

Framework for Training a VA that Supports Territorial Planning

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Abstract—Territorial planning plans are the result of the search for primary and secondary information sources with the knowledge of the technical team in charge of preparing or updating them, and ideally using the citizen's knowledge of the territory. To this end, various forms of citizen participation have been explored without much success. In the case study of this article, the Territorial Plan of the Cuenca Municipality, updated until 2022, has been analyzed, where the main result has been the lack of citizen participation. This article proposes a framework that describes the steps of organization, systematization and analysis of geographic information sources for Cuenca, where the large amount of existing but little used information is identified and that motivates the creation of a Virtual Assistant (VA) with specialized training according to the territorial planning axes defined for this municipality. This assistant must work on a platform for the integration and interoperability of geospatial information and existing geoservices, which is the SDI UCuenca.

Keywords—Public participation, Territorial Planning, Virtual Assistant, Spatial Data Infrastructure (SDI)

I. INTRODUCTION

The experience in teaching related to the generation of land use planning, has allowed to identify how to use Geographic Information Systems in the classroom. However, this knowledge is not received by most of the potential users of geospatial information, especially the citizens of rural communities. Added to this is the problem of identifying sources of official information for such planning. The greater the participation of the population in territorial planning, the better plans can be designed [1], [2]. However, those who know the territory best are the citizens, who unfortunately do not necessarily know how to use geographic information management tools.

An analysis of the geospatial information sources of the city of Cuenca was carried out in order to integrate them into the SDI UCuenca platform [3] following the organization normally used for territorial planning. The Methodological Guide for the elaboration of Development and Management Plans elaborated by SENPLADES [4], [5] establishes a methodology for the generation of territorial management plans where phases and axes are determined. This division into axes depends on the priorities determined by the local government. In the case of Cuenca, in order to develop the current territorial plan, five axes were determined: a) Human settlements and relationship channels, b) Physical

environment, c) Cultural and patrimonial, d) Economic, Socio cultural. The Land use and occupation axis (e) was added to the present project, because of its contribution to territorial planning of Cuenca.

On the other hand, mainly public organizations and companies have spent huge amounts of money on consultancies and studies that are not necessarily used by planning technicians. However, efforts have been made to make this information available through geoservices, geoportals and other forms that are not very accessible. To facilitate this access, a line of research has been initiated in the use of virtual assistants with geoinformation, as can be seen in [6], [7].

In the analysis of the information necessary for territorial planning, several approaches have been taken [8], [9] which have identified as the main problem the access to information from the servers and the lack of knowledge of the forms of access. In the case of Cuenca, thanks to the project "Virtual assistants as a contribution to the processes of citizen participation in development and land use planning", an analysis of the PDOTs (Territorial Plans) has been carried out, starting in 2011, in order to identify the secondary information sources necessary for their generation. This has led to the discovery of the large amount of information available in the servers of several local institutions, including the Local Government, Ministries, Military Geographic Institute, Universities, and others.

This article describes the process of identification of sources, organization of information, access through geoservices, for its integration and interoperability in the SDI UCuenca, taking as a case study the support to the territorial planning of the city of Cuenca. In addition, it describes the steps for the training of the VA that has been integrated into the SDI UCuenca platform and that will facilitate access in an organized way for the citizen, the technician and the leader of the GAD (Decentralized Autonomous Government). All this makes up the Framework designed for the training of the VA proposed in this research.

II. METHODOLOGY

A process has been developed for the implementation of the Framework, which has allowed users to have access to geographic information from different institutional sources, facilitating access to it. It consists of four components as shown in Fig. 1.

