System Design and Usability Evaluation of Ghana Music Documentation System Using the System Usability Scale

Alimatu-Saadia Yussiff[1](✉), Florian Carl[2], Wan Fatimah Wan Ahmad[3], Simon Mariwah[4], Otchere Eric Debrah[2], and Abdul-Lateef Yussiff[1]

[1] Department of Computer Science and IT, University of Cape Coast, Cape Coast, Ghana
{asyussiff,ayussif}@ucc.edu.gh
[2] Department of Music and Dance, University of Cape Coast, Cape Coast, Ghana
{florian.carl,eric.otchere}@ucc.edu.gh
[3] Department of Computer and Information Sciences, Universiti Teknologi PETRONAS, Seri Iskandar, Malaysia
fatimhd@utp.edu.my
[4] Department of Geography and Regional Planning, University of Cape Coast, Cape Coast, Ghana
smariwah@ucc.edu.gh

Abstract. Ghana lacks proper establishment of primary sources of information on Ghanaian music, musicians, artists, and performance group. In addition, there is lack of a channel for acquiring such data. In an attempt to solve these problems, an online system entitled, Ghana Music Documentation System (GMDS) was developed and evaluated. The research aim at developing and evaluating a sustainable, usable and interactive online database of institutions, musical practices, musicians, artists, cultural entrepreneurs, performance groups, producers, as well as other stakeholders in the fields of music performance, education, production, promotion, and dissemination. In addition, the GMDS will allow users to browse, search for musical information and mapped Ghanaian music information for further analysis and visualization. In order to achieve these objectives, the development we followed five development approach: background study, identification of need and establishing requirements, designs, building an interactive system, and evaluation. We employed the System Usability Scale (SUS) instrument to evaluate the usability of GMDS and the result shows that the GMDS has an average SUS score of 81.6. This demonstrated that the GMDS system is acceptable, has a grade scale of B and the rating adjective is excellent. Based on the evaluation result, we concluded that the system proposes an innovative mapping technique, and will serve as a powerful primary repository for mapping Ghanaian music thereby becoming a reliable, effective and efficient research tool for all.

Keywords: System Usability Scale · Ghana Music Documentation · System design · Ghana music database · Usability evaluation · SUS

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1 Introduction

Cultural globalization and the growing importance of digital technology are realities that artists, cultural entrepreneurs, as well as researchers and policy makers today must face. Scholars of cultural globalization have identified two opposing trends: One points towards an increased cultural homogenization, mainly associated with Western culture, but also taking place at the inter-regional level, where larger cultural markets often dominate smaller ones. The opposite trend, described as cultural heterogenisation, fostered by the diffusion of images, sounds, ideas, and cultural products through mass media as well as through increased inter-cultural exchange and transnational mobility [1–6]. Policy makers, practitioners and other stakeholders are therefore confronted with the question of how to respond to these contradictory global forces [7, 8].

At the national level, a response to the challenges of cultural globalization was Ghana's Cultural Policy, which came into effect in 2004" [9]. The Cultural Policy set out to define Ghana's cultural heritage and identify measures for its sustainable development, with the ultimate goal to promote "unity in diversity". In 2016, Ghana also ratified the UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions, which was the most explicit response to the threat of cultural homogenization at the international level.

Nevertheless, Ghanaian music culture from the past has been lacking behind as compared to other countries and continents in the globe. A major concern is that the interested persons find it difficult to find and locate Ghanaian musician across the world, especially when it comes to the native or cultural music which most of the traditional people and tourists are so much desperate. Currently, Ghana lacks proper establishment of primary sources of information on Ghanaian music, musicians, artists, and performance group. In addition, there is lack of a channel for acquiring such data. These has been a major problem for some time and the GMDS implementation has made it a concern to provide an appropriate solution by developing and evaluating an all-inclusive database of Ghanaian music culture.

In this regard, the goal of the research is to develop and evaluate a sustainable and interactive online database of institutions, musical practices, musicians, artists, cultural entrepreneurs, performance groups, producers, as well as other stakeholders in the fields of music performance, education, production, promotion, and dissemination. This will represent Ghanaian music culture on the globe for easy reach to all interested persons. It will also go a long way to benefit stakeholders, tourist and the public at large in promoting Ghanaian music culture.

