A Mobile Application to Share Georeferenced Tourist Experiences on a Discrete Global Grid

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***Abstract*—This work presents the prototype of a mobile application designed to make it easy for tourists to provide their opinions about the places they visit. Two characteristics make this application innovative. The first one is the use of a discrete global grid to collect the data, as discrete global grids are now just starting to be integrated with other Geographic Information System (GIS) technologies. And the second one is the strong emphasis on the emotions those places evoke on the users, an emphasis which is guided by the emotional cartography perspective. Besides this, tools are being added to allow the tourists to see and extend the views provided by previous visitors, in a collaborative, volunteered geographic information way.**

Keywords–Emotional Cartography; Collaborative GIS; Discrete Global Grid System; DGGS; Tourism.

I. INTRODUCTION

The United Nations World Tourism Organization points out that tourism is being transformed, by means of digital technologies, in order to offer, among other things, "hyper-personalized customer experiences" [1]. Indeed, it is more and more common for tourists to value the possibility to enjoy, discover and share personal experiences, as shown for instance in the rise of platforms such as TripAdvisor or Expedia. With these platforms, tourists make decisions related to their choice of destination based on the experiences, opinions and judgement of others, and can then design personal experiences for themselves.

Edward W. Soja defines a conceived space as objective, qualifiable and mappable, and a perceived space as subjectively experimented, imagined and desired. And then he adds a third space, the lived one, as the summary of the other two [2]. Emotional cartography is a methodological process to represent the emotional spaces that form the territory [3]. The application of emotional cartography to crowdsourced tourist experiences, allows us to represent the emotional spaces that form the touristic places and analyze them along with the physical spaces.

This work discusses the prototype of a mobile web application which is being developed to capture georeferenced emotional data from the tourists that visit certain places. The analysis of these data within the paradigm of the emotional cartography will allow to make personalized recommendations for more personalized experiences such as destination branding, by associating certain places with the emotions that these places tend to elicit. The application will provide its users with the data created by previous visitors. They will be able to create new data, or to add their perceptions to areas created by previous users, in a collaborative GIS way.

The rest of the paper is organized as follows: in Section II, the related work section describes some relevant related research. Section III describes some technical and functional aspects of the prototype application being developed. Finally, Section IV summarizes the work done so far, and describes some expected future results.

II. RELATED WORK

Geographic Information Systems have been used to make tourism more interactive and user informed by making use of the location data. Some recent examples of this are [4], for nature-based tourism, and [5] for tourism marketing.

Location-aware mobile devices and specialized applications may provide tourists with valuable information to enjoy their trips and adapt them to their interests. A recent review of context-aware tourism applications, [6], analyzed them from four dimensions: knowledge acquisition, knowledge representation, knowledge processing and services offered to tourists. One of its conclusions is that the acquisition of the knowledge required to make these applications useful needs to take into consideration the crowdsourced feedback. This does not only need to include the location of the tourists; their experiences should be analyzed in a high spatial resolution to be studied in detail [7].

Those technologies that allow us to explore mental and emotional lives in non-invasive ways, and from a certain distance, are registering a fast acceleration [8]. With them, and through the use of emotional cartography, we can develop new geographical knowledge of places, such as those oriented towards tourism, and therefore new economic and social development. We can observe and analyze how the experiences in those spaces configure the life there, and we can get a deeper understanding of both their physical and human geographies

[9]. This in turn may contribute to discover new therapeutic possibilities of the places and to create a new image that makes them different from others. This kind of “branding” is essential for touristic development [10]. Destination management and marketing studies can also benefit from more research on emotions and tourism [11].

Collaborative mapping development, such as the OpenStreetMap (OSM), has become a trend in recent years. It uses community engagement to produce quality data and applications that may empower multiple sectors [12]. When compared to passive crowdsourcing, active collaborative GIS has been observed to generate more fine-scale data with a more flexible value range, which is better suited for management and analytics [13]. Collaborative GIS is currently been used, or at least proposed, in diverse domains such us landscape inventory creation [14], city models creations [15], and satellite imagery analysis [16].

