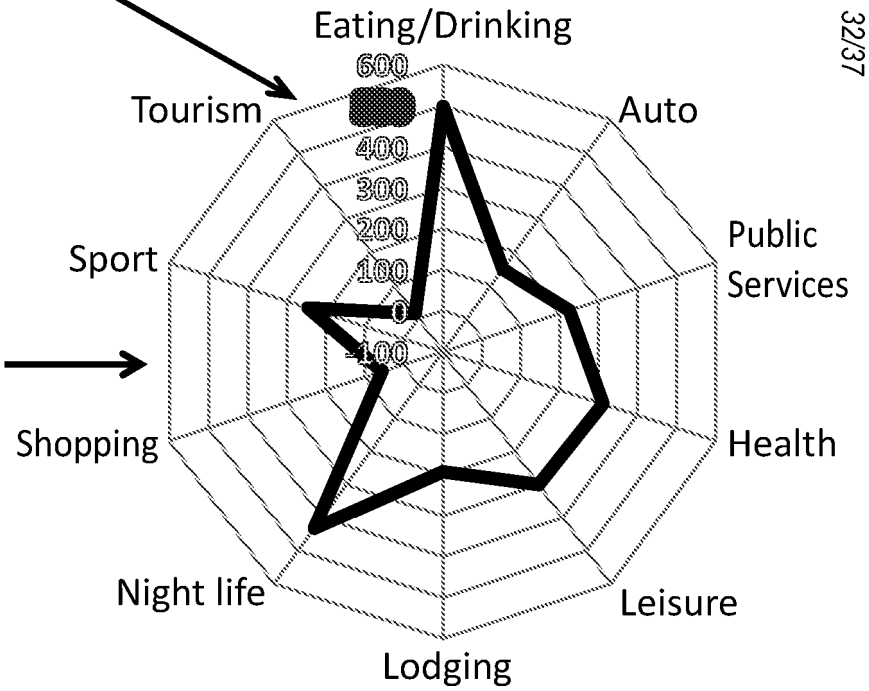
Costa Total interest score

↓ × (number of Costa locations)/area size

Normalized Interest Profile of Costa

37 Costa locations in the area





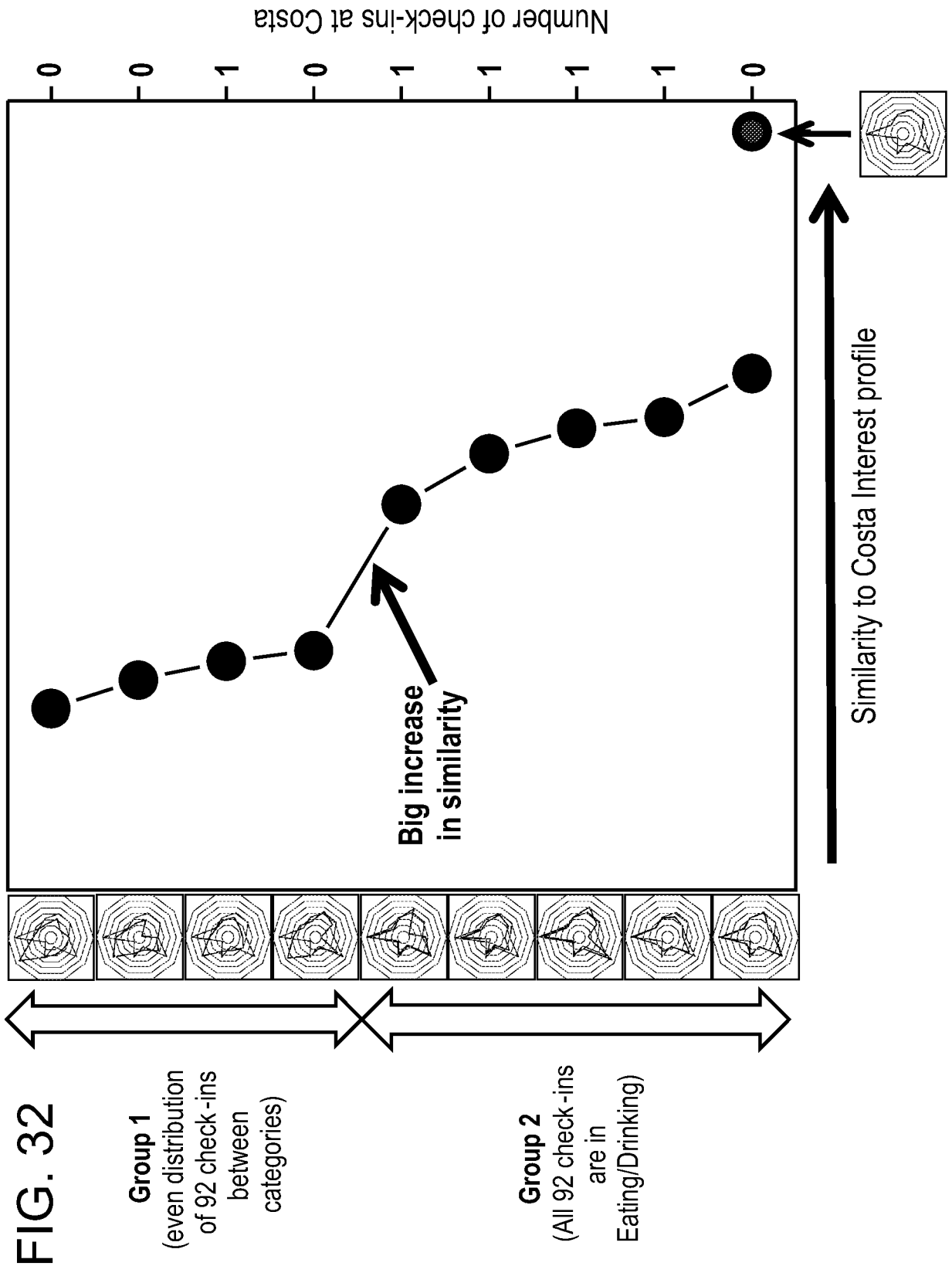

Number of check-ins at Costa
0
0
1
0
1
1
1
1
0
Big increase in similarity
Similarity to Costa Interest profile
Group 1 (even distribution of 92 check-ins between categories)
Group 2 (All 92 check-ins are in Eating/Drinking)

