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Barcellos, Raissa; Bernardini, Flavia; Viterbo, José; Zuiderwijk, Anneke

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Raissa Barcellos
Rio de Janeiro State University,
Mathematics and Statistics Institute
Rio de Janeiro, Brazil
raissa.barcellos@ime.uerj.br

Flavia Bernardini
Fluminense Federal University,
Computer Science Institute
Niterói, Rio de Janeiro, Brazil
fcbernardini@ic.uff.br

José Viterbo
Fluminense Federal University,
Computer Science Institute
Niterói, Rio de Janeiro, Brazil
viterbo@ic.uff.br

Anneke Zuiderwijk
Delft University of Technology
Delft, South Holland, Netherlands
a.m.g.zuiderwijk-vaneijk@tudelft.nl

ABSTRACT

The global initiative supporting open government data (OGD) has witnessed significant strides in the last decade. This study delves into the prospective integration of Artificial Intelligence (AI) with Hippolyta, a framework meticulously crafted to amplify the interpretability of government data. The aim is to scrutinize the viability of this integration, conducting a technical investigation in the realms of open government data and artificial intelligence. In contributing to the expansive field of OGD, this research focuses on elucidating the interpretability of data originating from governmental sources. Through an exploration of the technical feasibility surrounding the fusion of AI with Hippolyta, we aim to pave the path for advancements, fostering heightened interpretability and overarching enhancements in the understanding of government data.

KEYWORDS

Open government data, data interpretability

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Authors' Contact Information: Raissa Barcellos, Rio de Janeiro State University, Mathematics and Statistics Institute, Rio de Janeiro, Brazil, raissa.barcellos@ime.uerj.br; Flavia Bernardini, Fluminense Federal University, Computer Science Institute, Niterói, Rio de Janeiro, Brazil, fcbernardini@ic.uff.br; José Viterbo, Fluminense Federal University, Computer Science Institute, Niterói, Rio de Janeiro, Brazil, viterbo@ic.uff.br; Anneke Zuiderwijk, Delft University of Technology, Delft, South Holland, Netherlands, a.m.g.zuiderwijk-vaneijk@tudelft.nl.

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1 INTRODUCTION

The evolution of the open data movement has experienced significant strides over many years, indicating advancements in transparency and offering a nuanced perspective into improved government functionality. Open data portals, despite their importance, encounter challenges in fostering interaction and engagement with citizens [28]. A departure from a unilateral viewpoint on open government data initiatives is evident in the adoption of the data ecosystem perspective, positing mutual benefits for both society and government in their interaction [20]. As citizens' involvement extends beyond data collection to contain tasks of analysis and interpretation, identifying barriers and usage issues becomes pivotal [28]. Adequate transparency and citizen participation hinge on addressing challenges in searching and defining datasets, cleaning and processing data, creating appropriate visualizations, and interpreting the data provided [15]. The data presentation by open data portals plays a crucial role in citizens' ability to utilize them effectively. In this context, correct interpretation assumes an essential role in empowering all citizens [28]. Strategies and tools for data identification, management, and dissemination are foundational for interpretation [18].

Organizations providing datasets with low representational quality face challenges in mitigating the interpretation deficit, necessitating actions such as standardizing data using accessible metadata, employing semantic and sentiment analysis techniques, and utilizing data visualization for better understanding [15]. Despite the importance of computational techniques, the diversity of user profiles and skills must be considered. Placing citizens at the center of the data flow underscores the necessity for a tool proficient in efficiently assisting citizens in data interpretation [15, 18].

According to [21], OGD provides a means for information to be easily accessible to everyone. Specifically, when OGD is published as linked data, it brings additional advantages of well-organized information with semantic structure. This fact allows for handling complex queries and obtaining information that is not only factually correct but also regularly updated. By integrating the natural language understanding and generation capabilities of a Large Language Model (LLM) with the abundant information available in

OGD, a system could address the LLM's challenge of retaining factual information. Simultaneously, it could provide a more straightforward method for accessing and retrieving OGD. The authors in [21] already affirm that applications of this kind would eliminate barriers that currently practically restrict access to users with no technical knowledge from accessing available information. In essence, this could be considered as a concept working towards the goal of democratization of information, all the while maintaining a high standard in terms of accessed data quality.

In the study by [6], the authors conducted a user study that provided empirical evidence regarding the advantages of the proposed chatbot for searching and exploring OGD in comparison to traditional portals and data access methods. The authors used Google DialogFlow, incorporating entity recognition (NER) and intent matching. Within the context of NER, specific advanced LLM's exhibit proficiency in recognizing and categorizing named entities. This innovative approach capitalizes on the capabilities of cutting-edge LLM's, such as GPT-3.5 or GPT-4, to execute NER tasks with heightened precision and efficiency.

So, our decision to integrate ChatGPT into this investigation is grounded in the hypothesis that this model can effectively serve as a conversational assistant and may augment the reliability and completeness of the process, explaining the data origin retrieved in Hippolyta. The goal is to investigate the viability of this integration, conducting a technical analysis. One of the greatest contributions of this work is to advance the interpretability of government data, demonstrating the immense potential of AI to enhance our understanding and utilization of this data.