Discrete Global Grid Systems (DGGS) are spatial information frameworks which divide the surface of the Earth in tessellations of discrete cells [17]. These cells are organized in a hierarchical fashion forming a multi-resolution grid. These grids are intended to be information grids, not navigation grids, and thus, issues such as quantization operations, i.e., assigning and retrieving data to/from cells, and algebraic operations on the cells and their contents must be defined by the different DGGSs. A DGGS must also provide a way to address, i.e., identify, each individual cell. There are proposals that build on that capability to address any area defined on a given DGGS [18]. The rHEALPix is a cubic geodesic DGGS, which is compatible with the OGC proposal [19]. Its cells, once projected onto the plane, are squares.

III. The Prototype

Following the research goals, the application is designed to provide the users with an easy to use interface for capturing data. Data collection through the GUI is done by using the rHEALPix DGGS quadrilateral grids with the parameter $nside = 3$ (i.e., each square is divided into nine in the next resolution level). Only grids of resolution levels from 8 to 11 are shown (i.e., resolutions ranging from approximately 1.5 km, to around 55 meters). The users can navigate to their desired region using zoom in/out and panning functionality, and then select one or more grid cells just by tapping on their smartphone screen. The selected area will be added to the database with the submit button after fulfilling the information associated to it. The GUI of the current prototype is shown in Figure 1. Cells with a brighter color are those which have been selected by the user.

The source code of the prototype is currently available in two GitHub repositories: https://github.com/IAAA-Lab/grid-field and https://github.com/IAAA-Lab/grid-server. The first one includes the web application tier and the Django server with the grid models which are stored in PostgreSQL/PostGIS. The second one includes the Django Representational State Transfer (REST) based web server tier along with the rHEALPix and MongoDB components.

A. Architecture

The main components of the application are shown in Figure 2. The application is entirely built with open source technology. We followed a three-tier architecture: web application, web server, and databases. In the web application tier, we focused on a mobile-first design as we expect this application to be used mainly with smartphones. The web server tier is built upon the Python Django framework, which provides the server side logical processing as well as the connectivity between the users and the database. The web application tier connects there through the Django REST framework Application Programming Interface (API).

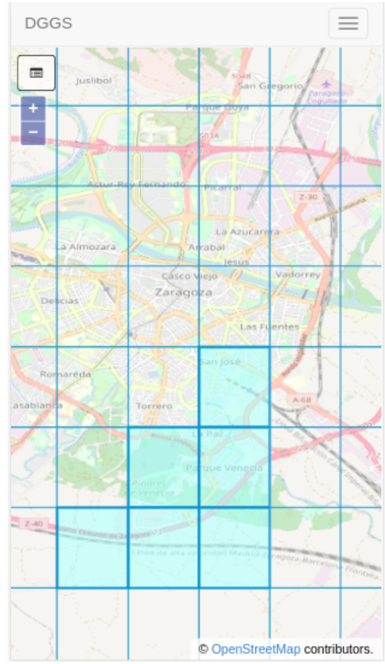

Figure 1. Application GUI: selection of an area based on a grid.

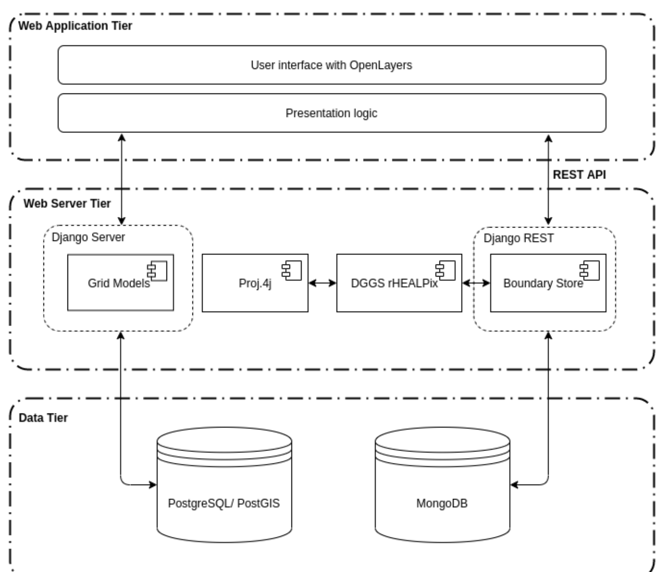

Figure 2. Component diagram: the 3-tier architecture of the application.

