Kalpa Publications in Computing

Volume 14, 2023, Pages 133–135

Proceedings of V XoveTIC Conference. XoveTIC 2022

kalpa Computing

Reducing complexity and cost of Digital Libraries development through Software Product Line Engineering

Delfina Ramos-Vidal, Alejandro Cortiñas, Miguel R. Luaces, Óscar Pedreira, and Ángeles Saavedra Places

Universidade da Coruña, CITIC, Laboratorio de Bases de Datos, A Coruña, Spain
{delfina.ramos,alejandro.cortinas,luaces,opedreira,asplaces}@udc.es

Abstract

Many research organisations depend on Digital Libraries, Catalogues, or Archives to support their activities, especially in Digital Humanities. These organisations confront the challenge of obtaining adequate financing to develop the necessary software. The funding devoted to software development in the grants available to these research groups is truly insufficient to confront the entire job at once, so they must use several funding rounds to complete the necessary budget, further delaying the development of the library. However, when viewed through the lens of Software Engineering, Digital Libraries have characteristics that place them in the development paradigm whose goal is to automate the creation of code from analysis specifications: Software Product Lines (SPL). Therefore, with the goal of minimising the complexity and expense of developing Digital Libraries, we propose a SPL that allows their software to be generated automatically from the definition of its data model and features, considerably reducing the budget and time necessary for its production. As a result, Digital Humanities organizations may concentrate on their study rather than worrying about software development. During the development of the project, we have followed a methodology created by the authors of this paper and successfully tested also in other domains.

1 Description of the target Digital Libraries

For the modeling of the characteristics contemplated by our Digital Libraries, and for the architecture and technologies of the products generated, we analysed the main Digital Libraries in national and international spheres, specifically, the Miguel de Cervantes Virtual Library and the Library of Congress. Figure 1 illustrates the functional architecture of the Digital Libraries we want to generate with the SPL. In particular, the target Digital Libraries must provide a database that offers the possibility of storing any type of work and its editions, collections, etc., with geographic information on where the edition took place, where the writer is born/lives or where it was published, and compile the different digital formats in which the work is presented: image, text, audio and/or video. Digital Libraries must also offer navigation and search functionalities (general, advanced/complex, by content, by geographic location), presenting the

information conveniently on lists and maps. Additionally, they should allow exporting the information to different formats (CSV, XLS, PDF); and implement the OAI-PMH protocol for the exchange of information with aggregators such as Hispana and Europeana. In addition, they support the entire data management and review workflow, enabling the management of the information stored through interfaces specifically designed for the type of information in question, facilitating and automating the feeding, and facilitating the review processes that the elements undergo before they are finally published.

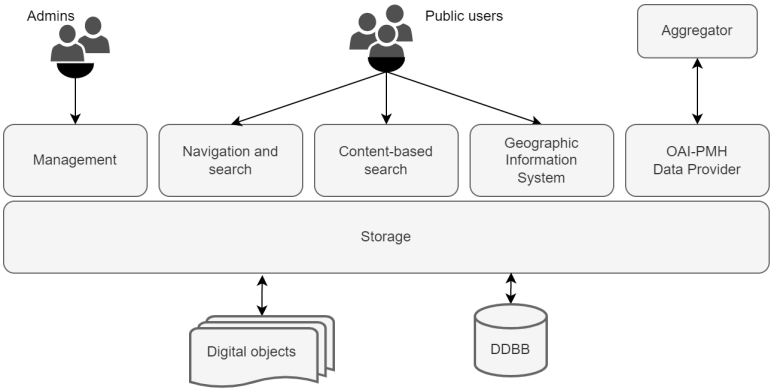

Figure 1: Functional architecture for target Digital Libraries

2 Software Product Line for Digital Libraries

Figure 2 shows the architecture of the SPL for Digital Libraries. Designing an SPL consists on defining a common set of software assets that our SPL can assemble and reuse in order to generate the desired Digital Libraries. Our SPL has a feature model among which the developer must choose in order to generate the product. Figure 3 shows a collapsed version of the feature model, which supports 165 features, classified into five categories: `LibraryObjects`, `LibraryDataExportation`, `UserManagement`, `LibraryAccess`, and `Language`.