This work is organized as follows: In Section 2, we introduce a background on ChatGPT for OGD initiatives and Human-Data Interaction on Government Portals, mentioning works related to the topics related to this work. In Section 3, we present the framework introduced in previous works, capable of leveraging the interpretability of open government data. In Section 4, we present our research design. In Sections 5 and 6, we raise the stages of our study, previously explained in the previous section, with the results. In Section 7, we offer a discussion, conclusions, and future work.

2 BACKGROUND

2.1 ChatGPT for OGD initiatives

According to [19], as a new Artificial Intelligence application, ChatGPT is relevant not only for academic, medical, legal, computer science, and other sectors but also for the public sector, as exemplified by the OGD initiative [10, 16, 17, 21]. The development of ChatGPT holds extensive potential to provide beneficial capabilities and enhancements across various activities and economic sectors [19]. It has the possibility of delivering transformative and substantial impacts, but the full realization of this potential may encounter significant obstacles and challenges, including some potential threats [19].

The study conducted by Loukis*et al.* [19], carried out research with experts, highlighted that user engagement with OGD will be enhanced by the "open" approach and easy accessibility provided by ChatGPT. This instrument can offer substantial assistance to users in precisely locating relevant datasets for their specific needs, processing these datasets (especially for those unfamiliar with data processing tools), interpreting results, and overall exploration for commercial purposes (such as developing value-added electronic services by combining various types of open government data and possibly private data) or for political purposes (seeking a more profound, data-driven understanding of government actions and expenditures, thereby enhancing transparency). Thus, a variety of stakeholders, including citizens, private sector entities, journalists, professionals, academics, software developers, and others, can significantly benefit by leveraging ChatGPT for value derivation and innovation searches.

A notable contribution to the exploration of leveraging large language models for the transformation of OGD portals is presented in the work by Mamalis *et al.* [21]. In this study, the authors specifically focus on integrating the GPT3.5 OpenAI model with OGD to enhance the accuracy of responses. They introduce an inventive approach for accessing statistical information through natural language queries, exemplified through a proof of concept application utilizing the Scottish open statistics portal. This research is pivotal as it tackles the challenge of distinguishing factual information from fictional content generated by large language models.

The authors, in [21], demonstrate that a critical aspect of their proposal is its ability to enable the generation of responses in natural language, which not only proved to be factually correct but also presented understandably and intuitively. This feature facilitates direct communication between users and the statistical portal, enhancing the accessibility and usability of OGD. Mamalis et al.'s work not only addresses the challenge of accuracy in responses but also emphasizes the importance of delivering information in a user-friendly format, contributing to a more effective and approachable interaction with OGD portals.

2.2 Human-Data Interaction on Government Portals

Our motivation stems from the premise that open government data portals should offer computational resources to generate more excellent added value to citizens from the provided data. In this regard, efficient architectures, frameworks, processes, and methodologies are necessary for identifying, mapping, developing, and planning resources to improve Human-Data Interaction (HDI) in open government data portals. Several initiatives discussed in the literature contribute to filling this gap, as described below. We found works aiming to promote more efficient interfaces, providing distinct functionalities that facilitate data understanding for different user profiles and offering data visualization options. In initiating our methodology, we essayed a literature review, examining the contemporary landscape of ChatGPT applications within contexts reminiscent of OGD initiatives. This preliminary analysis undertaking sought to contextualize prevailing scenarios of ChatGPT implementation, offering nuanced insights into established practices and the perceived benefits within these environments. This immersion provided a foundation to inform and guide our subsequent methodological efforts.

In the work by [23], the authors propose the use of chatbots on the "Open Cantieri" dataset, published by the Italian Minister of Infrastructure and Transport, with a user-friendly interface for

open government data. "Open Cantieri" is an open, comprehensive, and updated repository on the status and history of public infrastructures. The proposed architecture is implemented on the IBM Bluemix cloud computing platform, involving two instances: (i) a Watson Conversation instance and (ii) a Compose for MySQL instance. The citizen interacts through a chat interface, posing questions like "How much money was invested in public infrastructures in southern Italy in 2015?". The Watson Conversation instance receives the request and generates the corresponding response. Based on the provided answer, a SQL query is defined to be sent to the database through Composer for MySQL. After collecting all the necessary elements to build the output, the chatbot's page continues interacting with the citizen through the implemented interface. Future work includes a validation test set to legitimize the proposed architecture. In [5], the authors define a methodology to evaluate perceived social value in open government data opening initiatives. This fact aims to identify the most valuable information items in datasets and visualize them to allow citizens more personalized access to this information. The empirical study involved a sample of citizens, potential consumers of real open datasets, focusing on the healthcare domain. The methodology provides a conceptual tool to analyze, extract, and evaluate potential value characteristics in datasets. Services adhering to the presented methodology can personalize information according to citizens' profiles and preferences. The significant contribution of [5] lies in the idea that open government data portals do not require extensive data processing and various data transformation methods to provide more excellent social value to citizens. Instead, the creation of tertiary data—data generated about us, not by us, such as cache files—can be performed. This allows HDI techniques to select more helpful information, tailor it to citizens' profiles or preferences, and convey it most effectively.

