

Everything but the Kitchen Sink: From Netnography to Progressive Web Application (PWA) Heuristics for Design and Development of the Sarawak Digital Cultural Heritage Information System

Nurfarahani Norman Anuar

Master of Science 2023

Everything but the Kitchen Sink: From Netnography to Progressive Web Application (PWA) Heuristics for Design and Development of the Sarawak Digital Cultural Heritage Information System

•

Nurfarahani Norman Anuar

A thesis submitted

In fulfillment of the requirements for the degree of Master of Science

(Cognitive Sciences)

Faculty of Cognitive Sciences and Human Development UNIVERSITI MALAYSIA SARAWAK 2023

DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature

Name:

Nurfarahani Norman Anuar

Matric No.: 19020005

Faculty of Cognitive Sciences and Human Development

Universiti Malaysia Sarawak

Date : 8 May 2023

ACKNOWLEDGEMENT

All praise to Allah on whom we ultimately depend for sustenance and guidance. My sincere appreciation goes to my supervisor, Associate Professor Dr. Mohd Kamal Othman, for his endless guidance throughout my study. I've always known it was a great move for me to return to UNIMAS and be under your supervision again. Thank you for igniting my passion for UX research and supporting me in my academic and professional journey. I extend my sincere gratitude to other lecturers; Madam Shaziti Aman, Dr. Wan Norizan Wan Hashim, Dr. Abdulrazak Yahya Saleh Al-Hababi, and co-supervisor; Dr Mohamad Hardyman bin Barawi for giving me your assistance in my research and publications. To my peers and friends who have been lending their precious time accompanying me to Majlis Adat Istiadat Sarawak for data validation, actively contributing their cultural knowledge, and sharing my enthusiasm and interest in our precious culture; I am forever grateful for the support given throughout my post-graduate journey. I would also like to thank my family for their continuous prayers and well-wishes to complete my studies. Finally, I would like to thank the Centre for Graduate Studies and management of the Universiti Malaysia Sarawak for making it possible for me to complete my study.

ABSTRACT

Digitization enables us to fend against the vulnerability and fragility of intangible and tangible knowledge or material culture, allowing long-term storage of information storage and accessibility. The need to conduct digital crowdsourcing stems from knowing that current ethnographic research is inefficient for completing the documentation process because it is time and cost-consuming, has a language barrier and lacks expertise from each ethnicity. Despite different cultural agencies and government bodies overseeing the cultural efforts in Sarawak, there has not yet been a well-established information system to document and present the material culture for public access. The need to develop a new usability checklist for Progressive Web Application (PWA) stems from knowing that the available heuristics, which are catered for general usability purposes are not comprehensive enough to evaluate PWA due to its unique features. Recognising these problems, therefore the aim of this research was three-fold: (1) To utilize social media crowdsourcing in documenting Sarawak's cultural heritage; (2) To design and develop a one-stop information system for Sarawak's cultural heritage; and (3) To develop a domain-specific heuristic for Progressive Web Application (PWA). A mix of methods was implemented for each of the different research stages. The first stage of the research utilizing Netnography via social media has resulted in 342 validated cultural heritage information with 88.4% reliability and validity. Artefacts and costumes cover the highest percentages of the data collected, 36.5% and 34.2%, respectively. Regarding the efficacy of social media platforms used to collect data, it was found that WhatsApp and Facebook were the most effective, with 46.2% and 43% of the information were obtained through these mediums. The second stage of the research presented the outcome of the Sarawak Digital Cultural Heritage Information System (CULTAGE) PWA design and development. The process began by conducting Focus Group

sessions to understand user requirements, coming up with proposed design ideas, and developing the web application, and ended with a user experience evaluation using the User Experience Questionnaire (UEQ). Overall, the CULTAGE-PWA received an average impression due to the evaluation procedure. Further Importance Performance Analysis (IPA) indicated the attributes associated with the CULTAGE-PWA fell under the "Possible Overkill", meaning adequately developed and "Low Priority" in terms of importance and product requirement. The final stage of the research has developed 15 usability heuristics principles for PWA (PWAUH) using the heuristics development methodology by Rusu et al. (2011). This usability checklist was thoroughly validated and refined according to the systematic development method and through an expert validation survey and Heuristic Evaluation on 3 PWA sites.

