Towards Understanding and Improving Multilingual Collaborative Ontology Development in Wikidata

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ABSTRACT

Wikidata is a multilingual, open, linked, structured knowledge base. One of its major interesting features is the collaborative nature of ontological development for diverse domains. Even though Wikidata has around 4500 properties compared to the millions of items, their limited number cannot be overlooked because they form a major role in the creation of new items, especially for the manual interface. This article will take a look on understanding the present approach of property creation, mainly focusing on its multilingual aspects. It will also present a quick overview of an ongoing work called *WDProp*, a dashboard for real-time statistics on properties and their translation.

CCS CONCEPTS

• **Information systems** → **Web data description languages**; *Structure and multilingual text search*; • **Software and its engineering** → Collaboration in software development;

KEYWORDS

Collaboration, Multilingualism, Ontology development, Wikidata

ACM Reference Format:
John Samuel. 2018. Towards Understanding and Improving Multilingual Collaborative Ontology Development in Wikidata. In *Wiki Workshop (WikiWorkshop)* , 5 pages.

1 INTRODUCTION

Online collaboration [5, 6] has caught the interest of many researchers during past many years. As internet became an integral part of our everyday lives, it has become much easier to communicate and collaborate with people across the globe. Several collaboration tools with real-time editing capabilities are now available. These tools and their usage can give wide insights to understand human collaboration and to develop new time-saving features.

Collaborative software development has been around for several years with version control systems (VCS) like GIT, SVN, CVS playing an important role in development of softwares. VCS permits individual software developers to independently develop software code and later share their changes before making a final consensus on the final outcome. It is important to note here that the aforementioned tools are used with other tools of communication like email, blogs, mailing lists, internet forums for discussion and obtaining a final consensus. Understanding this whole process of communication during software development has helped to create new full-fledged development environments that not only includes version control systems but also incorporates continuous integration, bug reporting, discussion forums etc. Understanding the role of external communication mechanisms is therefore very important to build effective collaboration tools.

Wikis[24] are another major and often cited example of online collaboration. Wikipedia, undoubtedly comes to mind especially considering its global outreach. Editors from around the world create, edit and discuss various topics of interest. However, what distinguishes Wikipedia from many large software collaboration projects is also its goal of building a multilingual knowledge base right from its inception. This means, Wikis can be read and modified by users from different linguistic backgrounds in their own native (or preferred) languages. This multilingual nature is also one of the key factors for the popularity of Wikipedia, especially enabling contributors to target local-language communities.

Wikipedia has become a major source of information for human consumption. Even though, there are templates and information boxes (or infoboxes) that highlight key information that have been extracted and analysed for machine-consumption, Wikipedia consists of a large amount of unstructured data in the form of human-comprehensible text. With the growing explosion of data, it is now becoming difficult to maintain upto date information on Wikipedia. Information is evolving at a very fast rate, making it infeasible for any one human or any one community to update content on all the multilingual versions of an article[15]. This problem has been well-known and in 2012, Wikidata[23] was created to tackle some of these problems, giving an equal opportunity to both humans and machines to access and update content and thereby maintaining the collaborative nature of Wikimedia projects. Wikidata[1], is similar to its sister Wikimedia projects like Wikipedia, Wikibooks with the major difference that it is structured and linked knowledge base.

When multilingual Wikipedia projects are compared to Wikidata, it must be noted that in case of Wikipedia, every language has its own independent existence with a separate subdomain in the form of URL like *https://{lc}.wikipedia.org*, where *lc* is the language code for the concerned language. Wikidata is however different. There are no separate subdomains, but recall that Wikidata is still multilingual. Depending on the locale settings of web browser of the user, the user views the contents of a page in her local language. Details

WikiWorkshop, April 2018,

[1] https://www.wikidata.org/

of Douglas Adams[2], Albert Einstein[3], Alan Turing[4], Leonardo da Vinci[5] can be seen in the local language of the user. Nevertheless, user can see the details in any supported language by changing the default language. In some ways Wikidata may seem similar to Wikipedia commons[6], the media store for Wikimedia projects, where users can find description of media in several languages.