Cordasco *et al.* [9] presents SPOD, a social platform for open data. The goal is to provide an alternative to increase social value for citizens and engage them in local associations, forming communities of interest in open data. SPOD adds a social and collaborative layer to open government data initiatives in favor of transparency. Through SPOD, communities in a social environment can enable data-driven discussions. Citizens can retrieve existing open data directly from associated open government data portals, create visualizations, and use or reuse them in discussions. SPOD's main contribution is enabling collaboration among citizens as a critical aspect to ensure value creation from open government data. SPOD is fully interoperable with existing open government data portals, allowing citizens to directly list and access datasets, create reusable visualizations, and share, use, and reuse datasets and visualizations in integrated discussions. One notable feature of SPOD is the incorporation of provenance of data through Datalets, ensuring a direct link to the original dataset web page below visualizations. This linkage enables users to verify the authenticity of the depicted data, differentiating between original data and potential modifications. Moreover, the provided link serves as an indicator of the data source's authority, distinguishing between datasets published on official portals and those co-created by citizens.

In [6], the authors present a chatbot for accessing open government data. The developed chatbot allows searching and exploring datasets through complex queries easily constructed by non-expert users through natural language conversation. The user interacts with the chatbot through conversations in instant messaging applications. The textual statement from a user—manually written or automatically generated from voice messages—is sent to the NLP component, extracting entities and identifying the target intention. If the intention is to search a collection, the chatbot requests terms associated with relevant datasets, initiating a keyword-based search in a database index. The results are then presented to the user. If the intention relates to a database operation, it is sent to a query creation module. A conversation is maintained with the user, iteratively asking for the elements needed to create an SQL query representing their information needs. Once the query is created, it is launched in the database, retrieving the desired data items finally presented to the user. The authors also report a study evaluating the chatbot against a series of public service value ranges, along with measuring various objective and subjective metrics. Experimental results show that the proposed system outperforms traditional methods followed in open data portals. Additionally, the authors addressed user concerns about data trustworthiness and legitimacy, as participants expressed confidence in the veracity of the OGD used. However, the work does not provide a specific solution to enhance the issue of data provenance, reliability or completeness.

In [7], the authors identify a list of necessary features in the design of a generic data storytelling tool and implement these features in a usable tool called ODE (Open et al.). Unlike existing tools, ODE provides additional features to facilitate data storytelling for users of open government data, including direct connection to portals, data quality estimation, data overview, recommended visualization of selected data, and feedback collection. The authors conducted interviews with eleven users to assess whether ODE is easy to use and valuable in all stages of data storytelling, as well as to collect suggestions for additional features to be implemented. Unlike generic data visualization tools, ODE provides users with an end-to-end tool to transform data into information without needing separate tools. It also allows users to provide feedback on visualizations, subsequently using it to improve initial visualization rules. ODE establishes a direct interaction with data portals, enabling users to seamlessly search for connected data from CKAN or OpenDataSoft portals. ODE relies on the APIs provided by these two open data management systems (ODMS) to enable users to collect data directly from a portal. It is important to highlight that while ODE excels in providing an end-to-end tool for transforming data into information without the need for separate tools, the work does not explicitly address issues of traceability and trust [7].

All the works mentioned in this section have focus that we considered when defining the proposed architecture of the framework. The identified focus are detailed in Table 1.

An important aspect of the related works is the requirement for an advanced user interaction strategy that can facilitate better traceability and completeness of the collected data. Previous studies have often lacked a comprehensive approach to citizen engagement, which could improve the interpretability of the collected data. Currently, the research in this domain needs to propose sophisticated methods to establish a more robust connection between citizens and data. This lack of connection might hinder efforts to ensure a clear, complete, and reliable understanding of the origins of the collected data.

Table 1: Focus of the works listed in the Related works.

Author	Goal	Focus
Porreca *et al.*	Employ chatbots as an interface to open data published by organizations.	The proposal does not include data visualizations in its architecture.
Cabitza *et al.*	Define a methodology for assessing the social value of open government data.	The main contribution of the study is methodological in nature, and does not include a proposal for a computational technique to increase the social value of open government data.
Cordasco *et al.*	Propose an alternative to increase the social value added to citizens and involve them in local associations that form communities of interest in open data.	The proposal does not include in its architecture any resource for understanding the citizen's needs, using natural language processing techniques.
Cantador *et al.*	Propose a chatbot to access open government data.	The proposal does not include data visualizations in its architecture.
Chokki *et al.*	Present a tool that assists users in the different stages of data storytelling.	The proposal does not include in its architecture any resource for understanding the citizen's needs, using natural language processing techniques.

3 INTERPRETABILITY IN OPEN GOVERNMENT DATA: THE HIPPOLYTA FRAMEWORK

Citizens need to be able to correctly interpret the available data to participate more actively in democratic processes [24]. Open Government Data (OGD) programs aim to contribute to public transparency. Consequently, governments openly share their data with the public so that citizens can hold the government accountable and better understand how the government acts. In order to attain the objectives of transparency and accountability, governments generally assume that citizens can interpret their data. However, there still needed to be a formal definition in the literature about data interpretability. In this previous work [3] we formally conceptualize data interpretability as the capability of an accurate, complete, consistent, coherent, and organized dataset to convey significance to the user, stimulating the formation of his knowledge and his engagement, from a simple and clear language. Also, we grouped some characteristics that help us to constitute the concept of data interpretability, considering the context of OGDPs.