The fundamental questions the research addressed are; what is the state of cultural and musical diversity in Ghana? Can we use GMDS to document and map a musical diversity in Ghana? Also, to build interactive digital online database as a tool to help achieve musical sustainability? How usable and satisfactory is the GMDS for the users?

The benefit of the system include the development of a sustainable tool for the betterment of all stakeholders. Secondly, the system would provide a database environment that would help in organizing, storing and retrieving information on Ghanaian music culture. This will be convenient and efficient to use by stakeholders, artistes, tourists, and policy makers in different ways that best serve their respective interests. In addition, the System

also addresses five out of the six-implementation areas stated in Ghana Cultural Policy document. These are; "preservation and conservation of culture," "development and promotion of culture," "presentation of culture," "establishment of appropriate administrative structures," and finally "establishment of linkages with various sectors of national development" [10].

Thus, the paper presents first the introduction to the research. Followed by review of related work then the methodology employed in the study. In addition, we present the main interfaces and evaluation results. Finally, we present conclusions and future works.

2 Related Work

This section presents literature review on Ghana music culture, usability evaluation, System Usability Scale (SUS) and related work on the topic.

2.1 Ghana Music and Culture

Music has always been an integral part of the Ghanaian community even prior to the contact with European colonialists. Music is use to mark the cycles of life, animate religions, during rituals, and to communicate the social values of the various ethnolinguistic groups that inhabited the Ghana-Togoland sub regions.

Music performs a great function in ceremonies, religion, funerals, festivities and many social gatherings of the Ghanaian communities, coupled with the art of dancing and drumming.

According to Collins [11], the Ghanaian trans-cultural popular music can be divided into three broad epochs or eras with its roots far from the early 1880s. Colonialism then influenced the way of traditional music-culture and introduced some foreign elements, which continued up to the Second World War and erected several forms of music and musical groups; popular among them was the Ghanaian Highlife, which started from the Fante-lands and Adaha and Konkoma music groups. By the 1940's the term highlife became the generic term for all the new forms of Ghanaian music.

Innovations in current times has metamorphosed traditional music culture all over the world especially with the introduction of media, internet and other forms of coordinating musical components and composing music. This means that modern technology, innovation and globalization trends has accounted for the current state of the Ghanaian music culture. According to [12], technology is currently the means for the transformation and advancement of culture. Considering day-to-day practices, it was realize that music documentation was not taken seriously and there was very little research in this domain. Although there is an emerging and growing literature on the subject of preservation of digital documents since the beginning of this century, to the best of our knowledge the subject of documenting the Ghanaian music culture and mapping of the information have not yet been addressed [13].

2.2 Usability Evaluation

ISO (9241-11) defines usability as "…the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in

a specified context of use" [14]. Usability is an important attribute for ensuring the quality of products or systems in order to meet user's satisfaction [15]. Usability engineering was characterized into five; Learnability, Memorability, User's Satisfaction, Efficiency, and Few errors [16]. Usability in this regard is mainly about users understanding and effective use of system or product to satisfy their needs or wants.

Usability evaluation is a systematic assessment of the degree to which a given product, software, or service has met the usability needs of its intended user. It focuses on easy to learn, easy to use, and users' satisfaction [17].

2.3 System Usability Scale

John Brook developed the System Usability Scale (SUS) in 1986 for measuring the usability of systems and software products. Since then, researchers have been using the instrument to measure the usability of numerous products including hardware, software, mobile devices, websites and applications. More importantly, the SUS can be used as a "post-test questionnaire for the assessment of perceived usability" [18]. The SUS consists of ten-item Likert scale questionnaire with five responses for each question namely "strongly agree", "agree" "neutral", "disagree", and "strongly disagree" [19, 20]. Thus, the SUS as a measure of usability "provides a global measure of system satisfaction and as sub-scales of usability and learnability"[21]. While items 4 and 10 can calculate the measure of learnability, the remaining 8 items measure the system usability as shown in Fig. 1. It is therefore, a good tool for collecting quantitative data about users' opinions.

