The Development of SWSeum (Semantic Web Museum) in Mpu Purwa Museum Malang

Lidya Amalia Rahmania[1], Moh. Safii[2], Cicik Tri Jayanti[3],
Vertic Eridani Budi Darmawan[4], Yuh-Wen Chen[5]
{lidya.amalia.fs@um.ac.id[1], moh.safii@um.ac.id[2], cicik.jayanti.fs@um.ac.id[3]}

State University of Malang, Jalan Semarang No 5 Malang[1,2,3,4], Da Yeh University, Taiwan[5]

Abstract. The research of the Semantic Web of the Mpu Purwa Museum initiated because of the urgency of a more structured data about the records of the artefacts. The current official website of Mpu Purwa Museum is made from a Blogspot site that has no structure or whatsoever. This research intended to build a better website using Semantic Web to give the record a structure so that not only the human could understand the content, but also the machine could have a better understanding about it. This could help the Museum to reach better audiences and users so it could improve the image by building a better system. The method of building this website is using Waterfall Method in which the steps are requirement analysis, design the user interface and the system, coding both of the front-end and the back-end side of the system, testing the system using White Box and Black Box method, and finally the system could be implemented.

Keywords: Semantic Web; Museum Records; Software Development

1 Introduction

The Industry Revolution 4.0 revolves around the capability of human changing the environment they have been worked into data. The increasingly of cheap tools for data collecting enable us to produce data every second [1]. Not only for personal use, the number of cheap sensors enabling the industries to implement data science also [2]. The interconnection of these tools and sensors made data and information flooded the Internet and removing its boundaries. The interconnectivity made the users around the world could share their knowledge. This development increased the quantity of the website for knowledge sharing around the world that facilitate the user to create their own contents based on their skills and knowledge. The information that created by users or User-Generated Content is made by the people outside the professional institution, often without pay, and could be accessed publicly [3]. UGC could be in the format of text, photos, images, graphics, audio, video, or could take other forms like consumer reviews, comments on social media, Internet memes, contribution to Wikipedia, blog posts, podcasts, citizen journalism, or video that shared on online platform like YouTube. UGC is not only helping the people to improve their skills and knowledge, but also to affect the perception of consumers of the brands [4].

LIONG 2021, October 19-20, Purwokerto, Indonesia

DOI 10.4108/eai.19-10-2021.2316721

In short, the Internet contains the data from not only sensors, but also knowledge that generated by users. This made the Internet is such a place with unstructured data for the machine. The human mind probably could understand the information easier, but there is a limit on the capability of the human. Hence, the users need to categorize their contents so that the machine could understand the human language better. The purpose of this process is to help human to retrieve the information that they need in the right time. One of the methods to categorize the information is using Semantic Web [5]. Semantic Web distributes resources on the scale of the World Wide Web by giving it a certain protocol to change the way the data being represented. Semantic Web is the part of Knowledge Extraction for document retrieval can improve the performance of traditional term-based similarity approach [6]. The needs of information retrieval are getting higher day by day because human could produce tons of information every day. The information could not be used properly if they cannot be retrieved on time of the search and matched with the context from the user that needs the information. The Semantic Web treats the World Wide Web data as a distributed resource [7]. It means that the data could be easily used by another domain and only needs to be given an appropriate context. On the World Wide Web, most of the website of the government institutions still have not applied the Semantic Web correctly. This made most of them hard to be used by the users.

Most of the website of the institution of the local governments in Indonesia have low quality information [8]. The website of the government institution should be in high quality because there would be so many stakeholders who need to access the data and interact with it on daily basis. The quality of the information on the website could influence the public satisfaction of the government greatly [9]. One of the website institutions of Indonesian Government that has a lot of important information but low quality in data representation is the official page of Mpu Purwa Museum. Mpu Purwa Museum is one of the state-owned museums that collects mainly about historical statues, manuscripts, and other kind of artefacts. This museum is under the supervision of Ministry of Culture and Education Indonesia. Mpu Purwa has an extensive list of collections, some of them spread across Malang Regency because they cannot be removed from its original position. The list of the collections is showed online in their website that uses the free platform of Blogspot. The website doesn't use Semantic Web so that the user could easily retrieve the information they need. This would greatly improve the quality of the information. The need to restructure the data of the Mpu Purwa Museum could be met by the use of Semantic Web. Semantic Web could preserve a large data semantically and gave a meaningful content of unstructured data [10]. This paper would analyze the requirements to transform the static website of state-owned Mpu Purwa Museum and elaborate the life cycle of the website development.