- G1 **Understandability, simplicity, clarity and readability**: This set of characteristics is related to the method of data presentation, necessary to maintain the user's interest in consuming the data.
- G2 **Reliability and traceability**: This set of characteristics is related to the possible disbelief of users about the data presented, being a minimum condition for use but not essential to the interpretation.
- G3 **Structuring, organization**: This set of characteristics is related to the fact that poorly organized datasets make the task of information retrieval difficult, making obtaining value from these data more complex.
- G4 **Accuracy, correctness**: This set of characteristics is related to the fact of obtaining a misinterpretation, distorted. However, according to [26], knowledge requires trust, so for us to reach a valid interpretation, the dataset must remain correct, unbiased, and accurate.
- G5 **Completeness**: Completeness is related to the importance of detailing the dataset.
- G6 **Conciseness**: Conciseness is related to the proper way to remove unnecessary elements from a dataset — such as avoiding similar naming data differently — which can become a problem if it affects the completeness characteristic.
- G7 **Consistency, coherence**: This set of characteristics refers to the condition of the data's ability to fulfill, without contradiction, all the properties of integrity, equivalence, logic, authenticity, and standardization.
- G8 **Informativity**: Informativeness is related to maintaining the user's interest and satisfaction.

In order to complement the data interpretability definition, we also built a model for leveraging data interpretability in OGPDs, as shown in Figure 1. This model can provide a basis for leveraging interpretability in OGD. In the interpretability model for open government data, OGDPs must perform actions such as: uncomplicate the data, track the data, organize the data, adjust the data, complete the data, synthesize the data, adapt the data, and inform citizens. After the publication of the formal definition, other works in the area are already using the data interpretability concept [11, 22, 25].

In previous work [3], we defined and developed the architecture of a framework named Hippolyta, which (i) identifies the citizen's needs using a semantic enrichment module, (ii) performs the data collection through a data retrieval module, (iii) creates a visualization from the dataset chosen by the citizen, through a data visualization module. So, to understand whether Hippolyta

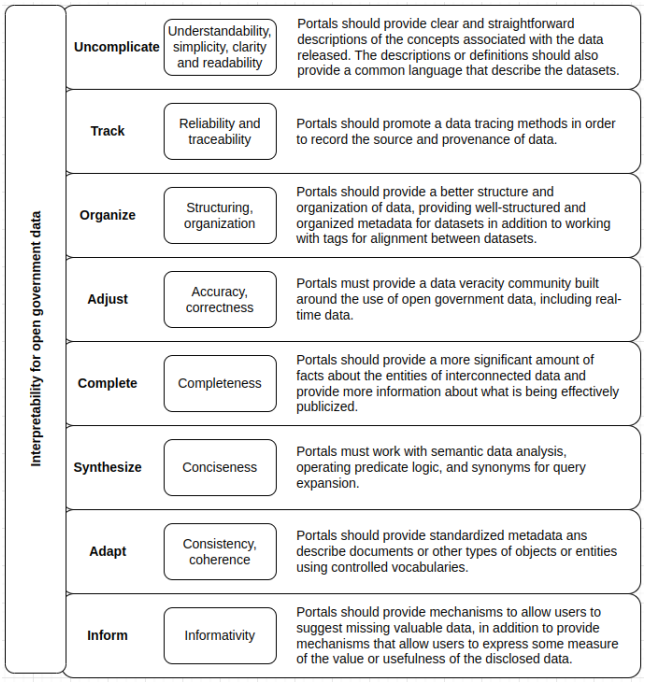

Figure 1: Model for leveraging data interpretability in OGPDs [2]

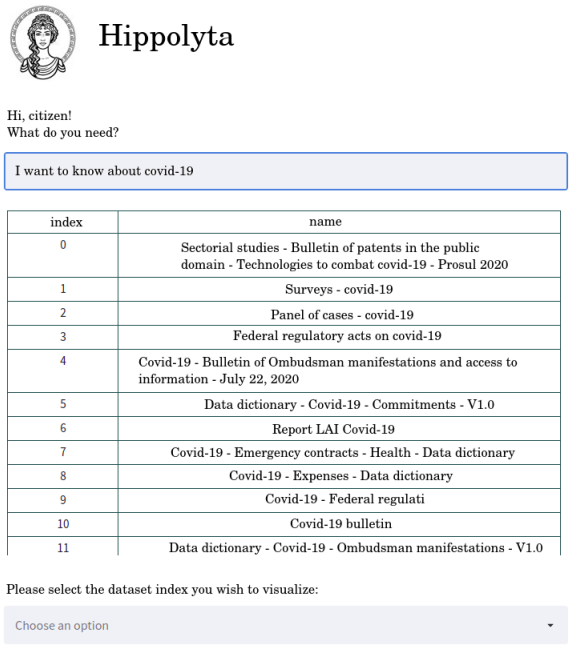

Figure 2: Hippolyta data retrieval.

could help citizens to interpret the available data, we carried out a set of evaluations. Considering the first evaluation performed on Hippolyta, the results were satisfying, considering that high values of precision and recall indicate a high data recovery power of the framework. The second evaluation of Hippolyta consolidated her ability to improve interpretability, considering that the best-evaluated functionalities of Hippolyta represent fundamental caractheristics for the interpretability definition.

Reinforcing that, we developed Hippolyta's instantiation in Portuguese, so for this publication, we edited the images for the English language. In Figure 2, we can see the initial screen of Hippolyta, where the citizen writes his need and the semantic enrichment module is executed. We emphasize that the full framework instantiation was carried out in Portuguese to evaluate it with Brazilian citizens.

