Abstract. Enticing users into exploring Open Data remains an important challenge for the whole Open Data paradigm. Standard stock interfaces often used by Open Data portals are anything but inspiring even for tech-savvy users, let alone those without an articulated interest in data science. To address a broader range of citizens, we designed an open data search interface supporting natural language interactions via popular platforms like Facebook and Skype. Our data-aware chatbot answers search requests and suggests relevant open datasets, bringing fun factor and a potential of viral dissemination into Open Data exploration. The current system prototype is available for Facebook\textsuperscript{1} and Skype\textsuperscript{2} users.

1 Introduction

The European Commission defines Open Data portals as “web-based interfaces designed to make it easier to find re-usable information”\textsuperscript{3}. It is exactly the task of finding re-usable information, however, where current data portals fall short: they focus on supporting users to find files and not the information. It remains a tedious task for users to drill out and understand the information behind the data. According to the EU Data Portal study, 73% of the open data users characterize finding data as Difficult or Very Difficult\textsuperscript{4}.

Currently, the data is brought to end users not directly but through apps, each focusing on a specific service and based on a handful of open datasets. The app ecosystem, promoted by Open Data portals, is thriving. The downside of this approach, however, is that the data remains hidden from the users, who have to rely on IT professionals to get insights into it.

An orthogonal approach is to lower the entry barrier for working with open data for a broader audience. Being a moving target, as powerful data analysis methods become increasingly complicated, this approach still has a number of unique benefits. One can argue that it is embedded in the spirit of the Open Data movement itself, to enable and empower citizens to analyze the data, to be able to draw and share their own conclusions from it. Working with raw data

\textsuperscript{1}https://m.me/OpenDataAssistant
\textsuperscript{2}https://join.skype.com/bot/6db830ca-b365-44c4-9f4d-d423f728e741
\textsuperscript{3}https://ec.europa.eu/digital-single-market/en/open-data-portals
\textsuperscript{4}https://www.europedataportal.eu/en/highlights/barriers-working-open-data
is and will probably remain challenging for non-experts, and thus the easier it is to find the right dataset and to understand its structure, the more energy a user has to actually work with it. Despite (or rather due to) the growing number of Open Data portals and ever increasing volumes of data served through them, their accessibility for non-technicians is still hampered by the lack of comprehensive and intuitive deep search, and means of integrating data across domains, languages and portals.

This demo showcases a novel natural-language interface, allowing users to search for open datasets by talking to the chatbot on a social network. We also address the challenge of cross-lingual dataset search that goes beyond the monolingual prototype we developed earlier for two Austrian open data portals. To improve user experience, it embeds a state-of-the-art approach to semantic linking for natural language texts into a dialogue-based user interface.

Our hypothesis is that using a popular and convenient communication channel opens new possibilities for interactive search sessions. The inherent interactivity of a chat session makes it easy to enhance user experience with context-based and personalized elements. We envision our prototype to be the first step towards an intelligent dialogue system supporting contextual multilingual semantic search, focused on retrieval of datasets as well as the individual data items from them. In the future work we plan to extend the chatbot to search within the content of the datasets rather than merely in the metadata.

2 Chatbot architecture

We implemented a prototype as a proof-of-concept by pooling and annotating 18k datasets from seven Open Data portals with dataset descriptions in seven different languages (see Table 1). The front-end is designed using Microsoft Bot Framework, which connects the implementation to both Facebook Messenger and Skype platforms.

| Portal         | Country | Language | Datasets |
|---------------|---------|----------|----------|
| dati.trentino.it | Italy   | IT       | 5285     |
| data.gov.ie    | Ireland | EN       | 4796     |
| datamx.io      | Mexico  | SP       | 2767     |
| data.gv.at     | Austria | DE       | 2323     |
| dados.gov.br   | Brazil  | PT       | 2061     |
| beta.avoidata.fi | Finland | FI       | 820      |
| www.nosdonnees.fr | France  | FR       | 290      |

Collection and annotation of datasets. The search results of our chatbot application are based on enrichment of dataset descriptions with BabelNet.
Fig. 1. Open Data Assistant chatbot. The system integrates metadata from different open data portals into a unified Schema.org format and enriches it with the concepts extracted from text via the Babelfy API. The chatbot interface provides access to the semantic (cross-lingual) open data Search API over the dataset metadata.