2 Methodology

This research used the research and development (R&D) method of Waterfall Model for developing this Semantic Web. The traditional Waterfall Model has weakness in the implementation, but it could be improved by adding iteration process every time the user, the client, or the analyst needs to change the design [11].

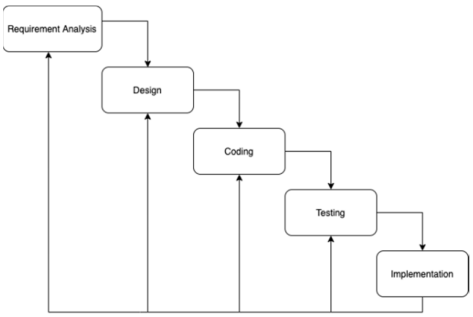

Fig. 1. Waterfall Model

The first step of Waterfall Model is Requirement Analysis, in this step the designer should create a set of instruments to analyze the requirement based on the request of the clients or the manual business model of the system. In this research, the Requirement Analysis phase is made by studying the current Website of Mpu Purwa Museum and trying to adapt it to the Semantic Web requirement. The second step is to design the Entity Relational Diagram (ERD) of the database, the User Interface (UI), and the User Experience (UX). The design process mostly takes time in software architecture, how the programmers need to implement the code based on the result of this phase. The next step is coding the entire Semantic Web based on the result of the previous step. First, the database structure should be matched with the ERD. Next, the UI is made to change the interface of the website so it would look more professional and sleeker. The UI should give the user an experience as if they read the record of the artefact themselves in the record room. This would give the user the personal feeling.

After the coding process, it comes to the testing step. This step is to review whether the Semantic Website has any bugs in it. The debugging phase is to make sure that there is no error while the users browse through the Semantic Web. It has to be no error when the deploying phase is due, not only in the aspect of the flow of the system, the database, the user interface, or the user experience. This would require to roll out the Semantic Web to a small group of people to use it in a normal way or in their own way just to see if there is a problem during an abnormal usage. The last phase of Waterfall Model is implementation. In this phase, we roll out the product to the open users out there. It could be use publicly by installing it on the server, migrating the old record to the new structured record, and maintain the Semantic Web if there are any bugs reported in the future. These phases not only stopped in the last phase but also could be reiterated to the requirement analysis phase and then cascade it to the second step and so on. Hence, this model is called by its name, “Waterfall Model”.

3 Result and Discussion

In this research the first step is to identify the problem so that the requirement analysis is on point and address the problem correctly. The requirement analysis step could help the development prioritize the problems and study it further. In this step, the analysis has been done by observation and interviews. The observation is done by taking a close look of the current official website of Mpu Purwa Museum. The current website shows the information of the collection of the museum without any structure or standardized system. The data of the artefacts showed in a single page of blog site with all of the data written in. That kind of

information should be presented in Semantic Web where the texts have the same meaning as the language that the machine understood. It means that the data should be rerecorded in a structured query language so that the user and developer could have a normalize data. The advantage of having a normal data is easier to expand or to add the attribute of a record. If the stakeholders decide to extent the information that they need to record, it is easier to do it in a Structured Query Language. The SQL is written in semantic way to tell whether the data is in the right category or field or not. The current website of Mpu Purwa Museum is in a blog form, while the record of the artefacts is written in one unstructured page long blogpost.

3.1 Requirement Analysis

The requirement analysis step is the most important step in a research and development. Especially in this research, the requirement analysis is done by taking the answer of the users from a questionnaire. This questionnaire aimed to dig the satisfaction of the user when they used the current website. This could help the developer to design the system in a better shape. Not only in User Interface or User Experience wise, but also in the structure of the data record. This needed to be addressed because the user had difficulties on using the current website of Mpu Purwa Museum. The observation had been done by rerecording the data into a spreadsheet so the developer could map out the real structure of the data that should be written. After the data is written in the spreadsheet, the developer could proceed to the design phase.

Table 1. Requirement Analysis Quesionnaire

No	Questions	Most Answers	Percentage
1	Age	25-40	75%
2	Have you accessed Mpu Purwa Museum official Website	No	20%
3	Have you tried to look into some kind information on the official website of Mpu Purwa Museum?	Yes	73%
4	Have you ever had any difficulties when you are looking for information on the official Website of Mpu Purwa Museum?	Quite Hard	78%
5	Do you think that the Official Website of Mpu Purwa Museum is needed to be restructured?	Very much	73%

3.2 Design

In the design phase, the developer would create the system based on the result of requirement analysis phase. The first design was to create the Entity Relationship Diagram (ERD). This diagram is the first step before creating the database of the structured record of the Mpu Purwa Musuem. This diagram showed what are the entities inside the record system and how they are corelated with other entities inside the database. The ERD of the system is below on Figure [xx].