Keywords: Netnography, User-Centered design, Domain-Specific Usability Heuristics, Progressive Web Application (PWA), Heuristic Evaluation (HE)

Satu Kajian Menyeluruh: Dari Netnografi kepada Pembangunan Heuristik Aplikasi Web Progresif (PWA) bagi Rekabentuk dan Pembangunan Sistem Informasi Digital Warisan Budaya Sarawak

ABSTRAK

Pendigitalan membolehkan kita melawan kelemahan dan kerapuhan budaya material yang membolehkan penyimpanan dan akses kepada maklumat jangka panjang. Keperluan untuk menjalankan crowdsourcing digital berpunca daripada pengetahuan bahawa penyelidikan etnografi tradisional adalah tidak cekap untuk melengkapkan proses dokumentasi kerana ia memakan masa dan kos, penyelidik mempunyai halangan bahasa, dan kekurangan kepakaran daripada setiap etnik. Walaupun mempunyai pelbagai agensi kebudayaan dan badan kerajaan yang menyelia usaha kebudayaan di Sarawak, masih belum ada satu sistem maklumat yang komprehensif untuk mendokumen dan mempersembahkan budaya material untuk akses awam. Keperluan untuk membangunkan senarai semak kebolehgunaan untuk Aplikasi Web Progresif (PWA) berpunca daripada pengetahuan bahawa heuristik am tidak cukup komprehensif untuk menilai PWA kerana ciri uniknya. Matlamat kajian ini terbahagi kepada tiga bahagian: (1) Menggunakan crowdsourcing menerusi media sosial untuk mendokumentasikan warisan budaya Sarawak; (2) Mereka bentuk dan membangunkan sistem maklumat sehenti untuk warisan budaya Sarawak; dan (3) Membangunkan heuristik khusus untuk domain Aplikasi Web Progresif (PWA). Kajian crowdsourcing ini menghasilkan sejumlah 342 daripadada 387 (88.4%) informasi warisan budaya yang telah disahkan. Artefak dan pakaian merangkumi peratusan tertinggi dengan 36.5% dan 34.2%. Berkenaan dengan keberkesanan platform media sosial yang digunakan untuk mengumpul data, kajian ini mendapati WhatsApp dan Facebook adalah medium paling berkesan dengan 46.2% dan 43% maklumat diperoleh. Fasa kedua kajian membentangkan hasil reka bentuk dan pembangunan PWA Sistem Maklumat Warisan Budaya Digital Sarawak (CULTAGE).

Proses ini bermula dengan menjalankan sesi kumpulan focus untuk memahami keperluan pengguna, menghasilkan idea reka bentuk, pembangunan aplikasi web, dan diakhiri dengan penilaian menggunakan User Experience Questionnaire (UEQ). Secara keseluruhan, CULTAGE-PWA menerima tanggapan "Above Average" daripada prosedur penilaian. Analisis Prestasi Kepentingan Lanjut (IPA) menunjukkan atribut yang dikaitkan dengan CULTAGE-PWA berada dalam lingkungan "Possible Overkill" dan "Low Priority" dari segi kepentingan dan keperluan produk. Di fasa akhir kajian, 15 prinsip heuristik usability untuk PWA (PWAUH) telah dibangunkan menggunakan metodologi pembangunan heuristic oleh Rusu et al. (2011). Heuristik ini telah disahkan dan diperhalusi secara menyeluruh melalui penilaian pakar dan penilaian heuristik pada 3 laman web PWA.