To evaluate whether Hippolyta could boost the interpretability of open government data, we carried out a qualitative research method called a focus group, in which the members interacted with Hippolyta. As a result of the sessions with the focus group, we obtained comments on how Hippolyta evidence, or not, each group of characteristics — groups that constitute the data interpretability definition. The focus group also proposed evolutions for Hippolyta, considering its functionalities. In summary, we verified Hippolyta's competence in promoting the interpretability of open government data.

According to the focus group, the interpretability groups in which Hippolyta is robust are (i) G1 — Comprehensibility, simplicity, clarity, and readability, (ii) G3 — Structuring and organization, (iii) G6 — Conciseness and (iv) G8 — Informativeness. Also, according to the focus group, the groups in which Hippolyta presents vulnerabilities are (i) G2 — Reliability and traceability, (ii) G4 — Precision and correctness, (iii) G5 — Completeness and (iv) G7 — Consistency and coherence. The focus group claimed that G2 — Reliability, and traceability is compromised due to the lack of some data traceability. And then, as the Brazilian Open Data Portal is the direct responsibility of the Federal Government, citizens tend to trust the available data more. However, a data traceability resource can be easily implemented in Hippolyta with direct links to the origin of the retrieved data.

Also, in previous work [3], we noticed that the most significant difficulties of the Brazilian Open Data Portal are related to groups G1, G3, and G8, groups in which Hippolyta has competence. An example that reinforces the fragility of the Brazilian Open Data Portal, which ends up impacting the use of Hippolyta, is the high rate of unavailability of the portal, which we sometimes face in the implementation process of Hippolyta. Therefore, in this work, considering the identified gaps in the framework, we aimed to mitigate its vulnerabilities, exploring the viability and delving into the technical complexities of integrating ChatGPT with Hippolyta.

4 RESEARCH DESIGN

In initiating our methodology, we essayed a literature review, examining the contemporary landscape of ChatGPT applications within contexts reminiscent of OGD initiatives. This preliminary analysis undertaking sought to contextualize prevailing scenarios of ChatGPT implementation, offering nuanced insights into established practices and the perceived benefits within these environments.

This immersion provided a foundation to inform and guide our subsequent methodological efforts. Figure 3 illustrates the methodology carried out after the initial literature research task.

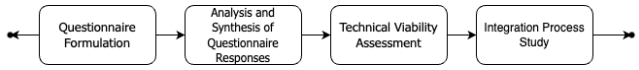

Figure 3: Methodology illustration

(1) **Questionnaire Formulation**: We developed a detailed questionnaire tailored for the specific group of focus that previously evaluated Hippolyta. The questionnaire aims to extract insights and opinions from this group regarding the potential integration of ChatGPT with Hippolyta. Questions are designed to gather perceptions, expectations, and potential benefits associated with the proposed integration.
(2) **Analysis and Synthesis of Questionnaire Responses**: We thoroughly evaluated the responses collected from the questionnaire to gain deeper insights into the potential benefits of integrating ChatGPT. The outcomes of this analysis help ascertain the actual advantages that the integration of ChatGPT may bring to enhance the Hippolyta framework.
(3) **Technical Viability Assessment**: We evaluated technical aspects — like compatibility, interoperability and ease of maintenance — associated with integrating ChatGPT into the Hippolyta framework. This evaluation delves into technical feasibility, practical considerations, and potential challenges that may appear during the integration process.
(4) **Integration Process Study**: The process of technology integration involves combining tested components into subsystems and then assembling these subsystems to create a functional system. This approach requires the careful assembly of individual elements to ensure compatibility. The integration process also involves designing and constructing tools and facilities to support the overall system. The main objective is to demonstrate the effective operation of the entire technological framework. In this work, we are specifically focused on verifying the integration between two technologies — Hippolyta and ChatGPT. Therefore, we developed an integration process delineating the data exchange dynamics between these technologies. This process outlines the step-by-step interaction between the two technologies, elucidating the information flow and integration points. The goal is to present a clear and structured overview of the integration process, emphasizing the coordinated collaboration to enhance the overall capabilities of the Hippolyta. Some questions guided us in this integration study:
   (a) What triggers the integration between Hippolyta and ChatGPT?
   (b) Why is the creation of a metadata file crucial, and what information does it cover for traceability and integrity?
   (c) What does the communication step involve, and how does ChatGPT process the embedded metadata from Hippolyta's request?

5 QUESTIONNAIRE: FORMULATION, ANALYSIS, AND SYNTHESIS OF RESPONSES

We administered a questionnaire to the focus group. This same group of five members had previously participated in a research study evaluating Hippolyta. The purpose was to address the following guiding question: "To what extent can the incorporation of ChatGPT drive the evolution of Hippolyta, promoting significant improvements in terms of precision, correctness, accuracy, consistency, and coherence of data from open data portals?". Data collection was carried out using the research method using an electronic questionnaire [1], which included open-closed and scale questions. The survey questionnaire questions were closed-ended questions using the Likert scale model and open-ended questions using a text box. They also completed an informed consent option in the first part of the electronic questionnaire. The consent form provided participants with information regarding the intention of the study, the confidentiality of the information, and the right to withdraw from participation without explanation. The qualitative questionnaire consisted of six questions, which referred to the integration between Hippolyta and chatGPT. The questions are detailed in Table 2.

