CROWD SENSING: APPLICATIONS FOR SMART CITIES

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Motivation of the work

- The combination of popular Social Network Sites and GPS devices has provided a continuously increasing number of geo-tagged post, messages and communications. This information from social media streams might be used to different purposes.
- Social media analytics makes it possible to detect public crowds with real-time data mined from Twitter [1] and other social networks. Besides, Text analytics uses natural language processing to spot key words and to infer topics from tweets.
- Our contribution is to find a solution for the community using open tools and available data to easier understand the phenomena of crowd in smart cities [2] in order to detect unusual situations and provide assistance to improve planning cities infrastructure.

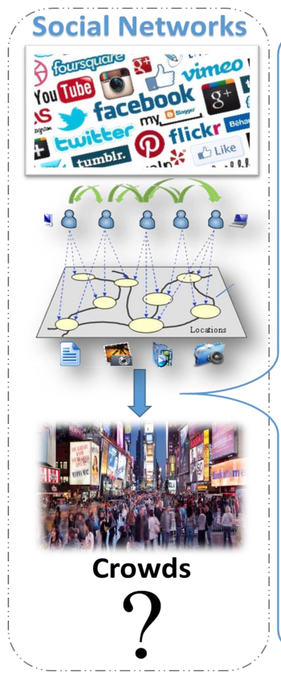
Thesis Objectives

- Collecting data from Social Media in order to identify geo-located time series representing crowds.
- Gathering unstructured data from different social media sources (data fusion)
- Applying Data Mining techniques to analyze communities behavior in Smart cities (clustering algorithms, classification algorithms, temporal series analysis, etc.)
- Designing and validating specific-purpose algorithms to detect & predict unusual situations from outliers' characterization.
- Designing and validating recommendation strategies to provide assistance to urban planning in scenarios related to the usage of infrastructure and services.

Next Year Planning

- 3rd Research stage:
  - Predicting the location of people crowds (unexpected collectives) by mining social networks.
  - Establishing the guidelines of alarm mechanism based on crowds' prediction.
  - Identifying unusual mobility patterns by mining social networks.
  - Establishing the guidelines of assistance mechanisms (recommendation) to urban planning, based on the application of collaborative filtering of citizens' tracking.
- Obtaining a realistic dataset and validating the proposed methods in a controlled scenario.
- Publishing the results of the 3rd research stage & Writing the PhD Thesis.

Research Plan

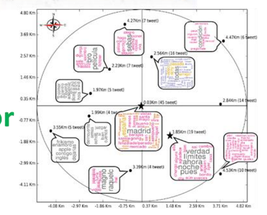


I. Crowd Detection
- Collecting data
- Applying density-based clustering
- Outlier detection
- Obtaining a crowd detection methodology