FIG. 32

FIG. 33

Creating the interest profile of groups of users

Individual Interest Profiles of users [1] to [N] (Fig. 15 -22)

↓

(Interest profile[1] + ... + interest profile[N])/N = **Group Interest Profile [1+ ... +N]**

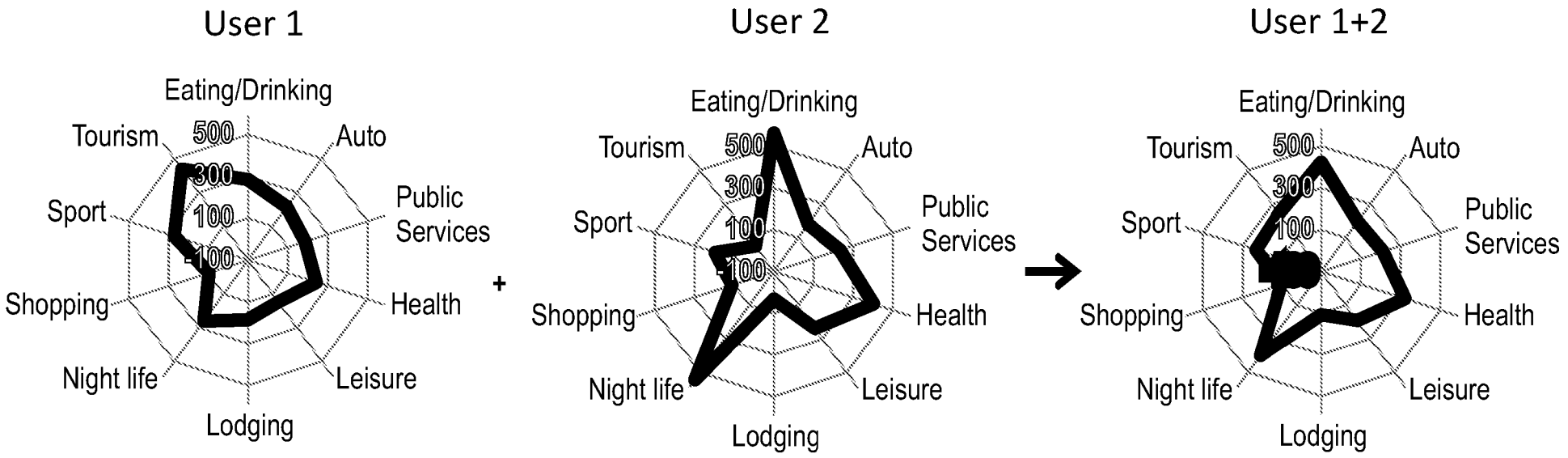


FIG. 34 Categorisation of **public activities** content into the established taxonomy structure

Primary categories (Tier 1) | Secondary categories (Tier 2)