Kata kunci: Netnografi, Reka Bentuk Berpusatkan Pengguna, Heuristik Khusus Domain, Aplikasi Web Progresif (PWA), Penilaian Heuristik

TABLE OF CONTENTS

		Page
DECI	ARATION	i
ACKI	NOWLEDGEMENT	ii
ABST	TRACT	iii
ABST	'RAK	v
TABI	LE OF CONTENTS	vii
LIST	OF TABLES	xi
LIST OF FIGURES		xiii
LIST	OF ABBREVIATIONS	XV
CHA	PTER 1 INTRODUCTION	1
1.1	Study Background	1
1.2	Motivation of Research	3
1.2.1	Practical-knowledge Gap	4
1.2.2	Empirical Gap	4
1.3	Objectives	7
1.4	Research Questions	7
1.5	Definition of Terms	7
1.6	Significance of Research	9
1.7	Chapter Summary	10

CHAI	PTER 2 LITERATURE REVIEW	17	
2.1	Overview	17	
2.2	Digital Cultural Heritage	17	
2.2.1	Digital Cultural Heritage Information Seeking Behaviour	21	
2.3	Cultural Heritage Crowdsourcing	26	
2.3.1	Social Media Crowdsourcing	30	
2.4	Knowledge Management System 32		
2.4.1	Integrated Digital Information System 3.		
2.5	Agile Software Development Methodology 3		
2.5.1	Agile SCRUM 4		
2.6	Development of Domain-Specific Heuristics		
2.6.1	Heuristic Evaluation with Domain-Specific Heuristics 4		
2.7	User Experience (UX) Evaluation for Digital Information System 5		
CHAI	PTER 3 STUDY 1 – DIGITIZATING SARAWAK CULTURAL		
	HERITAGE	57	
3.1	Overview	57	
3.2	Objectives	57	
3.3	Method	58	
3.3.1	Instruments	59	
3.3.2	Data Collection Method	60	
3.3.3	Data Analysis	61	

CHA	PTER 4 STUDY 2 – CULTAGE, SARAWAK CULTURAL HER	ITAGE
	PROGRESSIVE WEB APPLICATION (PWA)	69
4.1	Overview	69
4.2	Objectives	69
4.3	Methods	70
4.3.1	Design	73
4.3.2	Development	77
4.3.3	User Experience (UX) Evaluation	78
4.4	Results	83
4.4.1	Results from Focus Group Session	83
4.4.2	Development	85
4.4.3	UX Evaluation	89
4.5	Discussion	92
4.5.1	Discussion on Focus Group Session's Findings	92
4.5.2	Discussion on UX Evaluation Findings	98
CHA	PTER 5 STUDY 3 – PROGRESSIVE WEB APPLICATION USAB	ILITY
	HEURISTICS (PWAUH)	101
5.1	Overview	101
5.2	Objectives	102
5.3	Heuristic Development Method	102

•

5.4.6	Validation stage	131
5.4.6	Validation stage	131
5.4.5	Specification stage	125
5.4.4	Selection stage	122
5.4.3	Correlative stage	119
5.4.2	Descriptive stage	113
5.4.1	Exploratory stage	108
5.4	Results and Discussion	107
5.3.2	Second experiment procedure: Heuristic Evaluation procedure	106
5.3.1	First experiment procedure: Expert perception of the proposed heuristics	105

LIST OF TABLES

		Page
Table 1.1:	Definition of Terms	8
Table 1.2:	Summary of the 3-part study	11
Table 3.1:	Excerpts of cultural heritage obtained using different social media platforms	63
Table 3.2:	Data collected using Netnography based on ethnic and categories	66
Table 3.3:	Number of data obtained using different social media platforms	67
Table 4.1:	Screen-by-screen illustrations and summary of the proposed design ideas.	84
Table 4.2:	Result of UEQ in comparison to benchmark	89
Table 4.3:	Pragmatic and hedonic quality of CULTAGE-PWA	90
Table 4.4:	The result of each scale with mean, standard deviation, and confidence intervals	90
Table 4.5:	PWA mean value in terms of performance (UEQ) and importance	91
Table 5.1:	Exploratory stage	108
Table 5.2:	Descriptive stage	113
Table 5.3:	Existing heuristics as a baseline for the development of PWAUH	116
Table 5.4:	Comparative Analysis of existing heuristics	117
Table 5.5:	Correlational stage	120
Table 5.6:	Selection stage	122
Table 5.7:	The proposed sets of heuristics (PWAUH)	126
Table 5.8:	Specification stage depicting details sets of heuristics (PWAUH)	127
Table 5.9:	Average perception of each PWA usability heuristic from expert validation surveys	133
Table 5.10:	Summary of heuristic evaluation	137
Table 5.11:	Findings for Sarawak Digital Cultural Heritage-PWA (CULTAGE)	138

