

The Conceptual Framework of Megalithic Cultural Information Visualization

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Abstract— Improper method of data storage, lack of complete and up-to-date information sources, weakness in information sharing and decimation, and poor visual representation have attributed to loss of megalithic cultural heritage. Thus, the study aims to design a web-based application that visualises megalithic culture information in Malaysia, specifically in Negeri Sembilan. This study used the Rapid Application Development (RAD) research methodology, which consists of four phases: requirements planning, design development, testing, and implementation. The RAD model was selected to ensure that the design and development processes of information visualisation were conducted systematically. This study has discussed each phase in detail, highlighting specific activities involved. These phases were optimised using the Gestalt principles and Visualisation techniques, the main component of the conceptual research model. The Gestalt principles play an important role in ensuring the application development layout and web interfaces by considering the psychological aspects and experience of the users. Furthermore, visualisation techniques, including photos, maps, charts, and drawing illustrations, were applied to enhance the delivery of information for easier understanding and interpretation by the users. The conceptual framework was designed to reflect the overview of the application development and highlight the components and elements involved. In this light, Negeri Sembilan megalithic culture information should be highlighted to the public as it is a unique treasure and culture practised by previous generations. Thus, the web applications produced in this study are expected to encourage the digital preservation of Megalithic culture in line with current technological developments.

Keywords— *Information visualisation, conceptual design, Rapid Application Development RAD, Web Applications, megalithic*

I. INTRODUCTION

The advancement of digital information in today's world has resulted in the rapid decimation of information in line with fast-paced changes in our lifestyle [1] [2]. Moreover, the wide use of the internet has made web applications one of the main communication for disseminating information today, including introducing megalithic culture in Malaysia, especially in Negeri Sembilan, to the world's community.

Negeri Sembilan Darul Khusus is one of the states in Malaysia that has its unique cultural heritage, including the

megalithic culture. This process is significant to preserve the increasingly forgotten megalithic cultural heritage in this era of modernisation. Therefore, this study was conducted to design a web-based visualisation of Megalithic Cultural Information. Figure 1 shows the environmental visualisation model of megalithic cultural information.

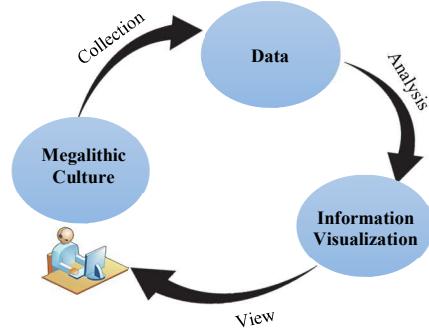


Fig. 1. Megalithic cultural information environment visualisation model

It is expected that web-based applications can benefit and substantiate the megalithic culture that is now less known and increasingly destroyed by universal development. This paper will present the problems statements in the current practices of sharing megalithic cultural information, the research objectives, related study, research methodology and the conceptual model.

II. PROBLEM STATEMENT

A. Conventional Data Storage

According to a study on archaeological site documentation [3], archaeological activities in Malaysia are relatively slow due to the outdated methods used in the management and documentation of historical artefacts. This situation has hindered the process of accessing and delivering information.

[4] also stated that the use of outdated, traditional storing and documentation methods created a barrier to decimating information on megalithic sites about these traditions and cultures to the general public. The use of traditional filing systems is no longer suitable to meet the needs of the current

environment. As a result, it is difficult for the public to access information about the megalithic culture in Malaysia.

B. Lack of information resources and data location of megalithic sites digitally

The lack of information resources results in the limited public understanding or knowledge of the community related to megalithic culture [4]. In this light, there is limited online information on the coordinates and location of megalithic stone sites in Negeri Sembilan.

C. Poor information sharing and visual representation are less obvious.

Megalithic cultural information is less and shared in general with the external community. The lack of complete and up-to-date information sources hinders information delivery, causing the megalithic cultural heritage to be lost and forgotten [5].