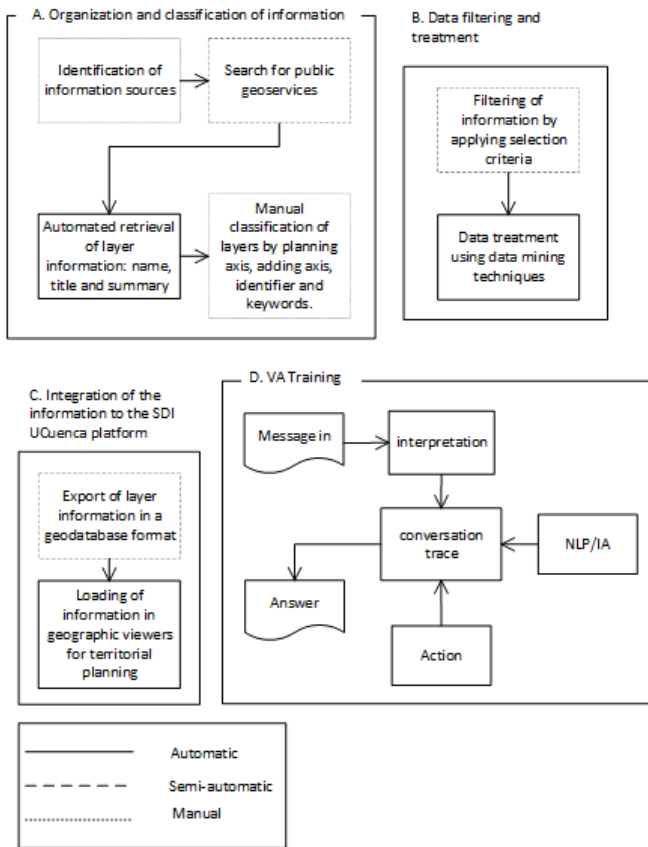


Fig. 1. Framework for training a VA in territorial planning

A. Organization and classification of information

First, the institutions that generate geographic information related to the topic of territorial planning for the city of Cuenca were identified. Then, a manual search of the geographic of these institutions was performed in search of open access WMS geoservices, published in the map servers, and the information related to the layers available in each of these geoservices was compiled. The above process was carried out in an automated way, through the script `script_recovery_layer_info` programmed in Python using the `OWSLib` library, obtaining as a result a matrix with information of more than 2,500 layers. An extract of the script can be seen in Fig. 2, where from a WMS link its layers are obtained and for each selected layer information on the name, title and summary is obtained.

```

from owslib.wms import WebMapService

url = 'http://geportal.sigtierras.gob.ec:8080/geoserver/sigtierras/wms?'
wms = WebMapService(url)

layers=list(wms.contents)
print("Layers:\n",list(layers))
title=wms['division_politica'].title
name=wms['division_politica'].name
abstract=wms['division_politica'].abstract

print("\n")
print("Title:",title)
print("Name:",name)
print("Abstract:",abstract)

Layers:
['relieve', 'ortofoto_proyecto', 'vias_acc', 'acc_educacion_mas_destino', 'acc

Title: Límites provinciales y cantonales
Name: division_politica
Abstract: CELIR 2013. Límites políticos referenciales del Ecuador Continental

```

Fig. 2. script_recovery_layer_info

This information was then manually classified, incorporating into each layer an identifier of the published information that labels the relevance for territorial planning in the canton of Cuenca. To perform this classification, the following parameters were considered: name of the layer, the title of the layer, and, if available, the summary and legend. Other fields that were added to the matrix were: keywords to be used in the VA searches/training and the planning axis to which each layer corresponds and will be loaded in the respective viewer.

In the case of geoservers in ArcGis the process was done manually due to the lack of tools for direct extraction.

B. Data filtering and treatment

After the information was classified, the layers labeled as not relevant or unavailable were excluded, and the data was cleaned using the RapidMiner tool that uses techniques for debugging, filtering, clustering, sequence tracking of patterns, association, grouping, classification, regression, and other techniques to upload this information to the SDI platform and used it to train the VA.

Once this process was completed, a total of 1075 valid layers were obtained. In Table 1 the number of layers by axis can be displayed and, in Fig. 3, the percentage of layers by institution is shown.

