New Ways of Exploring Connections Between Cultural Heritage Objects

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***Abstract*—This paper describes PLUGGY platform which is the first European social platform for cultural heritage and its extension the Smart Discovery tool. These tools were developed to bring culture closer to a wider public audience. After decades of digitization of cultural heritage objects there are several initiatives to present all these data in a meaningful, engaging and educational way. Most of the time these digital libraries present content only in searchable list format without meaningful interpretation. PLUGGY platform tries to fill this gap with a set of authoring and presentation tools. These tools allow creation of a wide variety of virtual exhibitions and narrative stories linked to the content from the digital libraries or user's uploaded content. We are extending PLUGGY with the Smart Discovery tool for the simplification of the curatorial process. It is a visualization, modelling and recommendation tool for the elimination of a cognitive load of art curators. The tool allows to model relationships between cultural heritage objects. During the modelling process the tool recommends related concepts aggregated from multiple external art content libraries. Created models can be transformed to the different types of virtual exhibitions skeletons ready for further PLUGGY curation.**

Keywords—data visualization, ontology, modelling, semantic search, art

I. Introduction

Within the last fifteen years the European Union invested huge amounts of financial and human resources to perform digitization of cultural heritage [1]. Digitization makes our history more accessible to everybody although this form of content is more attractive to the youth. Also, we shouldn't forget that the pandemic closed cultural institutions, and everything moved to virtual space. Thanks to these initiatives we have a lot of content available online via different online libraries or web portals. On the other hand, all this content is often just a huge database of searchable cultural heritage objects (CHOs). These CHOs are available and ready to tell great stories [2] when put into the context. There are different and better ways of presenting CHOs to the people than a simple list of artefacts. Technical University of Kosice was part of the European consortium that developed the first European cultural heritage social platform PLUGGY[1] [3][4]. It allows everybody to be a curator. Everybody can create engaging narrative stories, virtual exhibitions and share cultural content between his or her friends. The platform provides multiple curatorial tools to create specific types of virtual exhibitions with aggregated content from different external libraries or uploaded by the user. Finding right content to match the curator's needs could be confusing when multiple sources are available. This information overload can cause bad user experience and it can cause users don't want to create new content. This could be the problem for the portals where the main goal is to provide interesting and engaging content. Based on that we have created the Smart Discovery tool that helps to decrease cognitive load of the curators. The tool is used to visualise and model relationships between CHOs with the help of intelligent recommendations.

Next sections describe the core challenges that we tried to solve followed by the description of the PLUGGY platform, architecture of the Smart Discovery tool, and results from the user testing of the tool.

II. Background

Research and initiatives of digitization of cultural heritage objects is already well-established field. On the other hand, visualization and presentation of the cultural heritage content started significantly grow just decade ago [5]. Next paragraphs describe core challenges that content aggregation tools must solve and the same we faced in the PLUGGY project during development.

A. External libraries

One of the important functionalities was to create an interface for adding new external repositories with CHOs. Implementation of this functionality is tricky because every service provider has a different search API and also results from the searches are not unified. More on that below. The other problem is with updates of the third-party APIs and continuous service maintenance of the compatibility. During our development we have integrated 3 external repositories Europeana[2], Wikipedia[3] and British Museum[4]. However later the British Museum stopped providing their SPARQL QUERY API.

B. Search

As mentioned before every external repository is different and its integration should be done individually. Some repositories support only full text search with some filters.

1 https://pluggy.eu/
2 https://www.europeana.eu/
3 https://en.wikipedia.org/
4 https://www.britishmuseum.org/

Others support advanced QUERY languages like SPARQL[5] which allows the creation of advanced graph queries. They are helpful when searching for specific patterns in data.

C. Search Results

PLUGGY has a unified internal representation of CHOs. The representation is different for every platform and that's the reason why we should do mapping between our model and external repositories based on their specifications. Results are on different granularity and also in different formats. Europeana provides great structured data in their Europeana Data Model (EDM) [6]. Example structure of EDM is shown on Fig. 1. Some portals return unstructured results in HTML format. It depends on the value of the information source if it is worth doing integration.