This multilingual support is obtained thanks to the efforts of thousands of editors from around the world. Wikidata[23] consists of two types of pages: property pages and item pages. Item pages describe the entities like persons (some examples given above), books and articles, geographical places to name a few. Property pages are dedicated to properties for describing the above entities. Example properties include first name, last name, date of birth, native language, instance of, subclass of etc. Every domain may have its own dedicated set of properties, however some properties may be used across domains.

Defining the properties for a domain is one of the major tasks in ontology development. But in Wikidata, this ontology development is done by the community, who may or may not be the subject experts of the concerned domain. Additionally, as mentioned above, Wikidata has no subdomains, dedicated for every language like in the case of Wikipedia. Hence the creation of properties is done by Wikidata contributors from across the world, who propose, discuss, vote and translate on one single website of Wikidata. This process needs to be understood very well, especially in maintaining the significant feature of Wikidata: multilingualism. Property and item labels need to be translated in all the supported languages in order to avoid creating duplicate and redundant pages. Is it possible to achieve a truly multilingual collaborative ontology development[14] in Wikidata or other similar projects, where the entire process from discussion of ontology development to its final creation truly maintains multilingual nature?

In this article, the focus is on Wikidata properties. Though few in number (currently less than 5000) compared to millions of items, properties form the foundation of Wikidata. Collaborative ontological development is challenging, especially when it is both multilingual and multi-domain. Yet the property creation, approval and translation in Wikidata gives a deep insight of this current process. How far of this process is truly multilingual? Is there any way to track this entire workflow in a real-time manner for any Wikidata contributor? Is there any common pattern in the translation process that can be exploited to fasten the overall translation process and improve the overall multilingual experience on Wikidata? These are some of the questions that are discussed in this paper.

Section 2 explains the process of multilingual collaborative ontology development, especially focusing on how it is being currently done in Wikidata. It also discusses some of the challenges In section 3, we focus on various existing tools for collaborative and multilingual ontology development, related research works and their focus. Much of these works focus on giving a snapshot of Wikidata translation process at a given time providing interesting insights. Nonetheless, it is important to give real-time insights to Wikidata contributors so that the entire workflow of ontology development can be improved. That brings the readers to section 4 which describes *WDProp*, its goals, ongoing development and future works. It also briefly discusses how some of these statistics may help in improving the ontology development. Finally section 5 concludes the article.

[2]https://www.wikidata.org/wiki/Q42
[3]https://www.wikidata.org/wiki/Q937
[4]https://www.wikidata.org/wiki/Q7251
[5]https://www.wikidata.org/wiki/Q762
[6]https://commons.wikimedia.org/

2 MULTILINGUAL COLLABORATIVE ONTOLOGY DEVELOPMENT

A major step before setting up a knowledge base is to develop the required ontology. Ontology development is a long process and involves continuous discussion and feedback from domain experts[25] and key players of the field. Different domains do share some common properties, yet identifying these common properties, also called ontology reuse requires knowledge about the existence and capabilities of other existing ontologies. Nevertheless, ontology reuse do constitute a major step in the ontology development.

Many concurrent ontologies have been proposed by different competing partners and it becomes a major problem during information interchange. In order to work with these ontologies, automated ontology matching [11] has also been suggested. This matching helps to identify the overlap between different ontologies. One other way is to standardize the ontology development process by involving multiple key players of the field. But these ontologies may not cater to all the needs of the wider community since it may only resolve the problems of the members of the standards body.

Other approaches to ontology development [20] include automated ontology development[1–3, 9] from structured and unstructured text. It involves identifying the key properties from documents by using machine learning techniques.

Despite the existence of several automated ontological development methods, collaborative ontology development[4, 16, 19] still remains a major approach with feedback from not only the subject experts, but also members who may not have have much clue about the concerned domain. This sort of collaboration gives the community members an opportunity to bring expertise from other domains to the given domain in question. However, compared to the automated option, this is a very slow process. It is sometimes very difficult to come to a consensus in identifying the key properties for a domain.