The main goal of SUS is to help measure "people's subjective perceptions"[22] quickly and easily [18]. It has become an industry standard for evaluating a given system or product and as a measure of users satisfaction. The SUS is reliable, free, easy to set up and administer to participants online or in print [22], and "scores can be compared regardless of the technology" [23]. In addition, SUS provides a clearer understanding about users perceived usability and attitudes towards a system or products being tested

	The System Usability Scale Standard Version		Strongly Disagree				Strongly Agree
			1	2	3	4	5
1	I think that I would like to use this system frequently.		o	o	o	o	o
2	I found the system unnecessarily complex.		o	o	o	o	o
3	I thought the system was easy to use.		o	o	o	o	o
4	I think that I would need the support of a technical person to be able to use this system.		o	o	o	o	o
5	I found the various functions in this system were well integrated.		o	o	o	o	o
6	I thought there was too much inconsistency in this system.		o	o	o	o	o
7	I would imagine that most people would learn to use this system very quickly.		o	o	o	o	o
8	I found the system very awkward to use.		o	o	o	o	o
9	I felt very confident using the system.		o	o	o	o	o
10	I needed to learn a lot of things before I could get going with this system.		o	o	o	o	o

Fig. 1. Standard usability scale

[19, 21]. Not all, [24] summarizes the characteristics of SUS to be valid, reliable, not diagnostics, scores are not percentages, measures of learnability & usability, and SUS scores have a modest correlation with task performance.

2.4 Music Documentation and Information Systems

The Ewha Music Database (EMDB) system [25] was developed to store and share music information of East Asia. The goal of the system was to deliver a meaningful database system for East Asian music through technical solutions as well as experience in collecting and analyzing music materials. The implemented system accumulates educational music data from East Asia by creating a database that allows users to share the collected music database. The system also allow user to register and search for East Asia music information on the go. Other research using the EMDB system is entitled, "Enhancement of Understanding East Asian Music through Technical Innovation of the EMDB (Ewha Music Database)" [26]. This paper seeks to find out how useful two innovative search methods are for finding specific data in large volumes of data. Even though the EMDB provided the above-mentioned capabilities, the limitation is that it generated un-mapped.

Also, [27] developed a data and meta-data model for use in a music digital library system to support search and navigation of music content in multiple formats. This development was entitled, the Variations2 digital music library project at Indiana University. The goal of the project was to overcome the limitations identified in a traditional library databases and to accommodate the special needs of the music domain in several. First, it identifies, separates, and relates the logical and physical layers of musical works and their physical manifestations into four entities: work, instantiation, container and media object. In our view, the goals for developing Variations2 are very different from that of GMDS as stated above.

In addition, the Tuscan Music Documentation Centre (CeDoMus) is a service promoted by the Tuscan Regional Administration and Music School of Fiesole. The Center created an online database of musical collections to offer support to the music collections owned by Tuscan libraries, archives, and cultural institutions. The database offers information about provenance, nature, and extent of each collection, its history and place, relevant bibliographic information, links to catalogues, and other documentary resources available on the Web. The search schedule permits queries by name of the collection, name of the previous and actual owner, type, age and genre of the musical documents, and geographical coordinates. The website provide a global visualization of the dissemination of musical collections and their owners in the region through mapping [28]. Considering the kind of data stored in CeDoMus, it is different to that stored in [28] the GMDS database. However, we generated the idea of mapping data from this paper.

Not all, [29] developed a 3D technologies to document and disseminate information about ancient Maya musical instruments. The main purpose of the documentation is to address the inaccessibility of instruments housed in archaeological labs and museums across Mesoamerica. "In order to facilitate the study of ancient Maya music, it is necessary to create a database of numerous instruments from the Maya area that transcends geographical and temporal boundaries" [29]. Having a 3D printed replica of physical musical object and the ability to interact with them by students and researchers allowed

them to learn about the archaeological sites and excavated instruments. They were also able to visit the virtual sites and finally, learned how to play the instruments. Thus, the original object is preserved and protected while its duplicates continue to produce music. We therefore concluded from the Maya Musical database study that it deals with the development of 3D musical instruments for storage and use by both students and researchers. This is however different from the kind of data being considered under GMDS.