As ancient cultural heritage refers to historical events and communities that no longer exist, there are significant challenges in imagining or visualising the invisible historical elements and narratives. These include the narrative evidence of function and cultural traditions of megalithic stones.

An online survey of the Districts Council official portal [6] found that the megalithic information provided in the portal is mainly presented in the form of a summary, i.e. an introduction to megalithic cultures. It was also found that the pictures and the environments shown are unclear and less obvious. Furthermore, the pictures shown do not provide the actual appearance of the stone to be shown. This effort needs to be further enhanced by detailed and up-to-date information so that its sustainability remains preserved.

Therefore, this study is aimed to address the gap by producing a design to develop visualisation information of Megalithic cultural information, especially in Negeri Sembilan, so that this heritage could be preserved in line with current technological developments.

III. RESEARCH OBJECTIVE

The objectives in this study are as follow:

- 1) To design a conceptual framework model for the visualisation of Negeri Sembilan megalithic cultural information
- 2) To develop a web-based information visualisation application focusing on Negeri Sembilan megalithic cultural
- 3) To test and evaluate the usability of web applications

IV. RELATED STUDY

‘Megalithic’ combines two Greek words, ‘mega’, which means ‘big’ and ‘lithos’, which means ‘stone’. Thus, megalith refers to one or more large stones used to build a certain shaped structure with a special purpose in community life [7] [8] [4] [5]. The megalith stone is also known as a ‘live stone’ by the local community practising the megalithic culture. The concept of living stone is associated with spiritual elements, and it is believed the stone could grow, i.e. becoming taller and wider, as if it is alive [9] [7] [10] [4].

Previous studies reported more than 200 megalithic sites recorded around Kuala Pilah, Negeri Sembilan [8]. However, the latest data obtained are not in line with the previous study. The latest findings reported 126 megalithic sites around *Luak*

Tanah Mengandung with 4223 megalithic stones [7]. There is a difference in the number of megalithic sites due to the area’s destruction or displacement of megalith stones.

The discovery of megalithic stones in Malaysia shows that Megalithic culture was once actively practised in several communities. The study agreed with [11] that archaeologists are not just travellers looking for hidden artefacts. In this light, the field of archaeology does not only involve recovering, analysing, interpreting ancient cultures. It also involves presenting the remnants and artefacts left by the previous generation to the current generation.

As information and communication technology evolves, it has been widely used by different sectors, including archaeology. For example, information and communication technology has been used to digitally preserve and conserve cultural heritage [12]. Thereby, megalithic artefacts and sites discovered by archaeologists could be preserved through digital applications. This approach is in line with [2] and [13], which examined the development of system applications as the fundamentals in the rapid development of the ICT sector to change lifestyles.

The use of technology could provide a more attractive and interactive environment for information visualisation. [14] and [15] explained information visualisation is a method of delivery that could potentially support and enhance the understanding of contents through interactive information illustrations. A good visual display can influence users’ reactions and increase users’ tendency to observe and pay more attention to what they see [16] [15]. In other words, visualisation in information presentation helps human beings analyse and understand data easily.

In developing web applications, designers or developers are more likely to pay attention to design details such as writing, shadows, shapes (curved edges), and others than the whole design presentation [17]. Consequently, they sometimes forgot to emphasise psychological aspects. The Gestalt principle plays an important role in ensuring the accurate presentation of the application development layout. Moreover, the Gestalt Principle represents significant ideas that can be applied by designers. Its implementation provides a user-friendly approach to present the aesthetic designs of the megaliths and their functionality [18].

Hence, efforts to develop applications to document and decimate information through the latest technological approaches should ensure that documentation and information on megalithic cultures could be preserved. For example, visualisations allow real pictures and information about megaliths to be presented in an easy-to-understand manner. Information sharing through digital media is one of the efforts to preserve the historical records of heritage sites. It could also ensure the current, and future generations could see, appreciate and find references on megalithic culture [19].