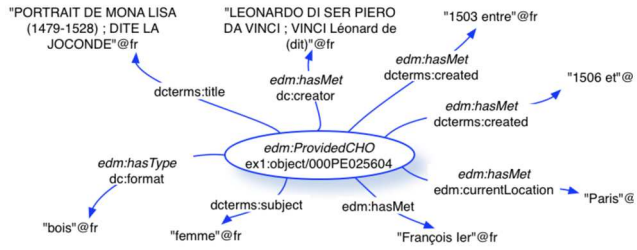

Fig. 1. Mona Lisa – EDM [6]

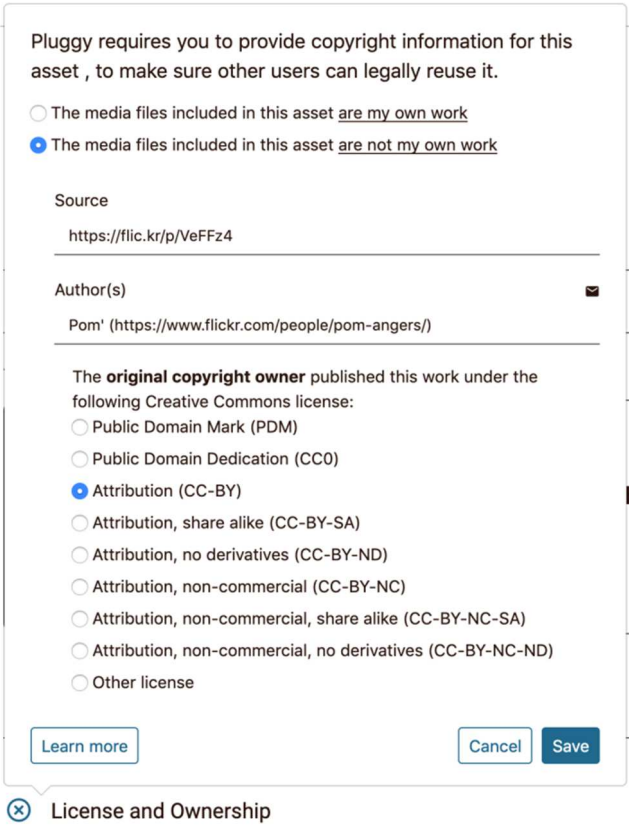

Fig. 2. Dialogue to specify the license of Creative Common media content

D. Content Licensing

There is still a weak education regarding content licensing, but it is getting better and better. Lot of times people think that content on the internet is free to use. Most of the time the opposite is true. The PLUGGY is facing the licensing problem very seriously. We have implemented an inference mechanism that recommends appropriate licence of the final virtual exhibition based on the used licensed content. It also allows users to use only content that is allowed to be used in the specific context. Fig.2 shows dialog that is invoked when any new content is added to the PLUGGY. Not all the external content providers take this problem seriously and content licences are omitted in search results.

III. PLUGGY

PLUGGY is solving challenges described in the previous section via pluggable platform that already integrate multiple authoring tools for the content creation and multiple tools and applications for content presentation. It reacted to missing technological tools that enable local communities to promote their local traditions, cultures, customs, and history into a wider European or even global network. Existing applications and social platforms did not focus on cultural heritage therefore their tools for content creation and content sharing are not suboptimal. PLUGGY focused on this gap and aimed at creating communities of people interested in Cultural Heritage, from simple citizens to cultural institutions, that would have the opportunity to share their own personalised stories of local cultural knowledge and experiences.

The PLUGGY social platform and the pluggable applications (PLUGGY3D, PLUGGY Pins, PlugSonic Suite and Games Hunter) were built upon the idea of empowering European citizens to be actively involved in cultural heritage activities and act not only as observers, but also as maintainers, creators, major influencing factors and more importantly as ambassadors of their country's Culture and History.

The Fig.3 shows pluggable architecture of the platform. Core of the platform is a unified Content Repository that stores and provides all data for the social platform and connected applications. There are two major expansion points. Adding new external content repositories and developing new user engagement applications. Newly created applications can be easily integrated via the provided REST API. However, adding a new external repository requires translating search queries to third party search APIs and mapping search results to internal generic PLUGGY data model, more on that in next section.