Crowds detected in Madrid and New York City

DONE

II. Crowd Analysis
- Tracking people crowds
- Analysing content
- Analysing user's behavior



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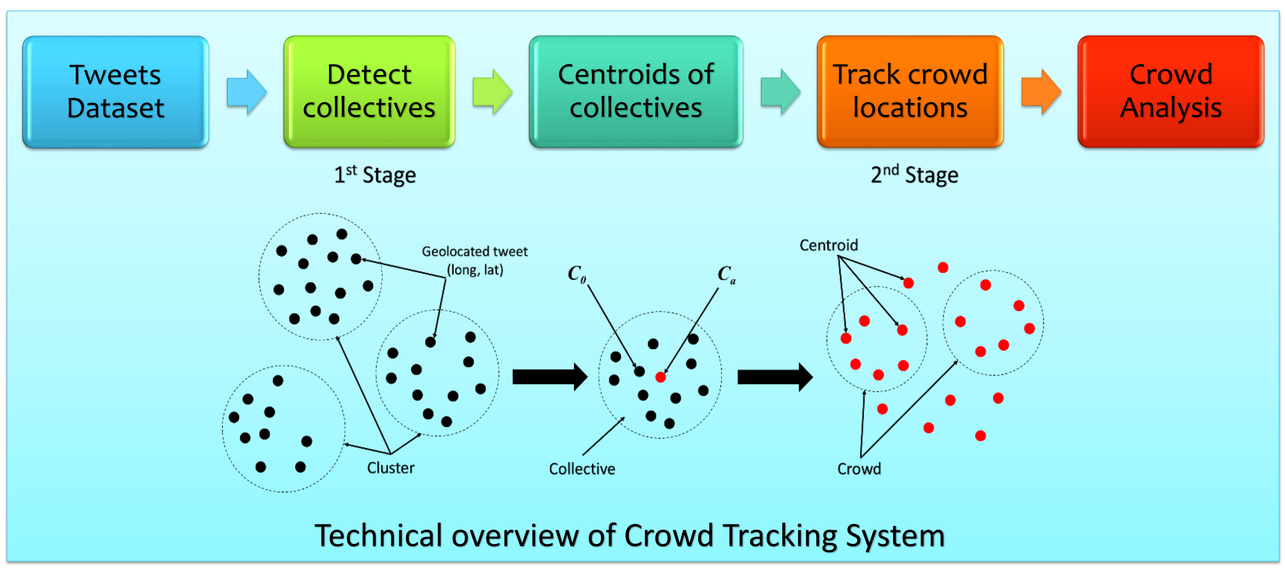
III. Crowd Prediction
- Crowd's location prediction
- Recommendation systems
- Alarm systems