V. RESEARCH METHODOLOGY

This study applied Rapid Application Development (RAD) in developing the web application. RAD consists of four main phases, requirement planning, design and development, testing, and implementation, as shown in Figure 2. The main goal of this method is to produce high-quality web system applications in accordance with consumer needs [20]. The RAD model was selected to ensure a

systematic and guided development information visualisation process according to the timeframe.

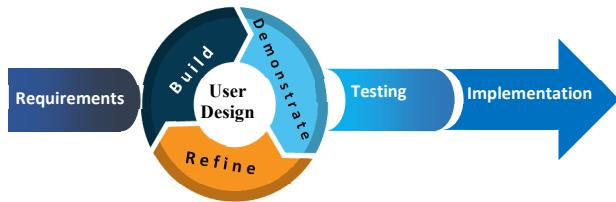


Fig. 2. RAD development model

A. Requirement Phase

The application development process began with the requirements planning phase. This phase involved identifying issues and problems, selecting research areas, objectives, and determining the scope of the study. In addition, a literature review was also conducted to ensure the application is developed based on the correct theoretical framework and supported by the literature. This phase involved collecting, searching, and reading articles and previous studies to support the research and development process.

Before collecting the real data, a preliminary survey and interviews with field experts were conducted to strengthen the development objectives. These preliminary steps were taken to ensure that development outcomes align with current requirements. This phase also involves determining user and application development requirements, including analysis of hardware and software requirements for the proposed application.

In addition, the theory of visual perception was reviewed to ensure that web applications developed meet the needs and enhance the users' visual perceptions. Psychological aspects and perception design were considered by implementing Gestalt theory during the web interface development. This theory explains how each element in the interface design works to ensure the information presented is aesthetically pleasing and easy to understand [21] [22]. The Gestalt principles applied in the interface layout consist of proximity, similarity and common region, as shown in Table I.

TABLE I. ELEMENTS OF VISUAL PERCEPTION IN GESTALT THEORY

Elements	Characteristics
Proximity	The proximity principle states that nearby objects will appear more relevant than objects further in the distance.
Similarity	The principle of similarity suggests that when something looks similar to each other, humans will tend to consider the object with the same function.
Common Region	The principle of the common region is also related to distance. This principle states that when the object is in the same environmental area, the object is grouped.

The data and information collected in the first phase were used as sources of reference in generating ideas in the next design and development phase. The summary of the processes in this phase is described in Figure 3.

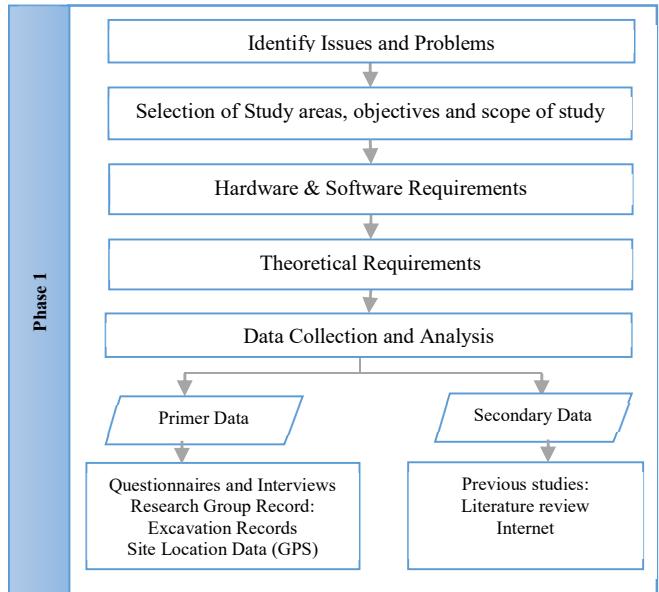


Fig. 3. Phase 1 activities

B. User Design Phase

The user design phase was conducted after the requirements planning process. The user design phase represents a continuous interactive process that allows developers to understand, change and eventually approve the system model to meet the user needs [23]. Finally, a conceptual model was produced to provide an overall picture of the research framework to guide the application development process.