Data was analyzed using the principles of thematic analysis [8]. In the initial step, "Familiarizing Your Data", researchers familiarized themselves with our participants' questionnaire responses. Moving on to the second phase, "Generating initial codes", we generate the corresponding codes. The codes represent distinct aspects related to the research question identified in the data set. Initial names were assigned to these codes, which underwent modifications and refinements throughout the analysis. The third phase, "Search for themes", involved organizing these codes into thematic groups. Themes encapsulate multiple aspects, sharing a common core organizing concept. While codes summarize individual aspects, themes summarize multiple aspects interconnected with each other. The themes, in turn, were further organized into more comprehensive themes. In thematic analysis, overarching themes typically do not contain their codes but instead comprise a collection of themes united by a common idea. In the fourth phase, "Review of themes", these themes were subjected to review both at the level of the data collected and throughout the entire data set. Subsequently, in the fifth phase, "Definition and naming of themes", the themes were given names.

Using the thematic analysis, we organized three themes: (a) User Interaction and Experience, (b) Challenges, Limitations and Improvements, and (c) Functionality, Expectations and Impact. The three themes can be described as follows:

- (a) This theme addresses the evolution of Hippolyta. It evaluates whether the ease of interaction, the encouragement of active use, and the overcoming of barriers, with integration with ChatGPT, can contribute to improvements in terms of precision, correctness, accuracy, consistency, and coherence of data from open data portals.

[1] https://forms.gle/N3ypLhVNb8wcn3aT7

Table 2: Questions used in the survey for qualitative study

No Item	Guide questions	Description
1	Do you believe that interaction with ChatGPT has the potential to motivate citizens to use the Hippolyta more actively?	The potential impact of ChatGPT on citizens' motivation to actively use the Hippolyta is a subject for investigation. The question aims to discern whether interaction with ChatGPT can influence increased engagement and utilization of the Hippolyta tool among citizens.
2	Does ChatGPT provide the explanations perceived as a clear complement to the data visualizations present in the Hippolyta?	The question explores whether explanations provided by ChatGPT are perceived as a precise complement to the data visualizations within the Hippolyta. It aims to assess the effectiveness of ChatGPT in enhancing the clarity and understanding of information presented through visualizations.
3	Do you believe that the integration of ChatGPT with Hippolyta can be effective in producing detailed explanations about data collection methodologies, covering aspects such as sources used and sampling protocols, among others?	Investigating the integration of ChatGPT with Hippolyta, the question examines the effectiveness of this collaboration in producing detailed explanations about data collection methodologies. It specifically addresses aspects such as sources used and sampling protocols, aiming to enhance the comprehensiveness of explanations.
4	Considering the integration of ChatGPT with Hippolyta, could ChatGPT help identify errors and inconsistencies in the data coming from the portals?	In the context of integrating ChatGPT with Hippolyta, the question considers the potential role of ChatGPT in identifying errors and inconsistencies in the data retrieved from portals. It aims to evaluate the capacity of ChatGPT to contribute to data quality assurance within the Hippolyta.
5	Could ChatGPT contribute to greater transparency regarding the origin of data in the Hippolyta?	The question explores the potential contribution of ChatGPT to transparency regarding the data origin within the Hippolyta. It investigates whether ChatGPT can provide insights into the sources and data origins, enhancing transparency for users of the Hippolyta.
6	To what extent can the integration of ChatGPT boost the evolution of Hippolyta, resulting in significant improvements in reliability and traceability, precision and correctness, completeness, consistency, and coherence since Hippolyta is a tool that consumes data retrieved from portals?	Examining the integration's impact on Hippolyta's evolution, the question assesses the extent to which ChatGPT can drive significant improvements in reliability, traceability, precision, correctness, completeness, consistency, and coherence. This evaluation is crucial since Hippolyta relies on data retrieved from portals, and the question aims to quantify the enhancement potential ChatGPT integration.
7	Do you have any suggestions, criticisms, or comments about the research?	This question is an invitation for respondents to provide their input, opinions, or feedback regarding the research. Participants are encouraged to share any suggestions, criticisms, or comments they may have about the study. The aim is to gather constructive insights that can contribute to refining and improving the research.

- (b) This theme addresses the challenges and limitations perceived in the integration of ChatGPT with Hippolyta. Suggestions for specific improvements are fundamental to understanding how the incorporation of ChatGPT can drive improvements in the aspects mentioned in the guiding question.
- (c) This theme explores the expected impact of Hippolyta integrated with ChatGPT. Examines expectations regarding model capability and assesses how this integration can impact data reliability and traceability, accuracy, correctness, completeness, consistency, and coherence.

5.1 User Interaction and Experience

Participants explored how users interact with ChatGPT, including aspects of facilitating interaction, encouraging active use, overcoming access barriers, and the overall user experience when exploring ChatGPT and Hippolyta. They linked the ease of communication that could be leveraged with the proposal for integration between

technologies: “There is an appeal for the use of technology, in addition to potentially facilitating interaction with the tool”; “Since ChatGPT is a tool for generating texts based on the input provided, it can motivate use because it gives the user more freedom to say what they are looking for. The generated text can be easier to understand, or the user can ask for an explanation of data found and make the interaction more attractive”.