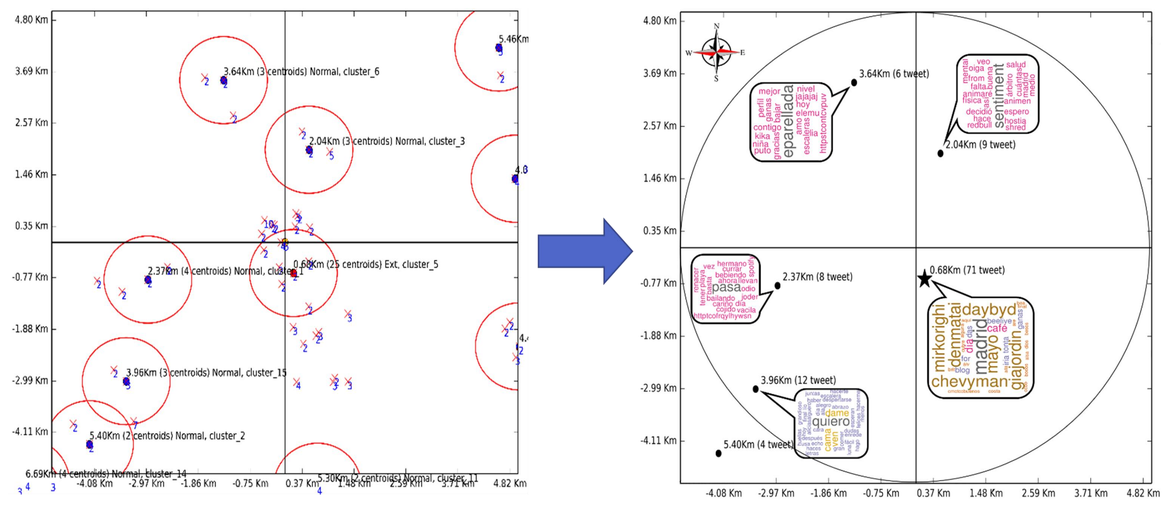
IN PROGRESS

Results & Discussions

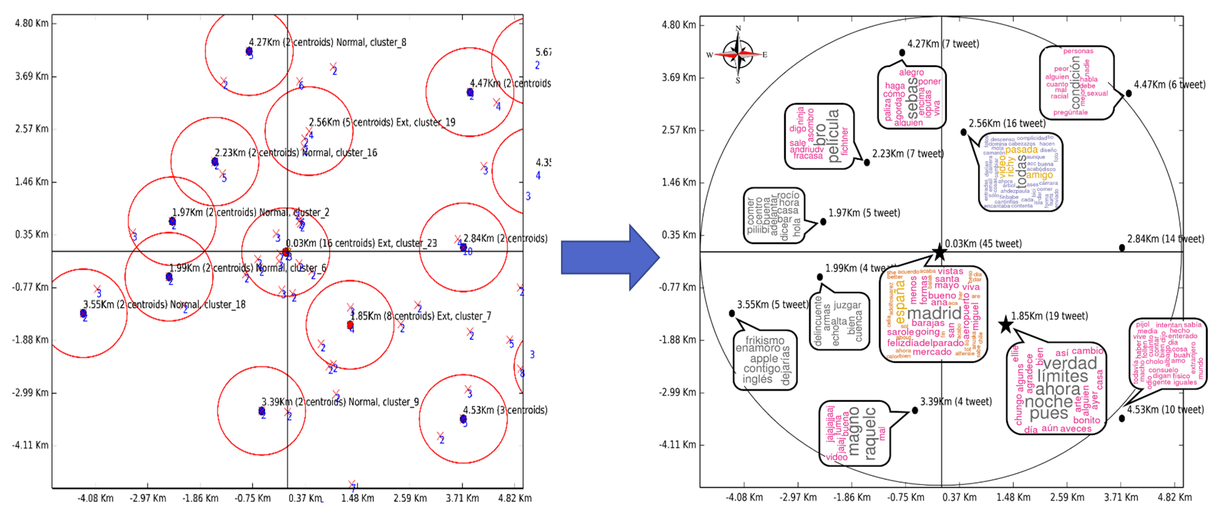


Technical overview of Crowd Tracking System

- ✓ In [3], we proposed a crowd detection methodology for smart cities, which combines Twitter mining, density-based clustering and outlier detection to identify predictable public crowds.
- ✓ Our work was validated in the City of Madrid in the International workers day (May Day) where large number of people normally concentrate in the city center and its surroundings during the event.
- ✓ Based on our preliminary results, it is possible to detect crowds as groups of people in the same area and then to describe the event by extracting the main topic and grouping them according to the frequency of the terms in the messages.
- ✓ During the peak time of the event (from 12 to 1p.m.), the two figures below show that tag clouds are depending on the distance from the City center, the nearest the crowd (red circles) is to City center (Puerta del sol), the highest number of common terms and tweets are.



Madrid City between 12:00 and 12:30p.m. in May Day



Madrid City between 12:30p.m. and 1p.m. in May Day

- ✓ Two papers **accepted;** one in the International Conference on Citizen Networks "**MIKE2014**" [3], and other in the International Conference on Information, Intelligence, Systems and Applications "**IISA2015**".
- ✓ Two papers **submitted** to International Journals; first to the Expert Systems with Applications Journal (JCR), entitled "Crowd detection based on Twitter activity" (In revision state) and Second paper submitted to The Journal of Network and Computer Applications.

References

[1] B. A. Huberman, D. M. Romero, and F. Wu, "Social networks that matter Twitter under the microscope," First Monday, vol. 14, 2009.

[2] G. Cardone, L. Foschini, P. Bellavista, A. Corradi, C. Borcea, M. Talasila, and R. Curtmola, "Fostering participaction in smart cities: A geo-social crowdsensing platform," IEEE Commun. Mag., vol. 51, no. 6, pp. 112–119, 2013.

[3] M. Ben Kalifa, R. P. D. Redondo, A. F. Vilas, R. L. Serrano, and S. S. Rodríguez, "Is There a Crowd? Experiences in Using Density-Based Clustering and Outlier Detection," Min. Intell. Knowl. Explor., vol. 8891, pp. 155–163, 2014.

[4] M. Ben Kalifa, R. P. D. Redondo, A. F. Vilas, "Why are these people there? An analysis based on Twitter", International Conference on Information, Intelligence, Systems and Applications (In press)

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