As mentioned PLUGGY currently provides multiple applications for experiencing cultural heritage from different perspectives. Every application has its own curatorial tool for authoring specific types of virtual exhibitions and narrative stories. Each specific type of created content requires different type of artefacts with metadata:

- PLUGGY 3D – virtual reality and augmented reality content requires annotated 3D models (see Fig.4)
- PLUGGY Pins – geolocation tours require geo coordinates for displayed artefacts
- PlugSonic Suite – 3D interactive soundscapes require audio files located within virtual map
- Games Hunter – collaborative game application requires set of quiz questions related to specific topic
- Timeline Exhibition – exhibition presenting events in historical order requires time annotated events

5 https://www.w3.org/TR/sparql11-overview/

- Narrative Blog Story – narrative stories that enhance individual digital artefacts (i.e., audio, video, image, 3D) with narrative content

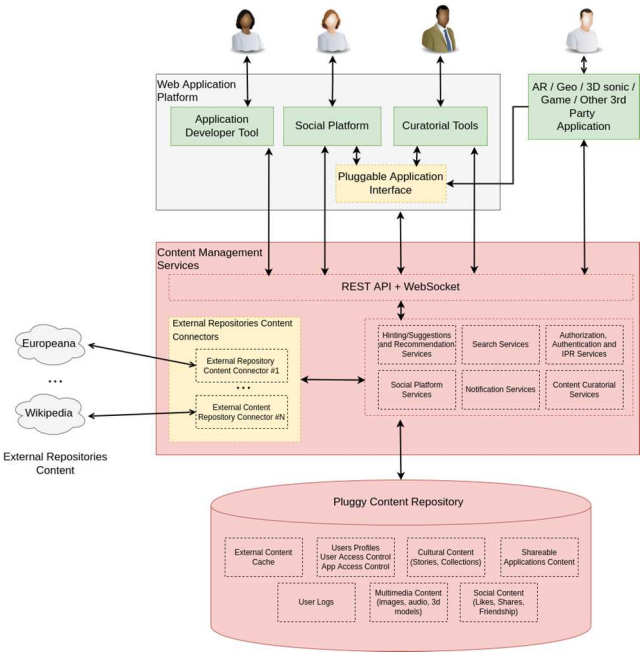

Fig. 3. Architecture of the PLUGGY – Logical view

As described PLUGGY provides wide variability, and this goes with complexity. Sometimes it could be confusing for the user. The Smart Discovery tool tries to address this issue and helps to better organise available content for curational purposes.

Fig. 4. Augmented reality with PLUGGY3D Experience Mobile application

IV. Smart Discovery Tool

The PLUGGY integrates multiple data sources and allows you to upload new content. When you think about the amount of data that is available for the user to create their stories it could be overwhelming. In this case we can quote E. R. Tufte: "Data visualisations are at their best when there is so much data that the only way to see it ... is to see it." [7]. We found inspiration for the modelling and visualisation tool in analytic tools for lawyers and investigative reporters. They visualise relationships between individual entities. Fig.5 shows a prototype of the Smart Discovery tool that allows users to model relationships between different entities (i.e., artists, artworks, places, time periods).

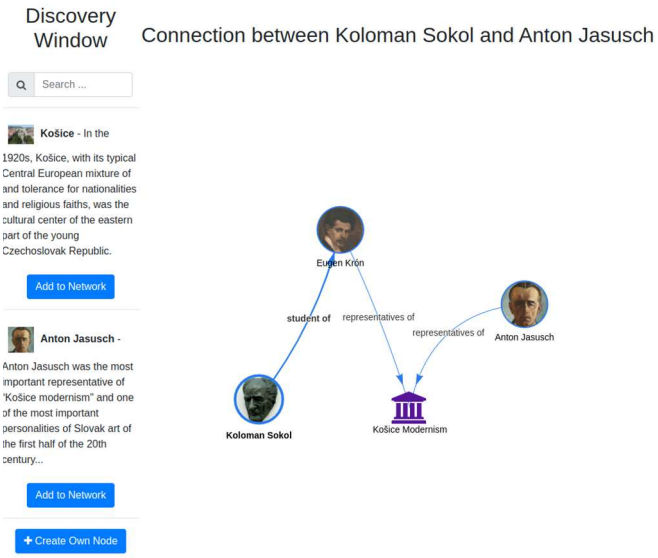

Fig. 5. Prototype of the Smart Discovery tool UI

Whole discovery process is shown on Fig.6. The tool sends a selected "template" search query to external and internal repositories of the PLUGGY to recommend relevant concepts based on the specified main theme/topic of the modelling. The user creates a model in an iterative way. He or she can use recommended concepts or can create custom ones. Added concept to the model is connected to the existing model with specific relation. Which specify time, space, ownership or customizable relationship between individual concepts. Every update of the model provides more information for the internal pattern discovery algorithm. Based on that the tool tries to recommend new relevant concepts. Recommendations are generated based on predefined "template" search queries, that try to find concepts that are similar to the already created model. Similarity can be based on the time period, the same place, same common friends.

