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Urban data and urban design: A data mining approach to architecture education

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Abstract - *The configuration of urban projects using Information and Communication Technologies is an essential aspect in the education of future architects. Students must know the technologies that will facilitate their academic and professional development, as well as anticipating the needs of the citizens and the requirements of their designs. In this paper, a data mining approach was used to outline the strategic requirements for an urban design project in an architecture course using a Project-Based Learning strategy. Informal data related to an award-winning public space (Gillett Square in London, UK) was retrieved from two social networks (Flickr and Twitter), and from its official website. The analysis focused on semantic, temporal and spatial patterns, aspects generally overlooked in traditional approaches. Text-mining techniques were used to relate semantic and temporal data, focusing on seasonal and weekly (work-leisure) cycles, and the geographic patterns were extracted both from geotagged pictures and by geocoding user locations. The results showed that it is possible to obtain and extract valuable data and information in order to determine the different uses and architectural requirements of an urban space, but such data and information can be challenging to retrieve, structure, analyze and visualize. The main goal of the paper is to outline a strategy and present a visualization of the results, in a way designed to be attractive and informative for both students and professionals – even without a technical background – so the conducted analysis may be reproducible in other urban data contexts.*

Key Words
Data mining
Urban data
Architecture education
Informal learning

1.INTRODUCTION

According to the Royal Institute of British Architects (RIBA) in its Plan of Work 20131 (Sinclair, 2013), the first key stage in a building project is "Strategic Definition", where the core project requirements are identified. In this stage, it is crucial to identify the requirements that need to be fulfilled by the proposed architectural or urban design.

Architectural education has traditionally relied on Project-Based Learning (PBL), where students are required to develop a proposal, usually over the course a semester, in a process that mimics the workflow of an architectural studio. During the running text should match with the list of references at the end of the paper development of this proposal, students learn to integrate often-conflicting aesthetic, constructive, structural, environmental, and usability requirements into a cohesive design, under the guidance of a tutor. In this scheme, the students are usually provided with the location where the design is to be developed and examples of related notable designs as reference.

Architects and urban designers (both graduate and undergraduate) learn about their discipline in a continuous and informal way, because the subject of their craft surrounds them almost anywhere and anytime, thus explaining the important historic role of travel in the formative years of architects. However, nowadays the world that surrounds us is increasingly digital, especially for the younger generations using mobile devices and cloud computing services (Moreira and Ferreira, 2017; Moreira et al., 2016), and in the specific framework of architectural education and professional practice it is clear that we should incorporate this new paradigm and approaches.

2. FRAMEWORK

Information and Communication Technologies (ICTs) are transforming citizens' lifestyles, adding new dimensions to the concept of socialization, as well as creating new habits. Other studies describe the opportunities offered by these emerging technologies as "creating a new kind of reality, one in which physical and digital environments, media and interactions are woven together throughout our daily lives." At the same time, new university students can be defined as Digital Natives or Digital Residents, because they coexist and use all kinds of network technologies, multiple applications and all kinds of mobile devices at very early ages.

2.1 URBAN DATA AND DESIGN PROPOSALS

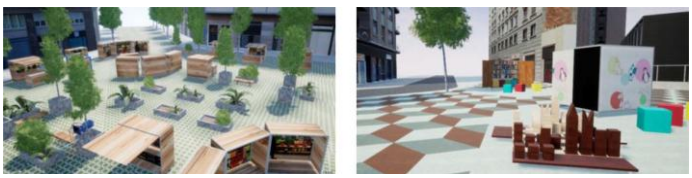

Fig-1: Some of the students' proposals, inserted into the simulated environment and with the capacity to be interacted with (moved and rotated).

During the course, stakeholders suggested that a possible reference for the students of a similar civic space could be Gillett Square, located in London (UK), a community-led regeneration project in a former car park, designed by Hawkins-Brown Architects, and recipient of a WAN Award in 2012 in the Effectiveness category2. The proposal to analyze the project carried out in Gillett Square, and its possible implications on the global project that will be held in Barcelona, was suggested by the municipality of Barcelona, one of the entities that is giving explicit support to the completion of the overall project.

In addition, geo-tagged pictures from Flickr and the content of the official Gillett Square website3 regarding the schedule and content of past events organized in the square were also retrieved and analyzed, with the objective of being used as teaching materials in the next edition of the course.