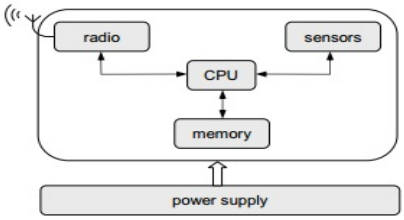

Fig. 2. Entity Relationship Diagram of the system (To be added later)

The next step is to design the User Interface for the website. This website should be more dynamic so the landing page would feel energize the users. The website landing page would show most of the photographs of the gallery so that the user could get the idea just from the gallery. The navigation of the website is to give the users easier access to the menu. It showed not only the hyperlink to the Home Page, but also the hyperlink to the News, Service, Profile, Gallery, Records, and Contact Us. Each of the menu on the navigation is pretty direct. The News menu is to show the current news from the Mpu Purwa Musuem activities that need to be shared to the public. The Service menu is to show the public about all kind of services that the Museum provided. The Profile menu is to show the current profile of Mpu Purwa Museum. The next menu is Gallery, in this section the administrator of the website could show the pictures or photographs of the Museum or the activities that happened in Musuem.

3.3 Coding

The programming process has been done after the designing process is completed. The coding processes is divided into two phases. The first phase is the front-end programming, the second phase is the back-end programming. The front-end programming is consisted of designing the User Interface and the User Experience. The UI/UX are using Bootstrap environment so that the design could have the default structure of a formal website.

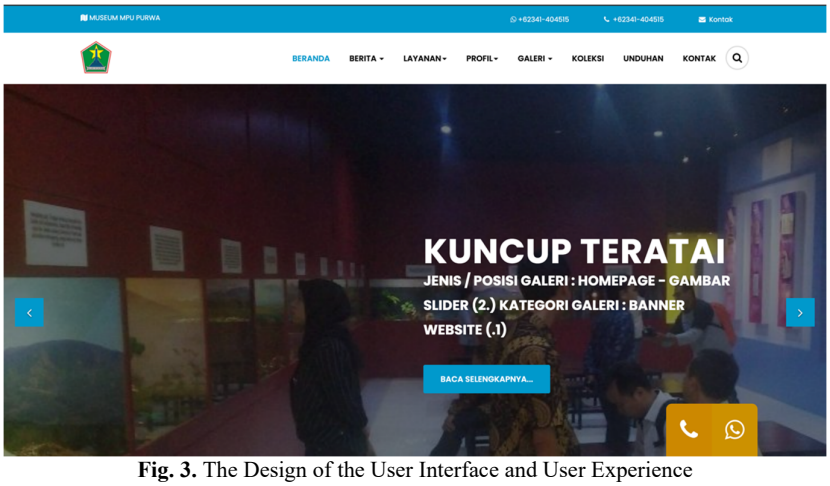

Fig. 3. The Design of the User Interface and User Experience

After the front-end design has been done, the next phase is the back-end programming. The programming for back-end is using PHP and using MySQL as the database. The back-end programming meant to use the semantic coding so the developer could build a website that made from programming language that understood human language. The website should make the user easier to access the records by the category. The difference between the current website and the semantic web is the information or the records of the artefacts in the museum would be categorized by a structure that could be understood not only by the users but also the machines.

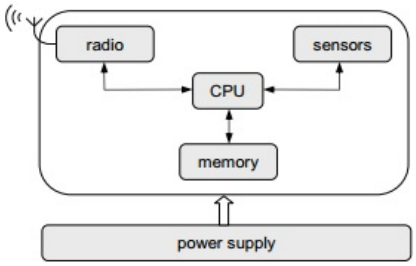

Fig. 4. The Page of Each Record of the Artefacts (To be Added later)

3.4 Testing

The testing phase is using the White Box and Black Box Testing. The first step is to do the White Box Testing—this instrument meant to test the flow of the system based on the code and databases. In this step, the debugger has to check whether the system is corresponding to the analogue business model without really checking the user interface. On the other hand, The Black Box testing is used to check whether a certain function, button, or link on the user interface is working in accordance to its purpose [12]. In this research, the White Box testing is done by checking each of the function that created based on the design. The debugger checked the controller page whether each feature could produce the aimed results. Currently the debugger found that one of the features to add record was malfunctioned. It could not add the desired record as the submit button was clicked. Moving on to the next testing was the Black Box Testing. In this step, the debugger found out that page that should show the details about the artefacts are not showing all of the data. Hence the developer should debug it by adding the complete details about the artefacts.