TABLE 1. NUMBER OF LAYERS BY PLANNING AXIS

Territorial planning axes		No. Layers
HUMAN SETTLEMENTS AND RELATIONSHIP CHANNELS	AND	384
PHYSICAL ENVIRONMENT		296
LAND USE AND OCCUPATION		249
CULTURAL AND PATRIMONIAL		75
ECONOMIC		38
SOCIO CULTURAL		33
TOTAL		1075

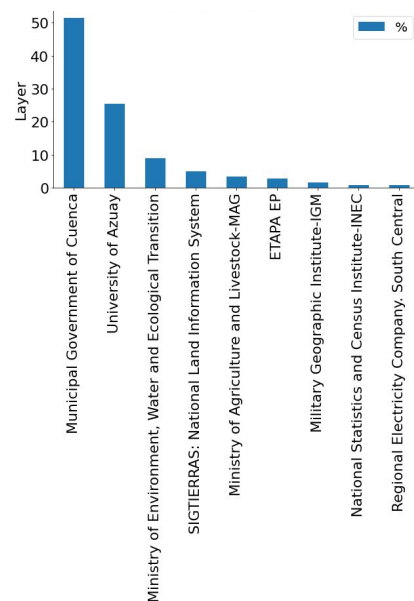


Fig. 3. Percentage of layers by institution

C. Integration of the information to the SDI UCuenca platform

As indicated above, for the publication of geographic information obtained from external sources, six viewers corresponding to the territorial planning axes of the canton of Cuenca have been created on the SDI UCuenca platform.

Before loading the information obtained in the processes described above, a field was defined to identify the layer, different from the layer name, because in some cases it was not available or did not provide useful information; instead, the identifier field created manually according to the layer content was used, which was modified so that it can be used in the searches.

A .csv file was then created with the cleaned information, in the geodatabase format, where the main fields were: *id_layer* that is the layer identifier, *layer* that is the layer name, *title* that will be used in the searches, *type* that can be WMS or arcgisrest (in ArcGis case), and *url* that allows us to access the geoservice.

With this file, all the information can be loaded directly into the database, however, to link the layers with the viewers, another .csv file is used containing a numeric identifier of the layer (*layers_id_layer*) linked to a numeric identifier of the viewer (*contexts:id_constext*). With this formation it is possible to load in each of the viewers. In Fig. 4 the interface to all viewers can be seen, in Fig. 5, information corresponds to Viewer 2: Physical environment.



Fig. 4. Territorial planning viewers in SDI UCuenca

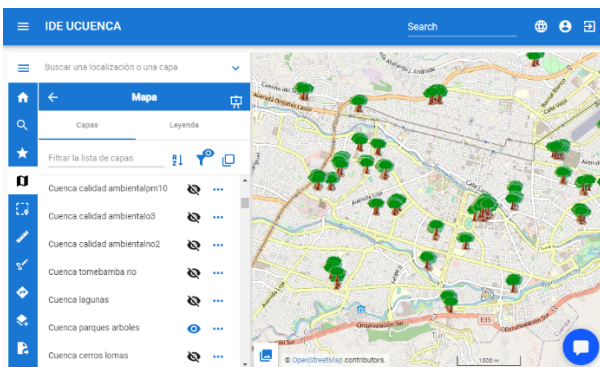


Fig. 5. Layers of the Physical Environment Axis

D. VA design and training

After data processing, VA training is performed, using a neural network with RASA Framework [10]. Two components, NLU and Rasa Core, are used. The first one is in charge of interpreting the user's messages to obtain an intention and extract entities according to the argument with which it has been programmed, through an analysis (Pipelines). On the other hand, the Core is a dialog-based manager, as a probability model to assemble the most accurate response based on the input messages provided by the user. During this process, the DIET (Dual Intent Entity Transformer) classification component is added, which allows to generate a model capable of extracting fragments of information to obtain intentions and entities.