Overall, the idea of creating a database of musical objects and the ability of users to interact with an intuitive interface is an added advantage for our proposed GMDP system derived from the review of the above existing system. However, we derive the idea of mapping the data from both CeDoMus and the Ewha Music Database system.

3 Methodology

Based on the proposed topic, the system design and evaluation of the GMDS followed five stages as shown in Fig. 2.

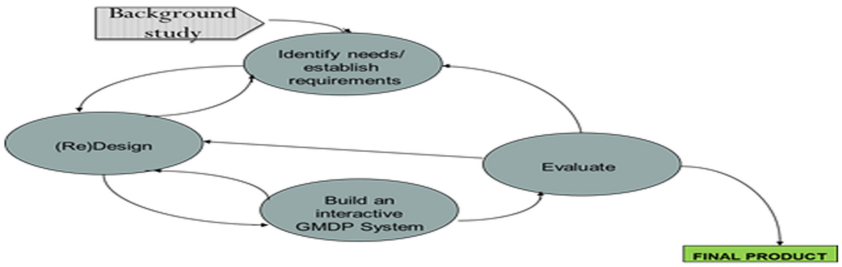

Fig. 2. Research methodology

The first phase, background studies, involved literature reviews of existing musical systems to identify concepts, gaps, issues, and measurable objectives. Needs identification and establishment of requirements in the second phase immediately followed this. In order to capture the right requirements for the system there was the need to identify the key stakeholders, those that the GMDS will affect either positively or negatively. This include representatives of the GMDS team from University of Cape Coast, developers, representatives from the Centre for National Culture, representative from Music Association of Ghana (MUSIGA) Cape Coast branch. We conducted Focus group discussions with stakeholders on three different occasions to elicit and establish requirements. In addition, we identified the functional requirements, usability requirements, performance requirements and non-functional requirements.

At the third phase, we designed the architecture, interaction model, object model and user interfaces. The fourth phase witnessed the development of an interactive GMDS using web technologies and multimedia elements. Some of the technologies employed include programming languages such as HTML, JavaScript, CSS, Bootstrap, PHP and SQL to build an impressive user interface for simple and clear user interactivity; Google

map for database mapping to show the exact locations of the various music groups and more description to the kind of music they perform and other information. Users will be able to browse, search and locate various music groups and organizations. Finally, the evaluation of the GMDS was done using SUS instruments and by following the systematic steps below.

3.1 Evaluation

The evaluation of the GMDS was done using SUS instruments and by following the systematic steps below. Criteria

3.1.1 Instrumentation, Participants Selection and Procedure

The evaluation process used a convenience sample from participants. Overall, 60 participants volunteered to take part in the study. The study adapted standardized SUS items (see Fig. 1) by replacing the word "system" in the original item with "GMDS", i.e. the product that is being evaluated.

This approach is supported by the work of [21]. We then designed Google Form using the SUS questionnaire with a link to the GMDS website. We also gave the participants the instructions i.e. list of tasks to perform on GMDS. Participants were introduce to GMDS, the expected tasks and the main purpose of evaluation. Immediately after completing the tasks listed in Table 1, participants filled the SUS survey online.

Table 1. List of tasks performed on GMDS

Number	Task
1.	Type the provided URL into a browser: https://gmdp.ucc.edu.gh
2.	Explore the interfaces by navigating through the pages
3.	Register a musician/artist/musical band, etc.
4.	Search the GMDS database by region/by name of artist/musician/musical band, etc.
5.	Fill out the SUS questionnaire based on your exploration of the GMDS