Table 5.12: Findings for Hermo	141
Table 5.13: Findings for 123rf-PWA	144
Table 5.14: Additional heuristics	150

LIST OF FIGURES

Figure 2.1:	Agile Scrum Fremework (Scrum Alliance, n.d.)	42
Figure 2.2:	User-Centred Design Framework (Anwar et al., 2015)	43
Figure 3.1:	Social Media Crowdsourcing Poster	60
Figure 4.1:	Initial main features of the system	70
Figure 4.2:	The Importance-Performance grid	80
Figure 4.3:	CULTAGE webapp on desktop view	86
Figure 4.4:	Mobile version of CULTAGE-PWA	87
Figure 4.5:	Features in CULTAGE: The sub-page for each ethnicity with artefacts categories & the page displaying all available data	87
Figure 4.6:	Artefacts displayed in the web app are stored in Tumblr	88
Figure 4.7:	"Contribute" page for users to contribute cultural heritage data and information to the web app	88
Figure 4.8:	Firebase console displaying & storing contributed information	89
Figure 4.9:	The relative UX quality of Sarawak Digital Cultural Heritage PWA per scale is based on the mean value in the benchmark data set	90
Figure 4.10	Results of the IPA for Sarawak Digital Cultural Heritage PWA:	92
Figure 4.11	The persona of a casual user (Alice) and a serious user (Kassim)	94
Figure 4.12	:Depiction of a user scenario	96
Figure 4.13	The Use Case diagram of users interacting with the system	96
Figure 4.14	High-fidelity wireframe for CULTAGE-PWA	97
Figure 4.15	Break down of the UX attributes based on mean value per item	98
Figure 5.1:	Heuristics Development Methodology	103
Figure 5.2:	Example of the Google Form for Expert Survey Validation	132
Figure 5.3:	Correlation coefficients scores between average perception scores of each PWA heuristic	134

Figure 5.4:	Average perception of overall PWA usability heuristics	134
Figure 5.5:	CULTAGE	136
Figure 5.6:	Hermo	136
Figure 5.7:	123.rf	137
Figure 5.8:	Some of the pictures unable to load	147
Figure 5.9:	Explain a bit the function of the "Contribute" button	148
Figure 5.10	The search button should be included on the homepage	148
Figure 5.11	:It is difficult to know what each icon means. The problem might be major for tourists that do not come from Sarawak because they maybe had no idea what the icon represents	149
Figure 5.12	Homepage does not explain the purpose of the web app, and cannot find that information anywhere	149

LIST OF ABBREVIATIONS

CULTAGE	Sarawak Digital Cultural Information System
HE	Heuristic Evaluation
PWA	Progressive Web Application
UEQ	User Experience Questionnaire

CHAPTER 1

INTRODUCTION

1.1 Study Background

The purpose of this research was threefold: (1) Utilizing Netnography to gather cultural heritage data, (2) designing and developing the Sarawak Digital Cultural Heritage Information System, and (3) developing a new usability heuristics checklist for the Progressive Web Application (PWA) domain.

Digitization is the digital representation of physical artefacts through pictures, graphics or textual information via electronic devices (Manžuch, 2017). The idea of digitising cultural heritage is widely known in heritage studies and Gallery, Library, Archive, and Museum (GLAM) institutions. Digitization aims to fend against the vulnerability and fragility of cultural heritage, acting as long-term storage information storage and enabling wider public access. This study has developed a comprehensive, one-stop digital information system in the form of PWA that stores and presents Sarawak's diverse heritage information and material culture to realise the need for cultural heritage digitization. This decision is also due to the realisation that such a platform has been considered useful as it can present a large amount of information in an easily understood and accessible manner.