When the modelling is finished the user can export the model to an exhibition skeleton. The exhibition skeleton can be used for creation of the specific type of virtual exhibition. Then it can be modified and updated with a curatorial tool for a specific type of virtual exhibition. Pattern recognition algorithm is able identify different types of patterns in the created model and recommend different types of virtual exhibitions. Fig.7 and Fig.8 shows that the same set of CHOs could be used for creating different virtual exhibitions whether we use time or space relationships.

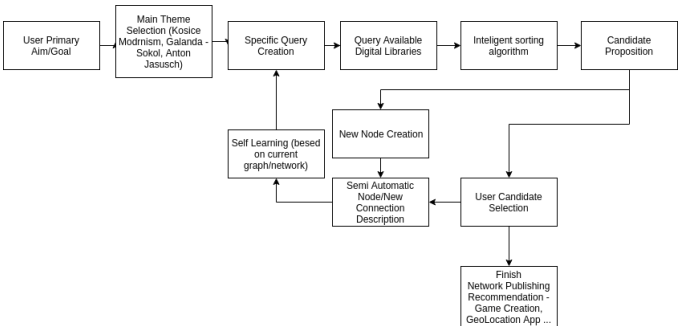

Fig. 6. Discovery process

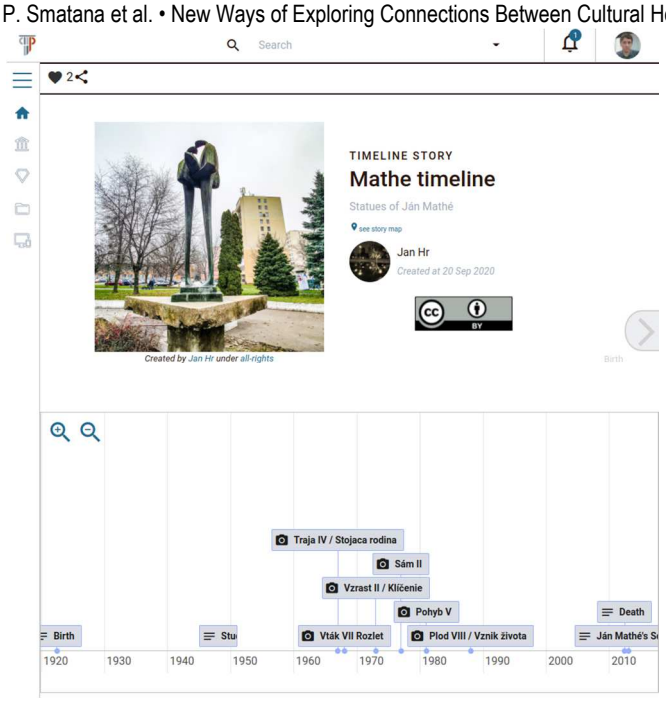

Fig. 7. Timeline exhibition

Fig. 8. Geolocation tour

V. Conclusion

The PLUGGY platform brings new tools for the users interested in cultural heritage. It makes it possible to experience different types of the virtual exhibitions, share cultural content between the friends or express individual creative needs with available curatorial tools. The extension of the platform with the Smart Discovery tool is still in phase of integration to the PLUGGY platform. We already did user centred tests with curators and non-professional users. We have received different opinions on the tool. Some curators don't like visualization tools; they prefer to create their models directly in their mind and make exhibitions based on their imagination. On the other side, non-professional users like how the tool can visualise the concepts and how the relationships are clearly visible. Sometimes it is hard to understand complicated relationships when they are not easily visible. They also value how recommendations work. They like that the recommendations navigate users directly to the source in the external repository, so they can see original content. Sometimes, it recommends interesting content that can be easily used for their exhibitions. In the next phase we will involve more expert curators and non-professional users to comment on our tool just after full PLUGGY integration. However, in the first stage of testing we see that our tool brings the curatorial process closer to the common users, not to the expert curators.

Main limitation of the Smart Discovery tool is that even the tool is accessible to all the users, there is needed some background knowledge to interpret relationships between individual artworks, authors, time, and places.

Our further work after full integration and testing would be to try the Smart Discovery tool for the different domains. We are thinking about a medical domain where we would like to reduce cognitive load of the medical doctor. We will connect our modelling tool to available medical databases. Tool can help doctors find relevant cases and case studies based on provided patient records.

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