3.1.2 System Usability Scale Data Analysis

At this stage, we downloaded data from Google form in excel format and analyzed it using SUS standardized calculation format proposed by [19, 20]. First, we assigned a value for the SUS score calculation with 1 being Strongly Disagree; 2 being Disagree; 3 being Neutral; 4 being Agree and 5 being Strongly Agree. After that for all even numbered Likert scale numbered response items (i.e. 2, 4, 6, 8, and 10); we subtracted the participants' response score from 5. In addition, for all odd numbered Likert scale numbered response items (i.e. 1, 3, 5, 7, and 9); we subtracted 1 from the participants' response score. At the end of this stage, all users' response values were scaled from 0

to 4 with 4 being the most positive response. Finally, we calculated the overall value of SUS by summing up all individual scores and multiplied it by 2.5. This convert the range of possible values from 0 to 100. This format of calculation is supported by [18–20]. We then interpreted the results of the analysis using Fig. 3. It illustrates how the percentile ranks are associated with SUS scores and the letter grades.

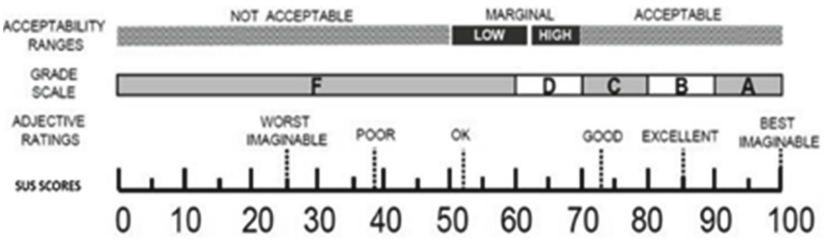

Fig. 3. SUS scores interpretations guide

4 Results and Discussion

This section presents and discusses the results of the study. First, it presents the GMDS interfaces and related functionalities. Then we present the SUS evaluation results.

4.1 The Ghana Music Documentation System

The GMDS is a web application with intuitive and usable interfaces that promote effective and efficient usage. Figure 4 illustrate the GMDS homepage and can be located at https://gmdp.ucc.edu.gh/en/. The homepage illustrates seven main menu (about, team, join, database, search, find out more, and homepage) for easy interactivity.

The system has three groups of users: the general users, the surfer and administrator. A surfer is a person who came to the site to explore and search for information. A general user is either an artist, music producers, performing group, etc. who is interested in joining the GMDS database. The main activity of the general user is registering the information about its organization by inputting data through the form into the GMDS

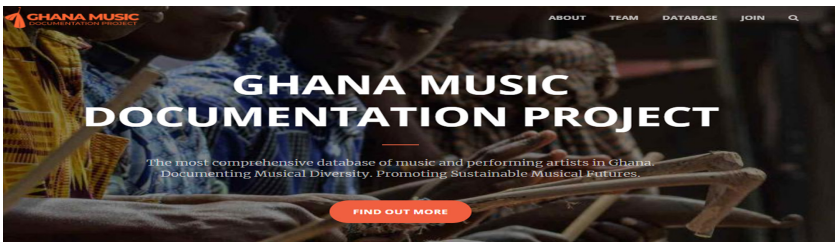

Fig. 4. GMDS homepage

database system. A general user can also search the GMDS database just as a surfer does and perform all the activities of a surfer. The final group of user for the GMDS is the administrator and his roles in addition to that of the surfers and general users include managing user accounts, publishing and mapping users' information, backup the database, and performing system configuration.

4.2 SUS Evaluation Results and Interpretation

Figure 5 presents the GMDS SUS scores, percentile ranks and letter-grades (from A to D) for users (N = 60). Considering the results of the SUS analyses performed within the data obtained, the usability of the developed GMDS proved to be at a higher rate with the overall average SUS score of 81.6 (i.e. sum of individual SUS score/number of participants = 4897.5/60). It also shows a high mean SUS score across all participants.