5.2 Challenges, Limitations and Improvements

Participants explored perceived challenges and limitations, such as identifying errors, transparency, and implementation difficulties, as well as including suggestions for specific improvements in the integration of ChatGPT with Hippolyta: “I believe this task is more difficult to implement”; “ChatGPT is still in its early stages. I believe it can offer some assistance in identifying errors and inconsistencies in the data. However, it has some limitations, such as: offering wrong, incomplete or off-target answers”.

5.3 Functionality, Expectations and Impact

Participants explored Hippolyta’s functional vision, expectations regarding its integration into ChatGPT, and the overall impact of this integration on the functionality and evolution of the framework. This theme helped us identify the two interpretability characteristics — previously identified as weaknesses — that could, in fact, be improved with the proposed integration between technologies: “I believe that ChatGPT can improve all interpretability characteristics, especially reliability and traceability”; “I believe ChatGPT can offer improvement by presenting the data sources and the website from which the information was extracted”; “For me the main point is completeness. Both chatgpt has a great capacity to address this point, and Hippolyta will provide a simpler and more effective way of dealing with complex data”. After reviewing this theme, we verified that for the participants, the significant contribution of the integration between Hippolyta and ChatGPT would be in the context of leveraging the groups of interpretability characteristics: (G2) Reliability and traceability; (G5) Completeness.

6 TECHNICAL VIABILITY AND PROPOSED INTEGRATION PROCESS

To carry out the technical viability study, we embarked on a literature review, exploring other works employing equivalent interactions with ChatGPT. This analysis aimed to examine approaches, methodologies, and research outcomes, providing a solid foundation for our investigation. By reviewing experiences from similar implementations, we sought insights that could inform and enhance our integration process.

We had as a basis for evaluating the technical feasibility of works such as [4, 13, 27]. One of the main difficulties identified in these works is related to the consideration of user data security. The literature review revealed that many implementations face significant challenges in dealing with privacy and security issues. Appropriately protecting user information during interactions with ChatGPT emerges as a critical priority. It is essential to highlight that, to guarantee the security of citizens’ data, Hippolyta will not send sensitive information in requests to the ChatGPT API, adopting a preventive and responsible approach to data processing.

In the proposed process, we aim to strengthen the Hippolyta framework through integration with ChatGPT, addressing identified weaknesses in interpretability groups, particularly G2 (Reliability and Traceability) and G5 (Completeness). The inclusion of ChatGPT as a conversational assistant adds an explanatory layer to the origin of data retrieved in Hippolyta, enhancing the interpretability of the framework — as it includes two new features - the explanation of the provenance of the data and the data sets themselves. These additions not only rectify previously identified vulnerabilities but also signify a substantial advancement, providing more excellent reliability and completeness to the interpretation of OGD.

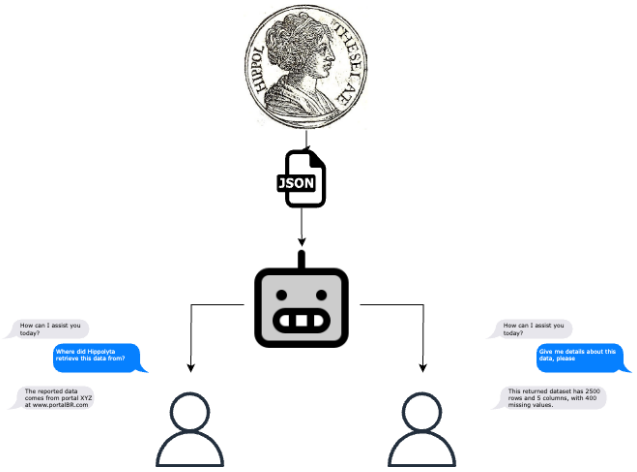

Figure 4: Illustrated example of Hippolyta and ChatGPT integration

While the evaluation with real users is a future endeavor, the implemented improvements delineate a positive evolution, paving the way for a more robust and transparent framework. In Figure 4, we can visualize an illustration of the integration, allowing users to interact with the platform in natural language and request explanations regarding the data origin and descriptions of the datasets recovered by the framework.

According to Figure 5, the integration process occurs as follows:

(1) **Data Retrieval by Hippolyta**: The integration commences with citizen-initiated requests, prompting Hippolyta to retrieve data from open government portals. This step involves querying relevant datasets based on citizen inquiries.
(2) **Metadata Creation by Hippolyta**: After successful data retrieval, Hippolyta creates a metadata file. The generated metadata forms a detailed dictionary, covering information crucial for traceability and integrity, such as the source of the data, descriptions of the retrieved datasets and portal URL, and timestamp data indicating when the information was accessed.
(3) **Request to ChatGPT**: Subsequent to metadata creation, Hippolyta initiates a communication step by sending a well-structured request to ChatGPT. This request includes the comprehensive metadata dictionary, serving as a contextual foundation for subsequent interactions.

(4) **Receipt of Request by ChatGPT**: ChatGPT receives the request from Hippolyta, parsing and processing the embedded metadata. The model readies itself to engage in a user-friendly and informative interaction based on the provided contextual information.
(5) **ChatGPT's Response to the Citizen**: Leveraging contextual metadata, ChatGPT creates a detailed response to the citizen's query. The response not only addresses the user's query but also includes explanations about the data provenance and a description of the retrieved datasets. This detailed response is then transmitted back to the user via Hippolyta.