This research implemented the Netnography method for collecting cultural data. This research understands the intricacy of Sarawak's cultural climate for its many ethnicities and sub-ethnics available, disputes amongst cultural organizations regarding who should be the independent body to sustain Sarawak's entire cultural heritage, and language barriers, and the geographical location of the different ethnic groups. Unlike traditional data collection

methods, Netnography or digital crowdsourcing collects data and allows information to be transmitted to respective audiences regardless of time and place through various social media platforms. It was not until the past few years that Sarawak's Minister of Tourism, Art and Culture expressed his intention to set up an Intangible Cultural Heritage (ICH) Centre in Sarawak to support UNESCO's ICH preservation effort (The Borneo Post Online, 2019). The unavailability of a centralized platform to document Sarawak's heritage motivates this research and will hopefully be a step forward in realizing this vision. Currently, the state has Jabatan Museum Sarawak, which oversees the different sorts of museums across Sarawak (Borneo Cultures Museum, Textile Museum, Sarawak Ethnology Museum, etc.), Sarawak Digital Economic Corporation (SDEC) owning the Sarawak Cultural Village, and government agency Majlis Adat Istiadat Sarawak doing their heritage research.

On top of improving digital records of Sarawak's cultural heritage, this research analysed the effectiveness of using social media for cultural heritage data collection efforts. It investigated the reliability of the crowdsourced data based on the accuracy of the information with experts.

The final stage of this three-part study resulted in a new PWA developed through an iterative development guideline introduced by Quinones and Rusu (2019). The PWA is a web service that allows users to quickly launch web apps from their mobile home screen while having access to the features of a website with the added perks of a native app but without its drawbacks (Anuar & Othman, 2020). However, with the development of the digital information system in the form of PWA, this research realises that there is no specific usability checklist for evaluating the domain. As the PWA is essentially a hybrid of both web apps and mobile applications, it is stuck in between smartphone and website

characteristics whereby it is readily available in multiple platforms in a way websites are and can be accessed offline in a way native apps can (Hu & Zhu, 2018; Khan et al., 2019). Due to the hybrid nature of the PWA, it is believed that a specific set of heuristics is required to better evaluate the usability of future and existing PWAs. Heuristic Evaluation (HE) is the most used inspection method in finding usability problems that use heuristics, or a set of principles, to evaluate a product's usability (Quiñones & Rusu, 2017). Despite facing criticism for the limited problems detected and the generality of the existing heuristics (Rajanen & Rajanen, 2018), HE is considered a popular option due to its cost-effectiveness, able to be applied in the early stages of development, and convenience that it does not require any advanced planning in conducting the evaluation (Umar & Khan Tatari, 2008).

1.2 Motivation of Research

This section discusses the four factors that motivate the research undertaken in this Master's study. First, there is a dearth in using digital crowdsourcing methods in the cultural heritage domain. This research attempts to demonstrate that Netnography for cultural heritage documentation will save time and cost, and the data obtained are reliable and valid. Second, there has not yet been a well-established information system enabling data storage and access to the public. Third, there is a need to evaluate and interpret the results obtained from the usability test done for CULTAGE-PWA using the User Experience Questionnaire (UEQ) survey with Importance-Performance Analysis (IPA). Forth, there is a need to develop specific usability heuristics for the PWA domain. These are discussed in the following two subsections: Subsection 1.2.1 discusses the two former motivations and Subsection 1.2.2 discusses the latter two motivating factors.

1.2.1 Practical-knowledge Gap

Based on recent experience, this study recognises the challenges and limitations of the large amount of work needed to gather cultural data and that the current ethnography approach will take years to complete the documentation process. Furthermore, there could also be a language barrier as they lack experts in each ethnicity, as inferred from the previous studies carried out by a homogenous group of researchers from one ethnicity. In addition, including researchers from different ethnicities in the research group established at Universiti Malaysia Sarawak (UNIMAS) could alleviate these limitations.

This study aims to bridge the gap in Sarawak's centralised cultural heritage information system. Due to the many ethnicities and sub-ethnics available in the State, several cultural organisations still debate who should be the independent body that maintains Sarawak's entire cultural heritage. Despite efforts from previous studies that have worked towards the digitisation effort of traditional crafts (Hashim & Jehom, 2014), culture (Campbell et al., 2016), and language (Saee et al., 2008; Zaman et al., 2016), there has still not yet been a single well-established and fully digitalised comprehensive information system on the cultural heritage of Sarawak. Furthermore, not until three years ago did Sarawak's Minister of Tourism, Art and Culture express his intention to set up an Intangible Cultural Heritage (ICH) Centre in Sarawak to support UNESCO's ICH preservation effort (The Borneo Post Online, 2019). Therefore, this research hopes that establishing a centralised system will be a step forward in realising this vision.