Table 2: Ghana Music Documentation Project SUS Scores

Respondents	Scales			
	Odd Items	Even Items	SUS Score (/100)	Grades
1.	14	19	82.5	B
2.	17	12	72.5	C
3.	15	13	70	C
4.	14	14	70	C
5.	13	15	70	C
6.	17	14	77.5	C
7.	16	14	75	C
8.	20	15	87.5	B
9.	14	15	72.5	C
10	12	12	60	D
11	15	12	67.5	D
12	18	13	77.5	C
13	19	12	77.5	C
14	20	17	92.5	A
15	20	17	92.5	A
16	15	18	82.5	B
17	20	17	92.5	A
18	20	17	92.5	A
19	19	14	82.5	B
20	16	15	77.5	C
21	16	15	77.5	C
22	16	15	77.5	C
23	20	17	92.5	A
24	20	17	92.5	A
25	16	15	77.5	C
26	20	15	87.5	B
27	20	17	92.5	A
28	20	15	87.5	B
29	20	15	87.5	B
30	20	15	87.5	B
31	20	17	92.5	A
32	20	15	87.5	B
33	20	15	87.5	B
34	20	17	92.5	A
35	20	14	85	B
36	20	17	92.5	A
37	20	15	87.5	B
38	20	14	85	B
39	16	13	72.5	C
40	12	12	60	D
41	13	13	65	D
42	15	13	70	C
43	16	15	77.5	C
44	20	15	87.5	B
45	15	13	70	C
46	20	12	80	B
47	20	15	87.5	B
48	20	17	92.5	A
49	20	15	87.5	B
50	15	13	70	C
51	15	13	70	C
52	20	15	87.5	B
53	16	15	77.5	C
54	15	15	75	C
55	20	15	87.5	B
56	12	20	80	B
57	19	15	85	B
58	20	17	92.5	A
59	20	15	87.5	B
60	20	17	92.5	A
		Average score	81.625	

Fig. 5. GMDS SUS scores

4.2.1 Acceptability, Grade Scale, Adjective Rating of GMDS Result

To determine the acceptability, grade scale, and adjective rating of the GMDS, we compared GMDS SUS evaluation result in Fig. 5 with the SUS Scores Interpretations Guide in Fig. 3. In addition, there are six SUS grade scale, ranging from A, B, C, D, E and F where:

- Grade A: with a score greater than or equal to 80.3
- Grade B: with the same greater score with 74 and smaller 80.3
- Grade C: with a score greater than 68 and smaller 74.
- Grade D: with the same greater score with 51 and smaller 68.
- Grade F: with a score less than 51.

In conclusion, comparing our overall SUS score of 81.6 in Fig. 5 with interpretation scale (A - F) and Fig. 3 demonstrated that the GMDS has the following levels of acceptability, grade scale, and adjective rating:

- Level of user acceptance falls into the acceptable category,
- The grade scale is included in category B, and
- The rating adjective of GMDS is excellent category.

Thus, the GMDS is usable, has good utilities and efficient to support the goal of its development, which means the end user can find it easy to learn, easy to use, and satisfactory.

4.3 User Suggestions for Future Improvement of GMDS

When we asked participants under item 11 of the questionnaire to provide us with any suggestion for upgrading the GMDS system. Many agreed that the GMDS is good, has nice interface with good application, has nice layout and easy to locate artists/groups and that the system will help promote Ghanaian culture to the world. Alternatively, some suggested we should add necessary items to the GMDS, help its usage with every other Operating system. Some also suggested that the satellite view of the map should focus more on Ghana and finally to educate people on GMDS.

5 Conclusion

This study developed and evaluated GMDS featuring an interactive on-line database of institutions, musical practices, musicians, artists, cultural entrepreneurs, performance groups, producers, as well as other stakeholders in the fields of music performance, music education, and music production, promotion, and dissemination.

The system provide users the opportunity to add their information into the database for further query, mapping and use by stakeholders. The system provided users the answers to the fundamental questions on how to access or locate a particular musician or music-group via near-by facilities, finding route, and contacting them. This is possible through searching GMDS user-friendly interface and the resulting mapped output. This helps the users to find the most relevant information or locate various institution with ease. The results of the evaluation conducted on GMDS with 60 participants resulted in the mean score of 81.6, has a grade scale of “A” and the rating adjective is excellent. Overall, the GMDS offer powerful, clear and user-friendly access to Ghanaian music data with great benefits to users. In future, we hope to add more features to the system by introducing music groups and artists’ performance photographs and the satellite view of the mapped data to focus more on Ghana.

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