The derivation engine assembles the core assets guided by the features selected by the

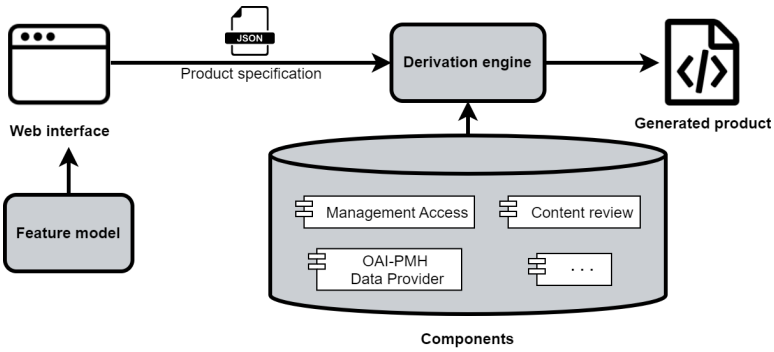

Figure 2: Software Product Line architecture

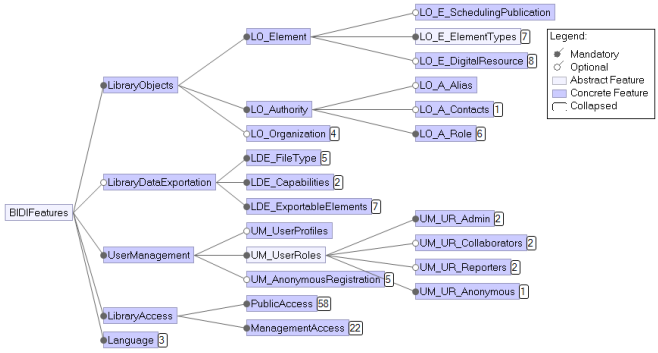

Figure 3: Feature model of the SPL for Digital Libraries

developer. We used the derivation engine spl-js-engine[1, 2], based on *scaffolding* and following the principles of negative variability. Thus, when the user selects which features to include in a particular product, the derivation engine takes those components and modifies or removes unnecessary code for that specific product. The specification web interface provides the feature tree for feature selection and the dependencies between features. Depending on what the user selects, it generates the product specification in JSON format, which will be the input for the derivation engine. The components were implemented in Java and Vue.JS. The specification interface invokes the derivation engine, which returns the complete product.

The product line detail was presented in [3]. Two test projects were created as part of the SPL for Digital Library development. The first was a "theoretical" library that covered a plausible but arbitrary set of properties. The second was the re-engineering of the BIDISO Digital Collections and Resources, a member of the Aracne Network, which contains smaller libraries and catalogues that fit inside the framework of the created SPL's variability, allowing for a diverse set of testing.

3 Acknowledgments

Part funded by:MCIN/AEI/10.13039/501100011033, NextGenerationEU/PRTR, FLATCITY-POC: PDC2021-121239-C31; MCIN/AEI/10.13039/501100011033 EXTRACompact: PID2020-114635RB-I00; Xunta de Galicia/FEDER-UE GRC: ED431C 2021/53; MCIN/AEI/10.13039/5-01100011033 MAGIST: PID2019-105221RB-C41; MICIU/FEDER-UE BIZDEVOPSGLOBAL: RTI-2018-098309-B-C32; Aracne-Nodus: RED2018-102755-T.

References

[1] A. Cortiñas, M. R. Luaces, O. Pedreira, and Á. S. Places. Scaffolding and in-browser generation of web-based gis applications in a spl tool. In *SPLC*, page 46–49, 2017.

[2] A. Cortiñas, M. R. Luaces, O. Pedreira, Á. S. Places, and J. Pérez. Web-based geographic information systems sple: Domain analysis and experience report. In *SPLC*, pages 190–194, 2017.

[3] D. Ramos-Vidal, A. Cortiñas, M. R. Luaces, O. Pedreira, and A. Saavedra Places. A software product line for digital libraries. In *WEBIST*, pages 381–389, 2020.