Once the operation was explained, it was defined to create a guided conversation in which the user could choose between two options, a search with common single words that would consume a service that came directly from the institutional geoservices, focused directly on the topic of land use planning.

A more advanced search for professional users directly to the technical knowledge base that has been created with the debugging of the data, it should be noted that to use this section was used a technical language used by professionals in the area of territorial planning, such as architects and engineers. In this case, by means of programming structures, the classification of a message in each of the six axes is defined, the information is processed, and the Action is performed, which would be to execute the communication with the SDI, processing and sending the layers of information that the user requested in his message to the AV. This process can be better evidenced in Fig. 6 with the example of the search request for the criterion "redes hidrográficas en Cuenca".

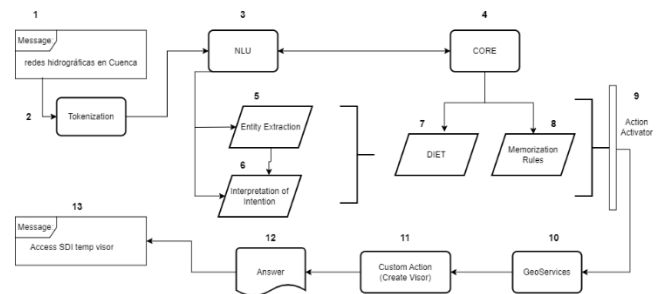


Fig. 6. Flowchart training with geoservices

III. RESULTS

The training has been executed for the axes "Human Settlements and Relationship Channels" and "Land Use and Occupancy" which are part of Territorial Plan of Cuenca. Using about 4.000 keywords that have allowed to classify the stories, so that the assistant is able to identify the corresponding territorial planning axis. Based on the keywords that the user enters, it should also classify the user's level of knowledge. The levels can be basic, medium and advanced, where the basic level corresponds to the common citizen, the medium level to the neighborhood leader, and the advanced level to the GAD manager and technicians.

The following is an example of searching information in two scenarios. The first one was performed in the geoportal of the Municipal Government of Cuenca [11] and for the second one the VA was used in a viewer of the SDI UCuenca.

The search criteria was "Farmacias en el cantón Cuenca".

A. Search in the geoportal of the Municipal Government of Cuenca (manual search)

In order to search in the first scenario, after a Google search to identify possible sources inside of limit of district Cuenca is not clear. Then it is necessary to access to the institution's geoportal viewer from Municipality of Cuenca. It was visited directly, as shown in Fig. 7. Since the required information was not found, we returned to the main menu (Fig. 8) and entered the option Maps Repository (Fig. 9). The options were reviewed looking for the required map, until reaching "Services". Here a viewer was displayed where the desired layers could be selected: pharmacies of the Municipality and pharmacies of the Municipal Corporation: Farnasol (Fig. 10).

