Out-of-home activity recognition from GPS data in schizophrenic patients

Sonia Difrancesco[1], Paolo Fraccaro[2], Sabine van der Veer[2], Bader Alshoumr[2], John Ainsworth[2], Riccardo Bellazzi[1], Niels Peek[2]

[1] Dept. of Industrial and Information Engineering, University of Pavia, Pavia, Italy

[2] Health e-Research Centre, The University of Manchester, Manchester, UK

Background

- Schizophrenia is a long-term mental health problem affecting approximately 1% of the general population.
- It is characterized by repeated psychotic relapse, with up to 82% of patients relapsing within 5 years from their initial psychotic episode.
- Social functioning is a common measure to monitor the risk of psychotic relapse.
- Monitoring of social functioning usually relies on infrequent clinic visits, limiting the capacity to detect sudden changes.
- Routinely collected GPS data from smartphones introduce novel opportunities to implement real-time monitoring of out-of-home activities that are related to social functioning.

Aim

To explore to what extent out-of-home activities can be assessed from geolocation data, routinely and passively collected with smartphones in schizophrenic patients.

Methods

Step 1: We conducted a five-day pilot study with schizophrenic patients. Participants used a smartphone to continuously record their GPS location, and completed a paper-based social functioning diary (SFD) to register out-of-home activities.

Step 3: We used the density-based algorithm and the time-based algorithm to detect geolocations visited by a person.

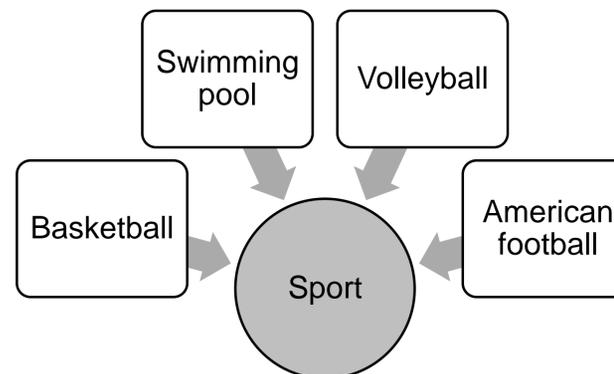Time-based algorithm
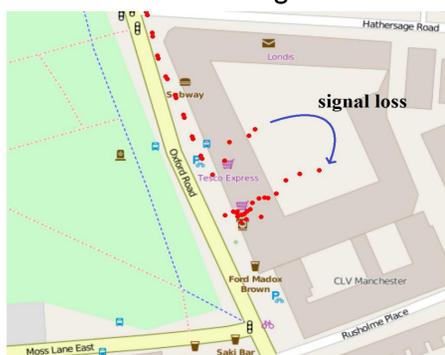
Density-based algorithm

signal loss
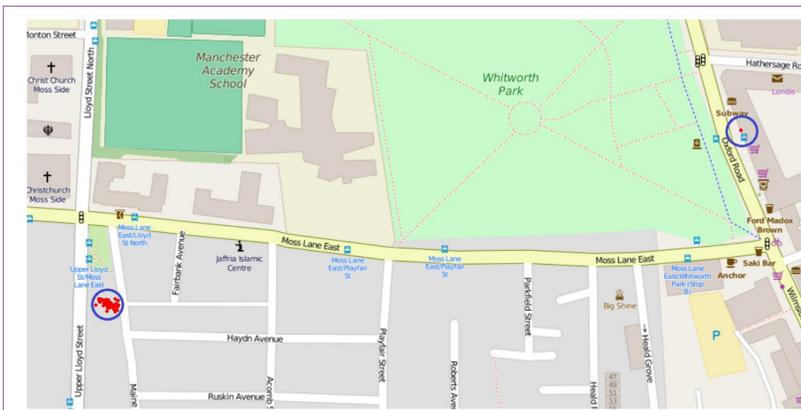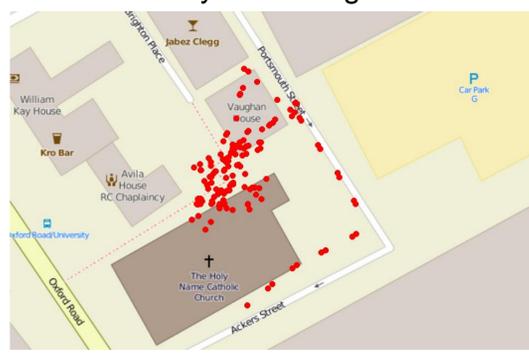
Step 4: We applied a modified k-means clustering algorithm to identify the coordinates of places visited from geolocations visited.

Step 2: We implemented two pipelines to to infer out-of-home activities (i.e. time-based, density-based) from raw GPS data (grey = output; white = method).

Raw GPS data

Detection of geolocations visited

Geolocations visited

Identification of places visited

Places visited

Recognition of Type of places and activities
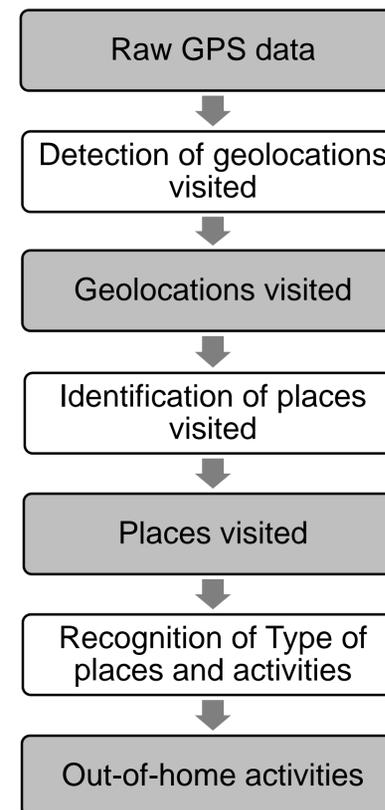
Out-of-home activities

Step 5: We used a series of heuristic rules and combined information from web services (i.e., Google Place API, GeoNames) and the OpenStreetMap (OSM) platform to identify the real world place associated to each place visited.

Work

Shop

Home

Step 6: We inferred the activities that patients performed in a real world place with the use of a taxonomy.

Swimming pool

Volleyball

Basketball

American football

Sport

Results

Table 1: Five patients participated in our pilot study.

	Total number of days	Total number of hours	Total number of SFD activities
Total	20	396.6	35
Mean (sd)	4 (1)	79.3 (30.6)	7 (2.9)
Range	3 - 5	36.8 - 109.9	3 - 11

Table 2: We assessed performance with Recall and Precision.

Algorithm	Recall	Precision
Time-based	0.600 (0.163)	0.909 (0.096)
Density-based	0.714 (0.168)	0.714 (0.157)

Conclusion

- This study has demonstrated the feasibility to assess out-of-home activities from geolocation data that is routinely collected with smartphones.
- This provides novel opportunities to prevent relapse in schizophrenic patients.
- In the future, more sophisticated analytical methods will be investigated to obtain better performance.