Discussions during ontology development often occur in one or two languages known to the majority of concerned ontology developers. So identifying a property, suggesting it for discussion, coming to a consensus on its semantics, all of these occurs in very few languages. It may be possible that a property proposer may suggest translations in languages known to her, but it cannot be guaranteed that its semantics can be fully discussed if these languages are unknown to the people involved in the property discussion. Property translations in all other supported languages can be made even after its final approval and subsequent creation. But this may also lead to a situation where, because of semantic reasons, it may be difficult to use certain properties in some languages.

Finally, hybrid approach may also be interesting, where automated tools can help in multilingual collaborative ontology development [22].

2.1 Wikidata properties

Now, we focus on how multilingual ontological development occurs in a collaborative manner in Wikidata. Wikidata knowledge base mainly consists of two types of pages: property pages and item pages. Both properties and items are identified by unique identifiers. A property identifier is of the form *P[0-9][0-9]**, i.e., *P* followed by a natural number and an item identifier is of the form *Q[0-9][0-9]**, i.e., *Q* followed by a natural number. These identifiers are useful for machine consumption. However, for human consumption, these numbers must be labeled and described. A property may have multiple labels, also called aliases. Therefore, every property and item may have labels and descriptions in all supported languages of Wikidata. These multilingual labels and descriptions play an important role in rendering a user-friendly interface on Wikidata, in the language chosen by the user or based on locale settings of the browser.

Properties are used to describe the features of a given item (or concept). Every property has a data type that is used to decide the domain values. Current data types include string, external identifier, media, coordinates, monolingual text, multilingual text, time, URL, number, geo-shape, tabular data type etc. Currently, a vast majority of properties have data type *external identifier* that is used to specify the identifier of the given item in an external database. Some properties may also their equivalents in other existing ontologies. Using external identifiers and equivalent properties, it is now possible to obtain a very large linked (open) data store.

2.2 Workflow

It is important to understand the overall workflow of ontology development in Wikidata [14]. Any Wikidata contributor can suggest new properties. A property proposal page[7] is the starting point, where several subpages for commonly used domains have been created. Some example domains include person, authority control, event, sports, space, transportation etc. A sample proposition page is shown in Figure 1. We will focus on two interesting fields on this page[8], something that is interesting to understand multilingual aspects of property proposition. The first field is used to give a label for the proposed property and the second field *description* is used to give a long description. Note the use of TranslateThis template[9] for both the fields, a feature that helps to give a localized interface to the users. This property proposition template, though seen in English can also be seen in other (already translated) languages (mainly the description of the fields seen on the right hand side of Figure 1). Once the required fields are filled, the property page proposition can be created and linked to the main page of proposition page of the given subpage (of the concerned domain). Once linked, the property is open for discussion and voting by the community members. Wikidata contributors can support or oppose a property proposition (without any justification, even though it is strongly recommended). A contributor can also leave a comment for more clarification, without giving any vote. Votes use templates, so when a user makes use of template {{s}}[10] to give support or

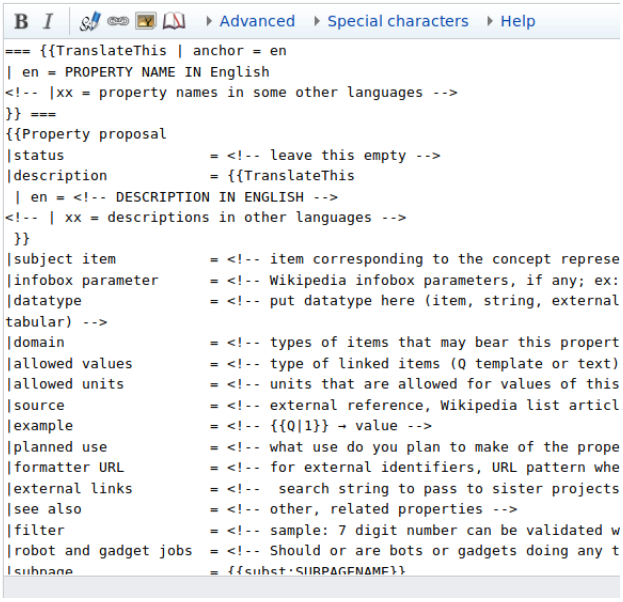

Figure 1: A sample property proposition page

template {{o}}[11] to oppose, users can see this vote label in their local languages (if template has already been translated to the concerned language). Even reasons for support/opposition can be asked to be translated using the TranslateThis template discussed above. These are the current possibilities of ensuring a multilingual support for property proposition, discussion and voting.