The web application tier, i.e., the frontend, uses the OpenLayers mapping library to display the rHEALPix grids on a base map, which currently is OpenStreetMap. The grids are retrieved in GeoJSON from the PostgreSQL database, with the PostGIS extension. For efficient processing, only the grids within the user extent are requested from the server and displayed.

Besides the access to the grid models stored in PostgreSQL, the web server tier also contains the DGGS-rHEALPix component. This component allows to store and retrieve sets of cells from rHEALPix that cover a given area, we call them Boundaries, which may be associated to some arbitrary JSON data. The storage and retrieval uses a MongoDB database to provide persistence. This rHEALPix grid component has been exposed as a Django REST framework API, and it also includes some basic level support for importing and exporting data from other GIS models and formats. This API is used by the frontend to manage the user generated geographic data based on the DGGS.

B. Usage

The users of this application, i.e., the tourists, will not choose among existing, common geographic features or points of interest. As pointed out before, they will be defining areas on the geodetic grid displayed on the application by touching and selecting/deselecting cells over the base map. Then, they will add some information associated to that area, i.e., the emotions they felt when visiting those areas. We are allowing users to choose freely the areas they want because we are specifically interested in how tourists see and feel the space around them, i.e., Edward W. Soja perceived space, without imposing too many constraints on their choices.

However, the application will also be able to show the areas drawn by other tourists and the emotions they associated to those areas. In this way, the perceived space of some users might become the conceived space for others. Indeed, we expect that some areas will be seen as “natural limits” for certain features in the real space, and many tourists will reuse them, while other places should prove themselves to be more diffuse and difficult to delimit.

All these areas will be stored in the application as Boundaries associated to the emotional data. The users will provide the kind of emotion they are feeling by choosing among the universal emotions pointed out in the model by Ekman and Cordaro [20]: anger, fear, surprise, sadness, disgust and happiness (contempt is left out because it does not make sense to feel contempt about something which is not a person or group of people). It will be possible to choose more than one emotion, as it is possible for a person to feel different emotions about the same place, even at the same time. Besides this essential input, the application will allow to collect other data from the users, both automatic (, the date and time) and manual (e.g., a description of the place). This workflow is based on previous works where paper maps and other generic mobile GIS applications were used [21], and we expect to collect information that will allow us to produce similar results, like the emotional cartography shown in Figure 3 but in a more automatic way.

C. The role of the DGGS

This prototype uses a DGGS to constrain the geometries of the areas that its users (the tourists) find of interest. This is driven by two main hypothesis. First of all, we hypothesize that it should be easier for non-expert users to draw geographic areas of interest on their smartphones by simply touching existing cells from a grid instead of drawing polygons as commonly seen in vector-based GIS data capture applications. We do not intend for this areas to have precisely delimited borders, and tools that allow to do that could prove themselves more difficult to use. And second, once we decide to use grids, it is rational to use some existing ones. The rHEALPix DGGS seems well suited to this project, as its cells are projected into squares. Although hexagons and triangles have some advantages, most non-expert users who have used any kind of map should be more familiar with rectangular grids.

Besides this, being intended to facilitate the integration of geographic data with different origins and scales, a DGGS should be a good candidate as a framework for the creation of emotional cartography. Within the frame provided by a DGGS, we can create a cartography where the objective is not to show, localize or collect all the details of a place, but the sensations and emotions that are disseminated over the space. And to do this in a diffuse, non-continuous way with different intensity, duration and temporality. The ability to select a resolution level, and a corresponding grid with specific cell sizes, from a DGGS provides us with a spatial framework that seems ideally suited to emotional cartography, where exactitude is not really possible and spatially diffuse areas are to be expected. For instance, it is perfectly reasonable to assume that a city in general sparks joy, but a particular neighborhood evoques sadness and a certain square in the neighborhood provides hope. The hierarchical spatial framework provided by a DGGS should facilitate this kind of multi-scale data collection.