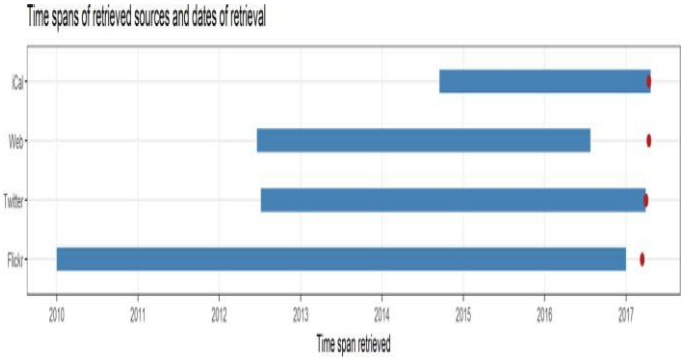

Chart -1: Time spans of the retrieved sources

3. DATA RETRIEVAL

3.1. RETRIEVING GEOTAGGED PICTURES THROUGH THE FLICKR API

The Flickr API allows requesting pictures inside a specific geographical area defined by bounding rectangle through the coordinates of its southwest and northeast corners. To retrieve the geotagged pictures around the area of interest, a geofence consisting on a 0.03×0.03 degree area centered on the center of the area of interest was defined. The API required authentication using an API Key, which is transmitted as part of the request URL through the HTTPS protocol.

The JSON strings were parsed using the R package jsonlite 1.4 and their latitude and longitude coordinates were extracted, along with other variables.

3.2. RETRIEVING TWITTER DATA

Twitter users have the capacity of following a specific account and the entire list of publicly posted messages of a user (timeline) is available for browsing. In addition, users can prepend certain words with a "#" symbol (hashtag), post URLs (usually shortened due to space constraints) and embed or link multimedia content (e.g. pictures or videos).

Twitter allows access to some of their data through its API (with some limitations), and requires authentication using OAUTH. There are several software components that allow interacting with the Twitter API using different programming languages; for this research the R package rtweet 0.4.0 (Kearney, 2016) was used, which can interface with the stream and REST APIs and convert the JSON responses into data frames.

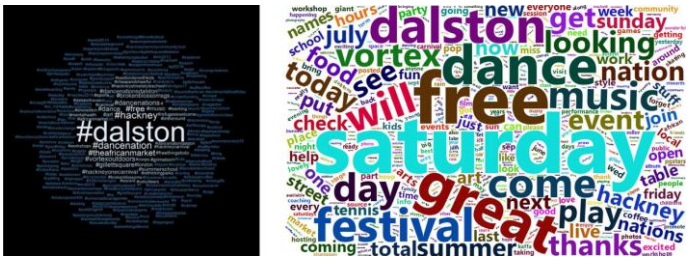

Fig-2: Static hashtag cloud (left) and interactive word cloud (right).

3.3. RETRIEVING CALENDAR DATA

The Gillett Square website provided a browse able list of events8 that linked to the specific page that explained each event in detail; this list contained 10 events and at the bottom of this list of events there were a set of buttons to navigate to other pages with information about the 10 next or previous events, and a button to download the information shown on the page as an iCal file.

However, the page had a search box at the top of the page that built a query as a URL that requested the data to the server, and it was possible to emulate this search behavior using the R package httr 1.2.1 and build the necessary URL strings to retrieve the pages with the desired data. The resulting files were parsed according to RFC5545, Internet Calendaring and Scheduling Core Object Specification for iCalendar. The format was human-readable plain text and the information was extracted using Regular Expressions with the R packages stringr 1.2.0, stringi 1.1.5.

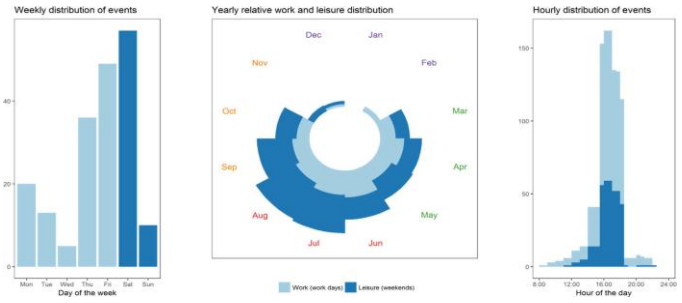

Fig-3:. Weekly distribution of events (left), relative yearly distribution of events (center), and daily distribution of events (right), colored according to work days (Monday to Friday) and weekends (Saturday and Sunday), with the same color scheme as the comparison cloud.

3. CONCLUSIONS

The analysis of the spatial patterns for educational purposes will be explored in future editions of the elective subject on Geographic Information Systems in the Barcelona School of Architecture, and the engagement of students using data from social media will be measured in comparison with previous editions of the course. In additional other techniques of automated knowledge extraction will be applied to additional cases of studies (e.g. museums, universities, sports facilities, shopping centers) to validate suitability and improve the developed methodology. Following these proposals, we cannot forget the preparation of teacher in order to give the correct support to students (Moreira et al., 2017). This issue is critical in order to include mobile education and informal learning in the skills and curriculum of our students by conducting good technological practices.

The generic approach used to analyze the data allows generalizing the conclusions and applications to other educational fields. The informal data extraction and its uses can improve the digital skills and academic development of our students, independent of the framework. Analyzing social data, students can develop more sustainable projects and products adapted to more users and/or users with different profiles or disabilities.

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