Once a property proposal has obtained majority number of votes, Wikidata administrators/property creators can create the given property. A newly created property is now available for use, but may require translation of labels, aliases and descriptions.

2.3 Evolution of Wikidata properties

A property may have a short lifespan. Depending on the current usage and changing requirements of Wikidata, community members may also vote for a property to be deleted on the deletion proposition page[12]. This procedure also undergoes a workflow similar to property creation. If the deletion proposition has garnered enough votes, a property can be deleted and may no longer be used.

But property labels, descriptions and aliases may also undergo changes at any time. Any of the above can be modified by the community members after discussion on the talk page of a property. Talk pages[13] are created by the users to provide key statistics concerning properties or items like the current usage count, specify constraints and to discuss any matter concerning a given item or property. This is in addition to Wikidata Project Chat[14] page, where such matters can also be discussed.

[7] https://www.wikidata.org/wiki/Wikidata:Property_proposal
[8] https://www.wikidata.org/wiki/Template:Property_proposal
[9] https://www.wikidata.org/wiki/Template:TranslateThis
[10] https://www.wikidata.org/wiki/Template:Support
[11] https://www.wikidata.org/wiki/Template:Oppose
[12] https://www.wikidata.org/wiki/Wikidata:Properties_for_deletion
[13] https://www.wikidata.org/wiki/Property_talk:PNumber, where *Number* is of the form *P[0-9][0-9]** or *Q[0-9][0-9]**
[14] https://www.wikidata.org/wiki/Wikidata:Project_chat

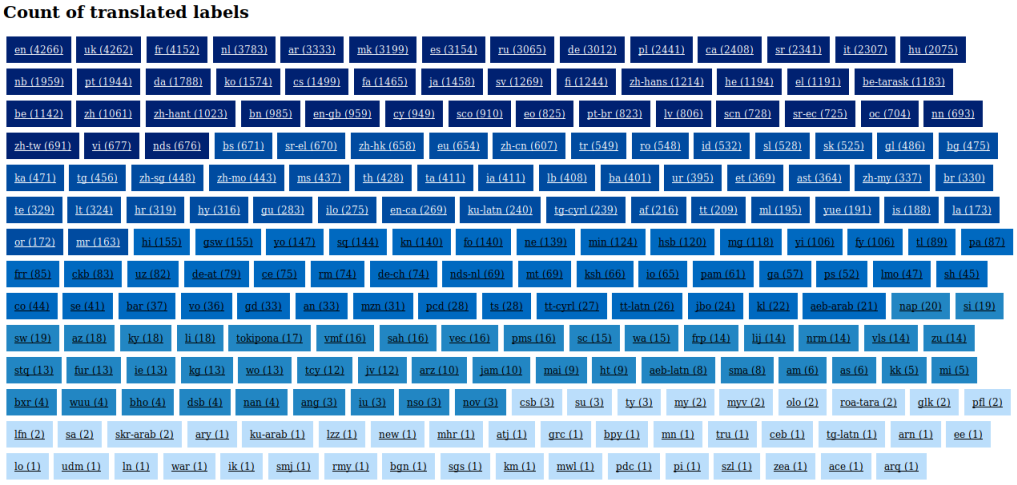

Figure 2: Count of translated labels in different languages

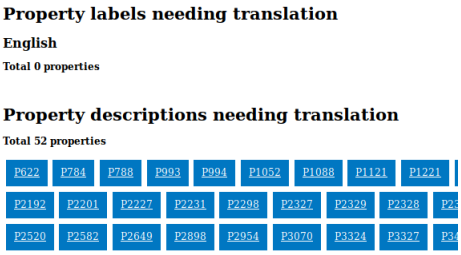

Figure 3: Property labels, descriptions needing translation

2.4 Existing tools and dashboards

The workflows of property creation, modification and even deletion need to be fully understood and analyzed. Even though, Wikidata has a large number of options that can permit multilingual support at any point of these workflows, its current usage by different contributors is a matter of extreme importance. Thanks to its structured nature and SPARQL endpoint[15], Wikidata can be easily analyzed. Additionally, Wikidata also provides periodic data dumps and a Mediawiki API[16] for analysis. Some of these are used to obtain the usage count of properties on the talk pages discussed above. WDCM (Wikidata Concepts Monitor)[17] also gives a detailed analysis on the usage of Wikidata by multilingual Wikipedia projects.