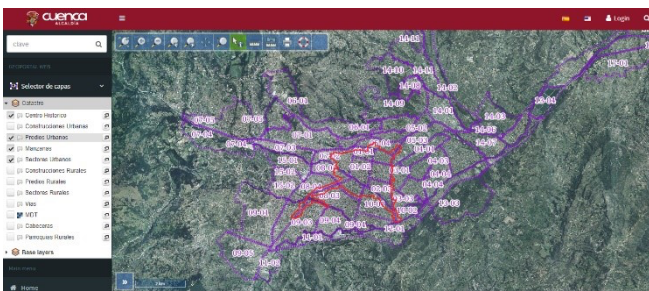


Fig. 7. Geoportal Viewer of the Municipal Government of Cuenca



Fig. 8. Geoportal of the Municipal Government of Cuenca

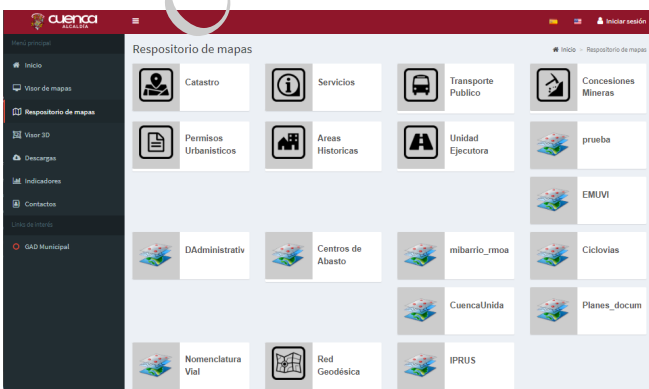


Fig. 9. Maps repository. Municipal Government of Cuenca

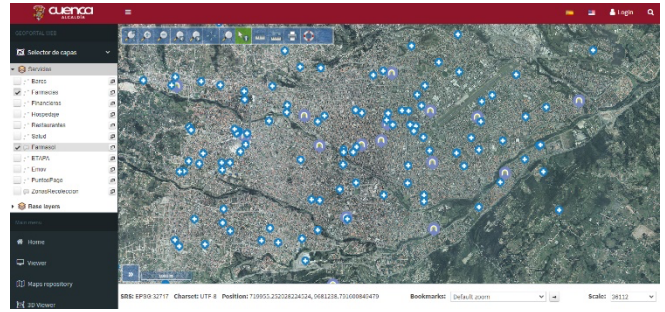


Fig. 10. GAD viewer with search criteria

B. Search in a viewer of the SDI UCuenca (using VA)

In this case, we proceed to load the viewer and the chatbot interface, as shown in Fig. 11. The search criteria is then entered: "muestra las farmacias en Cuenca" resulting in a link with the layers that match with the requested criteria, in this case two layers: "Farmacias" and "Farmacias Farnasol". (Fig. 12).

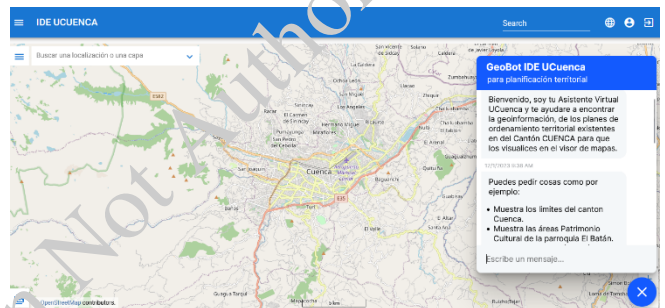


Fig. 11. Chatbot interface at SDI UCuenca with search examples

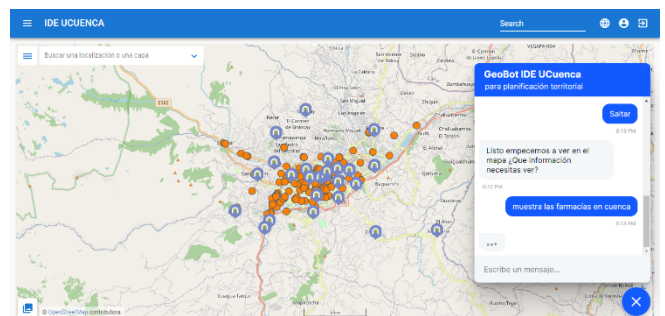


Fig. 12. Search criteria and display of results

Obviously, information for territorial planning is not easy to find in other sources such as Google Maps, for example property information for a specific parish in Cuenca.