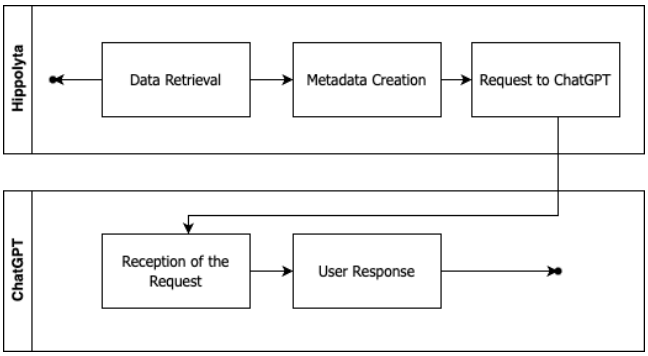

Figure 5: Process of Hippolyta and ChatGPT integration

```python
import openai

def chat_with_gpt(user_text, metadata):
    api_key = "openai_api_key"

    response = openai.ChatCompletion.create(
        model="gpt-3.5-turbo",
        messages=[
            {"role": "system", "content": "You`re a "
                                          "helpful assistant."},
            {"role": "user", "content": user_text},
            {"role": "assistant", "content": metadata}
        ],
        max_tokens=150
    )

    return response['choices'][0]['message']['content']


# Use example
user_input = ("Tell me about the data retrieved from "
              "Portal Hippolyta.")
metadata = {"portal_name": "Hippolyta", "url":
            "https://portalHippolyta.com",
            "timestamp": "2023-01-01"}
response = chat_with_gpt(user_input, metadata)
print(response)
```

Figure 6: Example of code sending metadata to the ChatGPT API.

In Figure 6, we can visualize an example of integration code passing metadata to the ChatGPT. This Python code uses the OpenAI API to integrate the ChatGPT model and generate natural language responses based on citizen interactions. The chat_with_gpt function accepts user input text and metadata related to the request, sending a request to the ChatGPT API. The conversation is structured into three parts: (i) the first defines the role of the assistant, (ii) the second represents the user's input, and (iii) the third includes metadata. The response generated by ChatGPT is then extracted and returned by the function. The usage example indicates how the function can be used, with the user requesting information about data retrieved from a specific OGD portal. This integration provides an approach to natural language interactions, enabling the virtual assistant to deliver contextualized responses based on citizen requests and associated metadata.

The integration between ChatGPT represents a substantial evolution in Hippolyta. This collaboration not only addresses previously identified gaps in the framework but significantly enriches the framework's capabilities by offering a contextualized and informative answer about the origin and description of the retrieved datasets; this fusion notably reinforces the OGD interpretability, as already stated in previous works [1–3]. Thus, the union between Hippolyta and ChatGPT is not limited to resolving previous vulnerabilities but positively redefines the narrative of OGD roleplaying.

7 DISCUSSION

This study aims to investigate whether ChatGPT can enhance the interpretability of OGD. It does so by examining the potential of integrating ChatGPT in Hippolyta. Hippolyta is an architecture that (i) identifies citizens' needs for OGD using a semantic enrichment module, (ii) performs the data collection through a data retrieval module, and (iii) creates a visualization from open government datasets through a data visualization module. The semantic enrichment module, data retrieval module, and visualization module together make it easier for citizens to interpret open government datasets.

Hence, the scientific contributions of this study can be formulated as (i) exploration of ChatGPT integration, specifically with the Hippolyta framework, to increase the interpretability of government data — this can provide valuable insights into how AI can be effectively incorporated into specific frameworks targeting government data; (ii) specific investigation into the technical feasibility of merging ChatGPT with the Hippolyta framework. This practical approach can offer valuable insights for developers and researchers interested in implementing similar solutions; (iii) contribution to advances in the interpretability of government data, highlighting the potential of AI, more specifically ChatGPT, to improve the understanding and usefulness of this data — this may be especially relevant for transparency and accountability initiatives.

Several types of practitioners relevant to this study include OGD portal developers and OGD policymakers. First, OGD portal developers may benefit from the findings of this study since this study provides them with specific insights into how developers can enrich the experience of OGD users. The identified architecture modules of Hippolyta can be integrated into national and local OGD portals to enhance the user experience. For OGD policymakers, this is also an important insight. Previous research showed that the easier OGD

use becomes, the more likely it is that it will be used [12]. Moreover, a previous study also showed that more demand for OGD use may motivate OGD providers to make more government data available [12]. Thus, if the integration of ChatGPT with OGD portals makes the use of OGD easier, this may lead to more OGD provision and use — this could contribute to realizing the benefits of OGD, such as increased transparency [12], innovation in government services [12] and enhanced economic growth [12].

Regarding the limitations of the study, there are general limitations of ChatGPT, like The challenge of data privacy and ethics, bias, and fairness, which are critical issues related to developing and deploying chatbots [14]. In our future work, we plan to evaluate the use of Hippolyta integration with ChatGPT among end users. The purpose of this evaluation is to gain a comprehensive understanding of how the interaction between Hippolyta integration and ChatGPT affects user experience; this will help us identify strengths, challenges, and areas for improvement. We will be conducting usability studies and qualitative research to gather direct user feedback; this will help us uncover perceptions, preferences, and suggestions for enhancements. Technologies such as AI, and more specifically ChatGPT, are developing fast. In the future, AI may become more valuable as a technology to support not only OGD interpretability but also other aspects of OGD provision and use.

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