IV. Conclusion and Future Work

This paper has described the prototype of a mobile web application intended to capture georeferenced emotional data from tourists. This application uses a DGGS as a framework both to capture and analyze the data. We hypothesize that this kind of grid-based framework makes it easier for the users to delimit the diffuse geographic areas that can be associated to the different emotions they felt over the place. We also consider that the hierarchical nature of the grids in a DGGS will facilitate the analysis of data at different scales as needed.

Once we have deployed an operative version of the application, we intend to validate, or refute, the hypothesis that have driven the design of the application. Besides testing the application itself, the data collected will be analyzed, and cartographically presented, under the paradigm of the emotional cartography.

After that, we want to advance on the collaborative part of the application. As different users provide their own views about a territory, we should provide them with to opportunity to create new data, or to add their perceptions to areas created by previous users, in a collaborative GIS way. It will be necessary to develop a system where the mechanisms implemented to solve conflicts, merge similar entries and find possible relations allow to study how consensus and compromises emerge, or not.

Finally, we also expect to find cartographic challenges to portray a collaborative work based on personal feelings, which are not only different for different people, and associated to slightly, or not so slightly, different locations, but that may vary for example under a different weather, or just with the time of the day.

 ISBN: 978-1-61208-762-7

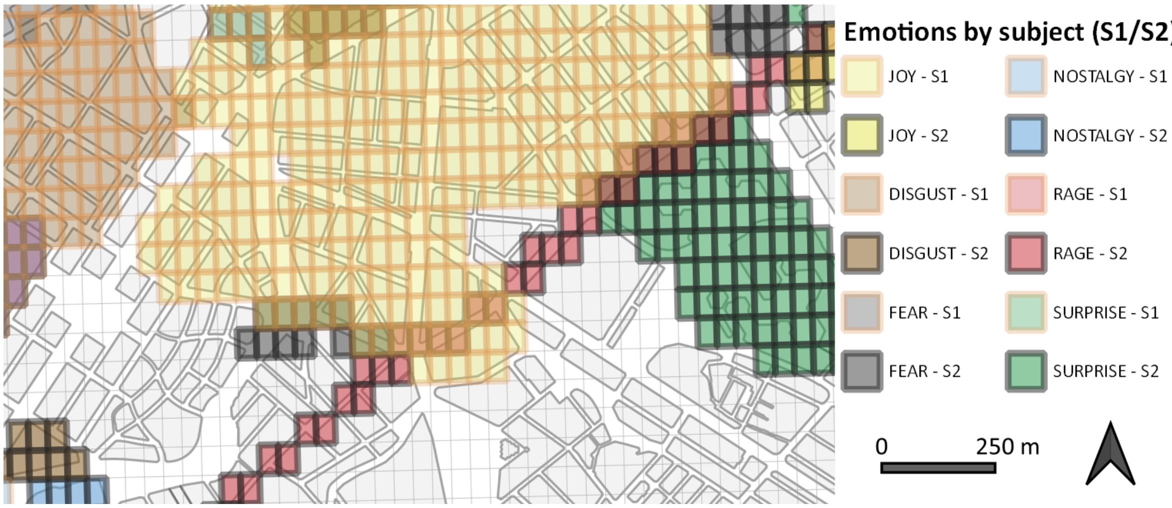

Figure 3. An example of emotional cartography using a geodesic grid to depict emotions associated to areas on a base urban map.

ACKNOWLEDGMENT

This work has been partially supported in 2019-2020 by the project LMP19_18, with Aragón FEDER funds 2014-2020, "Construyendo Europa desde Aragón", and by the project T59_20R of the Aragón Government.

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