Eating/drinking	Shopping	Auto	Public Services	Heath Care	Leisure	Lodging	Night Life	Sport	Tourism
American Cuisine	Antique Shops	...	...	...	...	...	...	...	...
Barbecues & Grilling	Arts & Craft Stores	...	...	...	...	...	...	...	...
Cajun/Creole	....	...	...	...	...	...	...	...	...
Chinese Cuisine	Bike Shops	...	...	...	...	...	...	...	...
Cocktails/Beer	Bookstores	...	...	...	...	...	...	...	...
Coffee/Tea	....	...	...	...	...	...	...	...	...
Cuisine - Specific	Clothing Shops	...	...	...	...	...	...	...	...
Desserts & Baking	Department Stores	...	...	...	...	...	...	...	...
Dining out	Furniture and Home stores	...	...	...	...	...	...	...	...
French Cuisine	...	...	...	...	...	...	...	...	...
Health/Low Fat Cooking	Music Stores	...	...	...	...	...	...	...	...
Italian Cuisine	Service Shops	...	...	...	...	...	...	...	...
Japanese Cuisine	...	...	...	...	...	...	...	...	...
Vegetarian	...	...	...	...	...	...	...	...	...

SUBSTITUTE SHEET (RULE 26)

FIG. 35

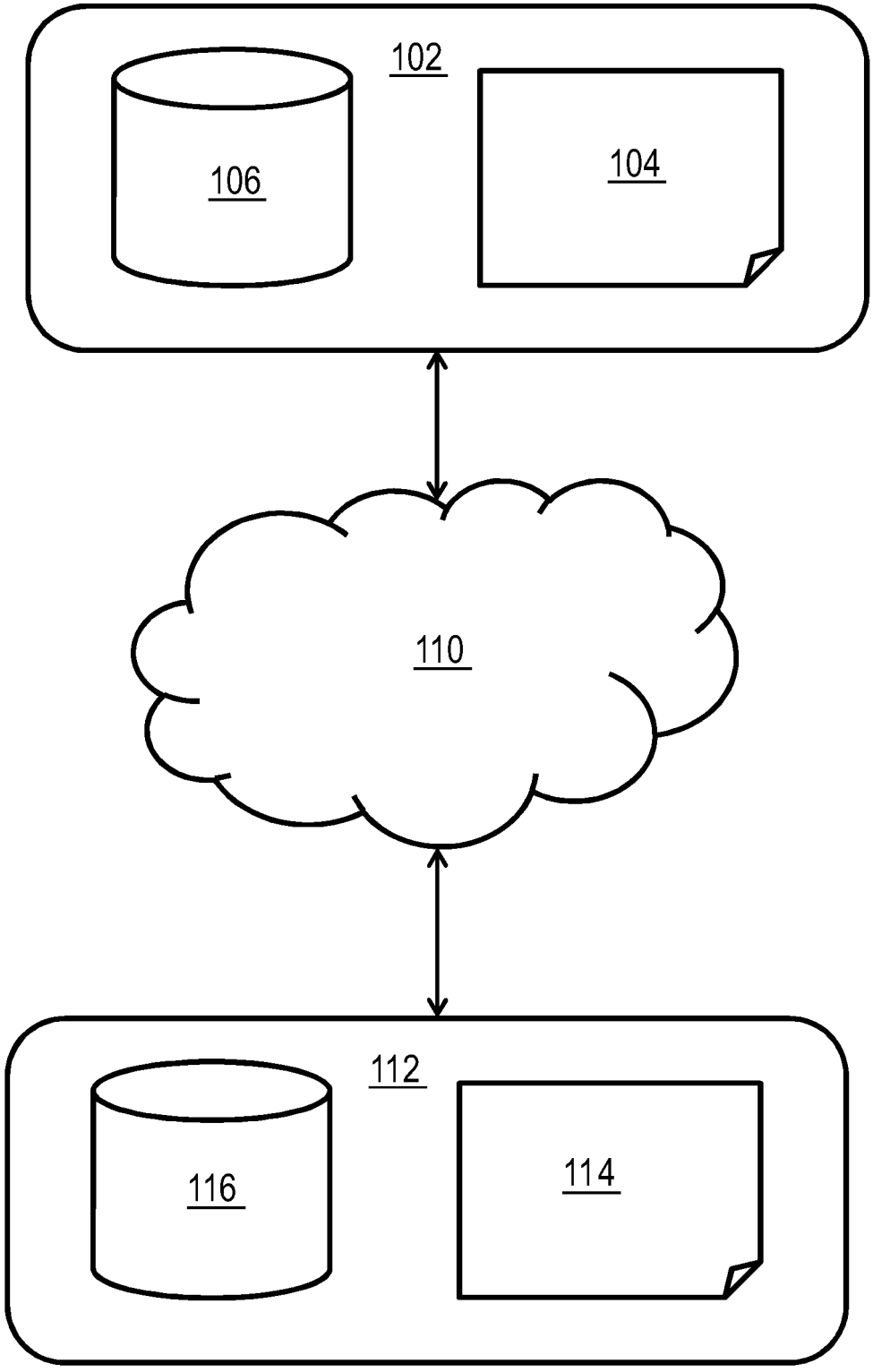
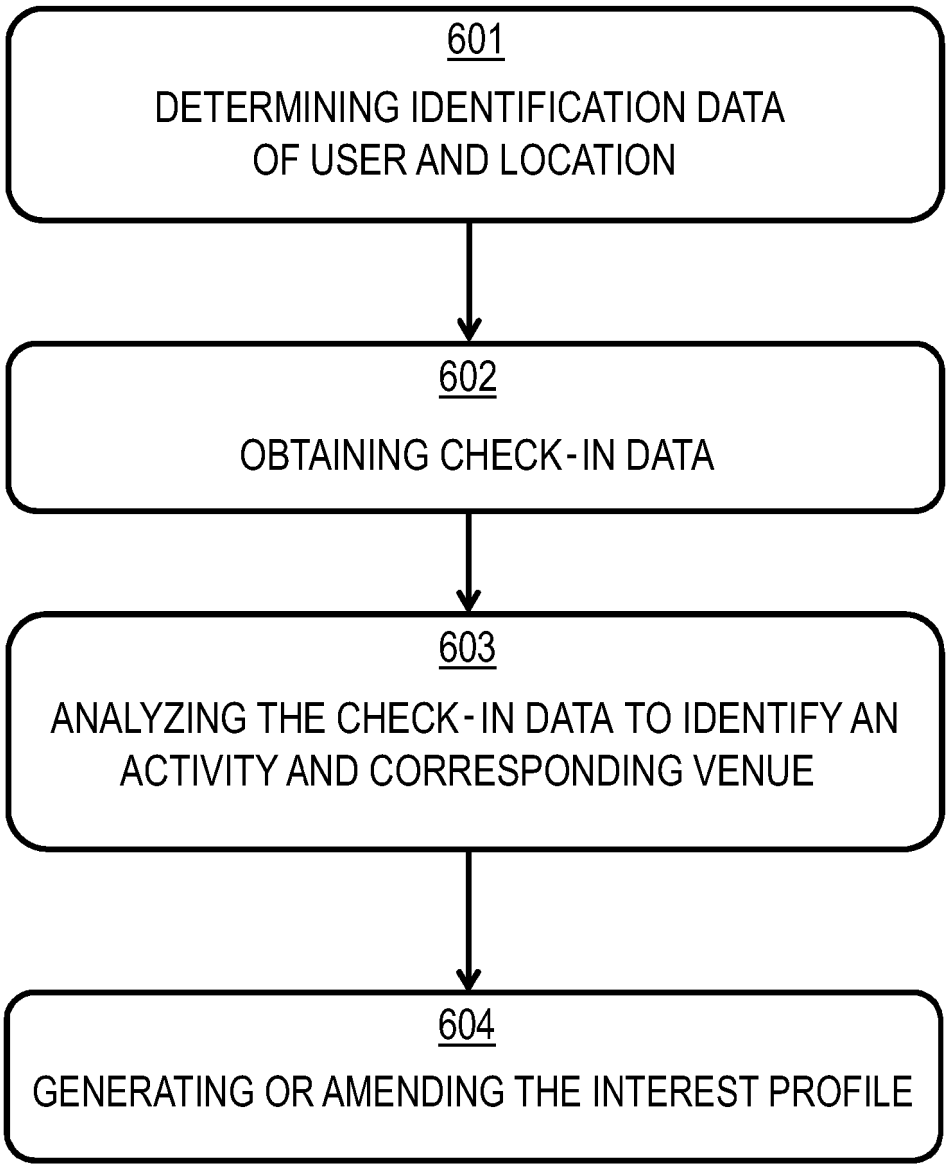


FIG. 36


601
DETERMINING IDENTIFICATION DATA OF USER AND LOCATION
602
OBTAINING CHECK-IN DATA
603
ANALYZING THE CHECK-IN DATA TO IDENTIFY AN ACTIVITY AND CORRESPONDING VENUE
604
GENERATING OR AMENDING THE INTEREST PROFILE