3 RELATED WORKS

Several tools for collaborative ontology development are now currently available like in Universal Knowledge Core (UKC) [21], VocBench [18], TurtleEditor [12] with some of them having multilingual support [18, 21]. But collaborative approaches can also be used in conjunction with other automated approaches like DBPedia[1, 2] which has successfully mapped various infobox labels in different languages using automated approaches.

Evaluation of such multilingual collaborative environments [4, 8] is important, especially for ensuring quality [10] and also for giving insights about their efficiency. [7], for example analysed the state of multilingual translation of Wikidata items using data dump of a particular period.

However Wikidata is rapidly evolving and contributors need to get real-time dashboards or dashboards with periodic updates. New properties and items are created from time to time. It is difficult to ensure that Wikidata contributors (humans) can easily catch up with this fast pace. Hence automation and real-time analysis may help in improving multilingual ontology development and in turn the overall Wikidata experience for human contributors.

Analysis and data visualization tools play an important role in detecting patterns in collaborative environments. Several existing works like Notabilia[17] aims to understanding change and visualizing deletion discussions on Wikipedia. It will be interesting to consider such works to provide periodic or realtime analytics to Wikidata contributors to improve various workflows of ontology development in Wikidata. Improving the overall experience on Wikidata is important to ensure greater participation[13] of the contributors.

4 WDPROP

In this section, the author presents an ongoing work called *WDprop*[18] [19], to understand various aspects of Wikidata properties, starting from giving statistics on translation of Wikidata properties. The main goal of *WDprop* is to understand various aspects of multilingual and collaborative ontological development of Wikidata.

WDprop is built using web technologies like HTML, Javascript and CSS and can be accessed through the web browsers. It makes use of the Wikidata SPARQL endpoint to give real-time statistics

[15] https://query.wikidata.org/
[16] https://www.mediawiki.org/wiki/Wikibase/API
[17] http://wdcm.wmflabs.org/

[18] http://doi.org/10.5281/zenodo.1174372
[19] https://zenodo.org/record/1174372

of Wikidata properties. Its standalone nature allows any Wikidata contributor or user to get these statistics easily or even integrate it with other Wikidata dependent web applications.

Through WDProp, the user can get the details of the total number of supported languages and available properties. It currently provides statistics on the count of translated labels (e.g., Figure 2), descriptions and aliases in different supported languages. Additionally it also shows an overview of property labels, descriptions and aliases that require translation in a given language. Figure 3, for example shows the details of English language with 0 property labels that needs to be translated. Users can navigate WDProp by supported languages, datatypes of properties. They can even search a property by specifying a text.

The future goals of WDprop are to understand the usage of translation templates in ontology development and to detect translation patterns in property proposal, creation and evolution stages. Future Wikimedia projects like Structured Commons[20] and ArticlePlaceholders[21] [22] are also driven with the similar requirements of building a structured, linked and mutlilingual data store. Hence real-time insights from current working of Wikidata may also help in such similar projects.

5 CONCLUSION

Wikidata provides a number of options that can ensure an almost complete multilingual ontological development experience. However their usage needs to be fully analysed and understood. This article presents the different aspects of this ontology development, particularly focusing on the different workflows concerning Wikidata properties. *WDProp* is an ongoing work towards understanding collaboration and multilingualism in Wikidata. Currently, apart from providing different ways to navigate the properties, it gives real-time statistics on the translation achieved in different languages and also gives a detailed real-time overview of property labels, descriptions and aliases that need to be translated in any given supported language of Wikidata.

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