1.2.2 Empirical Gap

User experience evaluation measures can be divided into objective methods for quantitative data, namely questionnaires or usability scales, and subjective methods for qualitative data, structural interviews, or lab tests (Dobreva & Feliciati, 2011). Commonly, the cultural heritage system is evaluated objectively. The main reason is because of its simplicity and efficiency. Regardless of the methods used in evaluating user experience, the primary purpose of the usability evaluation remains the same: giving developers the tools they need to better understand user needs, improve overall product usability, and boost user satisfaction.

UEQ is an easily applied, trusted, and good data processing tool to facilitate fast and direct measurement of UX (Dewi et al., 2020). The UEQ also provides quantitative evaluation results making it easier for researchers to process data. UEQ can be used on its own or paired with other tools to evaluate further the user experience of one's product or services. Regardless of being used on its own or combined with other available tools, the UEQ may serve these few purposes: To compare products' level of user experience, test its user experience, and determine areas to improve. Due to its efficiency and effectiveness, this questionnaire has been implemented in this research. Arguably, although UEQ provided the numbers and benchmark, it cannot provide recommendations or actions to be considered for improvements.

Hence, the IPA was implemented. IPA is a low-cost and understandable technique that provides insights into which aspect a researcher or developer should focus on and determines whether a product underperforms or outperforms its attributes (Abalo et al., 2006; Martilla & James, 2018). The results presented on the grid will facilitate data interpretation and increase its usefulness in deciding a way forward.

The available heuristics for general usability purposes, such as Nielsen's, and the specific usability checklists intended for smartphone applications, such as Joyce and Lilley's (2014) SMART heuristics, are not comprehensive enough to evaluate the PWA due to its unique features. PWA is a web-based application built with a modern and enhanced

application programming interface (API) designed to be capable, reliable, and installable to provide a native app-like experience. The advantages of PWA include being a reliable, fast and engaging service that allows users to launch web applications from their home screen, cross-platform availability, discoverability, and its ability to keep up-to-date knowledge upon refresh. PWA serves as the perfect alternative to the drawbacks of both native and webbased platforms. While the web-based was identified as lacking in security, unable to access devices' hardware, and incomprehensive user experience (UX) when users primarily performed actions or transactions on their mobile devices, the native mobile application was reliable and connectivity-dependent. It provided users with access to an independent experience. The native mobile app, however, comes with high development prices, is not up-to-date, and requires more user data and storage. As it is essentially a hybrid of both web apps and mobile applications, PWA is stuck in between smartphone and website characteristics whereby it is readily available on multiple platforms in a way websites are and can be accessed offline in a way native apps can (Hu & Zhu, 2018; Khan et al., 2019). Khan et al. (2019) amplify PWA's importance by citing a report by Gartner indicating that by 2020, 50 % of existing native, hybrid, and mobile web applications will be converted into PWA. The midway characteristics of PWA become a motivating factor in developing a specific tool to better evaluate the usability of future and existing PWAs.

1.3 Objectives

- i. To utilise Netnography using social media in documenting cultural heritage data
- To design and develop a Progressive Web Application (PWA) for Sarawak digital cultural heritage information system (CULTAGE)

iii. To evaluate the user experience of the Sarawak digital cultural heritage information system (CULTAGE)

iv. To develop a PWA usability heuristics

1.4 Research Questions

RQ1: How effective and valid is using Netnography via social media for cultural heritage documentation?

RQ2: What is the cultural heritage information obtained through Netrography via social media?

RQ3: What are the findings obtained from the focus group session?

RQ4: What are the main components and design of CULTAGE-PWA?

RQ5: How did CULTAGE's user experience perform through usability testing using User Experience Questionnaire (UEQ)?

RQ6: What are the PWA usability heuristics?

1.5 Definition of Terms

Table 1.1 summarises the definition of terms used in this study.