IV. CONCLUSIONS

In the search to facilitate access to the end user of information that may be available from different sources, virtual assistants have given interesting results. This article proposes a framework for the training of a Virtual Assistant that has been designed for its specific use in Territorial Planning. It presents the complexity of the geoinformation that is handled in this field and how it should be used in said training. Although territorial planning depends on the axes that each Local Government decides to prioritize, however, the training will ensure the identification of axes and levels of knowledge. This level classification allows the citizen (basic

level), the neighborhood leader (medium level) and technician or manager (advanced level), to connect to specific geoinformation sources as well as to increase the complexity of the search. The example that was presented demonstrates only the basic level generating a search with the SDI UCuenca engine, but allows interpolation to the other levels. Ease of use is demonstrated against the need to know that a citizen normally does not have. It should be noted that this geoinformation is not normally indexed by Google and this results in additional complexity for the user. On the other hand, the interaction with other more complex sources of information such as metadata in Geonetwork remains as future work.

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REFERENCES

- [1] L. R. Vivanco Cruz, «La participación en la formulación de los planes de desarrollo y ordenamiento territorial: hacia un modelo de participación ciudadana en el caso del Plan Cantonal de Cuenca», 2013.
- [2] G. Delamaza y L. E. Thayer, «Percepciones políticas y prácticas de participación como instrumento para la gobernanza de los territorios», EURE Santiago, vol. 42, n.o 127, pp. 137-158, sep. 2016, doi: 10.4067/S0250-71612016000300006.
- [3] V. Morocho, «Mejorando la Usabilidad en las Plataformas de Infraestructura de Datos Espaciales», Congr. Cienc. Tecnol. ESPE, vol. 9, n.o 1, Art. n.o 1, may 2014, doi: 10.24133/cctespe.v9i1.90.
- [4] SENPLADES, «Guía metodológica para la elaboración de Planes de Desarrollo y Ordenamiento Territorial de los Gobiernos Autónomos Descentralizados». 2015. [En línea]. Disponible en: https://app.sni.gob.ec/sni-link/sni/PORTAL_SNI/data_sigad_plus/sigadplusdocumentofinal/0560019720001_PDOT%20FINAL_01-11-2015_19-29-28.pdf
- [5] SENPLADES, «Lineamientos y directrices para el Seguimiento y Evaluación de los Planes de Desarrollo y Ordenamiento Territorial (PDOT)». 2019. [En línea]. Disponible en: <https://sni.gob.ec/documents/10180/3830914/Seguimiento+y+Evaluaci%C3%B3n+PDOT/7b509004-2561-4404-8eec-37d9f5be8543>
- [6] C. Granell et al., «A scoping review on the use, processing and fusion of geographic data in virtual assistants», Trans. GIS, vol. 25, n.o 4, Art. n.o 4, ago. 2021, doi: 10.1111/tgis.12720.
- [7] V. Morocho, R. Achig, J. Bustamante, y F. Mendieta, «Virtual Assistants to bring geospatial information closer to a smart citizen», en 2022 IEEE Sixth Ecuador Technical Chapters Meeting (ETCM), oct. 2022, pp. 01-06. doi: 10.1109/ETCM.2022.9935761.
- [8] L. Vivanco, R. Mejía, y V. Morocho, «Políticas para la gestión de la información en la Planificación Territorial», Rev. Geoespacial, vol. 15, n.o 2, Art. n.o 2, 2018, doi: 10.24133/geoespacial.v15i2.1354.
- [9] G. P. Veintimilla, L. V. Cruz, N. P. Cáceres, y V. M. Zurita, «Geoprocesos para la macrolocalización de equipamientos de salud para atención primaria y educación básica», ASRI Arte Soc. Rev. Investig., n.o 13, p. 10, 2017.
- [10] T. Bocklisch, J. Radzikner, N. Pawlowski, y A. Nichol, «Rasa: Open Source Language Understanding and Dialogue Management», ArXiv171205181 Cs, dic. 2017, Accedido: 8 de junio de 2021. [En línea] Disponible en: <http://arxiv.org/abs/1712.05181>
- [11] Municipality of Cuenca, «Geoportal of the Municipal Government of Cuenca», 2022. <http://ide.cuenca.gob.ec/geoportal-web/index.jsf> (accedido 20 de diciembre de 2022).

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