3.5 Implementation

This phase should be done after the testing phase is finished and revised based on the note from the debugger. The operating phase is done by uploading the system to the hosting server and let it live. The website could be accessed by the public for a short time or soft release. After the soft release is done, should any bug or error notification arise, then the website has to be rolled back for a revision. The hard release is done after the revised version of the system is finished.

4 Conclusion

The research of the Semantic Web of the Mpu Purwa Museum initiated because of the urgency of a more structured data about the records of the artefacts. The current official website of Mpu Purwa Museum is made from a Blogspot site that has no structure or whatsoever. This research intended to build a better website using Semantic Web to give the record a structure so that not only the human could understand the content, but also the machine could have a better understanding about it. This could help the Museum to reach better audiences and users so it could improve the image by building a better system. The method of building this website is using Waterfall Method in which the steps are requirement analysis, design the user interface and the system, coding both of the front-end and the back-

end side of the system, testing the system using White Box and Black Box method, and finally the system could be implemented. There is some minor revision when the testing phase happened, mostly because the coding result did not match with the blueprint of the design. These bugs were easily addressed by recoding it so that it could give the same result as the expected result.

References

[1] K. Krishnan, "Data discovery and connectivity," in Building Big Data Applications, 2020, pp. 199–212. doi: 10.1016/b978-0-12-815746-6.00011-9.

[2] M. Horrell, L. Reynolds, and A. Mcelhinney, "Data Science in Heavy Industry and the Internet of Things," Harvard Data Science Review, no. 2, pp. 1–14, 2020, doi: 10.1162/99608f92.834c6595.

[3] M. S. Daubs, "The SAGE International Encyclopedia of Mass Media and Society," in The SAGE International Encyclopedia of Mass Media and Society, Thousand Oaks, 2020, pp. 1826–1827. doi: 10.4135/9781483375519.

[4] G. Christodoulides, C. Jevons, and J. Bonhomme, "Memo to marketers: Quantitative evidence for change - how user-generated content really affects brands," Journal of Advertising Research, vol. 52, no. 1, pp. 53–64, 2012, doi: 10.2501/JAR-52-1-053-064.

[5] F. Antoniazzi and F. Viola, "Building the Semantic Web of Things through a Dynamic Ontology," IEEE Internet of Things Journal, vol. PP, no. XX, pp. 1–1, 2019, doi: 10.1109/jiot.2019.2939882.

[6] F. Corcoglioniti, M. Dragoni, M. Rospocher, and A. P. Aprosio, "Knowledge extraction for information retrieval," Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol. 9678, no. i, pp. 317–333, 2016, doi: 10.1007/978-3-319-34129-3_20.

[7] D. Allemang, J. Hendler, and F. Gandon, "Semantic Web for the Working Ontologist: Effective Modeling for Linked Data, RDFS, and OWL," in Semantic Web for the Working Ontologist, 3rd ed., ACM, 2020. doi: 10.1145/3382097.3382102.

[8] F. Syahroni, A. Nurmandi, and Salahudin, "How Does Local Government Use the Website and Twitters as Public Services Tools? A Case Study of Aceh Province Government, Indonesia," pp. 127–135, 2022, doi: 10.1007/978-981-16-1781-2_13.

[9] H. Li, "An empirical research on the construction of a government website public satisfaction index model in China," Journal of Global Information Management, vol. 29, no. 5, pp. 112–135, 2021, doi: 10.4018/JGIM.20210901.oa7.

[10] S. Muhammedi and N. Gherabi, "Heterogeneous Integration of Big Data Using Semantic Web Technologies," pp. 167–177, 2021, doi: 10.1007/978-3-030-72588-4_12.

[11] J. H. Liu, H. X. Xia, and H. B. Zhang, "A Research into the UML Legend in the Waterfall Model Development," Applied Mechanics and Materials, vol. 519–520, pp. 322–328, 2014, doi: 10.4028/www.scientific.net/amm.519-520.322.

[12] R. Bierig, S. Brown, E. Galván, and J. Timoney, "Essentials of Software Testing," Essentials of Software Testing, Aug. 2021, doi: 10.1017/9781108974073.