Initially, we use the Open Data Portal Watch (ODPW) framework to collect the dataset descriptions of the selected portals. ODPW harvests the metadata descriptions and maps them to the Schema.org standard vocabulary (cf. fig. 1). We extract title, natural language description and keywords from these metadata and identify their language using langdetect Python package. Then, we provide them as a single concatenated string (title, description, and keywords) for each dataset alongside the detected language to the Babelfy API to detect and disambiguate entities and concepts within this string. The Babelfy API provides a list of corresponding “babelSynsetIDs” for an input string, language-independent entity identifiers in the BabelNet framework.

To deliver a good performance for the search functionality, we built an Elasticsearch index from the Schema.org dataset descriptions and the corresponding BabelNet entities. This allows us to retrieve all dataset descriptions that are annotated by a specific BabelNet entities and aggregate over the top co-occurring entities.

**Search API interactions.** There are two modes of interaction and obtaining search results in the chatbot interface. First, the user can issue a free text search query. Our search API hands this input over to the Babelfy API which provides a list of disambiguated concepts and entities. We query our Elastic-
search index for any of these entities and return all matching datasets. The datasets get ranked by the number of matching entities. For instance, if a query includes the entities dog and vienna, then a dataset annotated with both of these gets ranked higher than a dataset annotated with either dog or vienna.

In the second interaction step the user can refine the search results by selecting one of the top co-occurring concepts and entities. We then use the selected entities to filter the result set, i.e., the selected entities must occur in the dataset description. This way we implicitly implement both AND/OR query operators.

3 Usability study

Seven participants took part in a usability study designed to evaluate our system prototype. We asked the participants to complete a predefined search task and reflect on their experience of using the system. The search task was to find the official statistics data from different countries concerning climate change so that the participants could also experiment using various keywords related to the topic of climate change, e.g. air temperatures, snow level, etc.

Most of the participants found the system useful but in some cases limited in scope and functionality. Suggestions from the users include: (1) complementing open data with additional resources, such as Wikipedia; (2) user-specific answers, such as adjusting the language of interaction and geolocation-relevant queries; (3) context-specific answers, i.e. ability to follow up and refine the previous query. Often the participants were not able to assess the quality of the produced results when they were in an unfamiliar to the user language. More details on the evaluation task and results are available on-line.

4 Related Work

The originality of our system is in applying chatbot interface to the dataset search, which, as we believe based on our early evaluation, has large potential for popularizing and promoting open data, e.g. through easy access and gamification component.

Chatbots, e.g. Google Allo, recently gained an increased attention in the developers' communities worldwide. They integrate cutting-edge technologies, such as auto-reply, image and speech recognition, enhancing them with multimedia elements, which results in an attractive interface accessible also for users without IT background. Chatbot UI arguably provides a more natural and personalized way of human-computer interaction, as opposed to the traditional “book-like” web page. To the best of our knowledge ours is the first chatbot focusing on dataset search.

The LingHub data portal is another example of cross-lingual data search implementation. It integrates language resources from Metashare, CLARIN, etc.

9 https://github.com/vendi12/oda_evaluation
10 https://allo.google.com
11 http://linghub.lider-project.eu
using RDF, DCAT and SPARQL on the metadata level. Similar to our system, LingHub employs the Babelfy disambiguation algorithm.

5 Conclusion

We present a prototype of a conversational agent for Open Data search. The early user evaluation showed that such a cross-lingual dialog-based system has the potential to enable an easier access to Open Data resources.

The set of indexed portals can be easily extended since we rely on the ODPW framework that provides mapping of metadata from over 260 data portals into a homogenized schema, and Elasticsearch, which implements scalable search functionality. We also plan to extend the chatbot to search within the content of the datasets rather than merely in the metadata. Furthermore, the user query understanding needs to be enhanced to improve the results ranking. One way to facilitate it in the interactive chat context would be through asking user the questions to disambiguate the query, e.g. “Did you mean apple as a fruit or as a company Apple Inc.?”

Demonstration plan. Conference participants will be able to interact with the chatbot via Facebook and Skype. They will be free to experiment and come up with their own queries to the system. We will also provide the participants with the query samples that showcase both the strengths and the pitfalls of the current approach.

Acknowledgements. This work was supported by the Austrian Research Promotion Agency (FFG) under the projects ADEQUATE (grant no. 849982) and CommuniData (grant no. 855407).

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