The web application development process applied visual techniques such as pictures, digital mapping, and diagrams. A summary of the techniques used in this study is presented in Table II. The application will be developed using the appropriate software set in the previous phase.

TABLE II. VISUALISATION TECHNIQUES

Technique	Description
Photo	Photos allow users to see the real picture and situation of the megalithic stones and the environment in more detail. In addition, the use of photos also increases the perception and understanding of the information to be conveyed.
Map	The digital map displayed through the geographical surface spreadsheet is interactive, moving to select the required location. Users can select the plotted megalithic to obtain more details of the attributes presented.
Diagram	In the context of megalithic culture, the megalith stone finding data is analysed and translated in graphics such as pie charts, bar charts, etc. The table is used to display distribution analysis data for the finding.
Illustration	Illustrations are a form of art used to combine data analysis with the storytelling texts they want to communicate. Besides the text-based information, the drawing illustrations are used to increase the perception and understanding of the user quickly.

The developed application will then be presented to the parties involved. Next, some changes or improvements were made to refine the application based on the inputs and suggestions received. The processes in the design phase are illustrated in Figure 4.

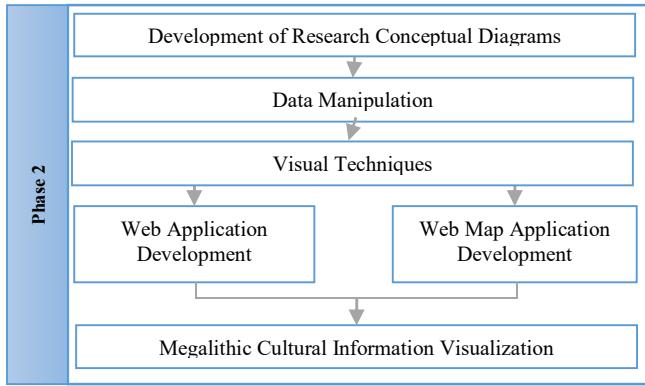


Fig. 4. Phase 2 Development Activities

C. Testing Phase

Each part of the application will be tested to identify any possible errors or problems. This is to ensure that the application has been developed could work properly as planned. Testing is also implemented to ensure that the elements developed are error-free and meet the study's scope and objectives.

The testing phase involved getting feedback from users regarding the usability of the application. Usability is one of the quality attributes in evaluating websites to measure how easily the interface could be used [24]. This is to ensure the final product that has been developed can operate properly and smoothly that meets user satisfaction. In addition, usability is also a necessary condition for a website or system to last longer [25]. This study tested four main components, as proposed in [24] and [26], to determine the usability of the web application, as shown in Table III.

TABLE III. USABILITY COMPONENTS

Factor	Description
Learnability	Easy to understand and learn how to use. Easy for users to accomplish basic tasks the first time they encounter the design.
Efficiency	Users can easily and quickly use the developed applications
Ease of Use	Easy to use with clear guidelines and simple steps. Consistent applications and flexible interactions.
Satisfaction	Users are satisfied using the developed application

The processes in the testing phase are described in Figure 5.

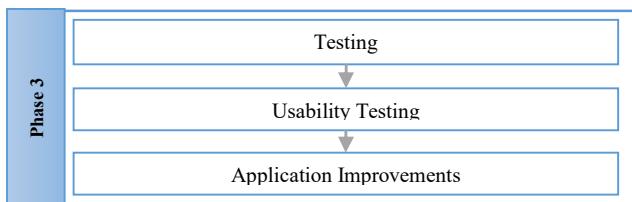


Fig. 5. Testing Phase Activities

D. Implementation Phase

The final development phase involved the implementation process that allows the application to be accessed by users. This process involved uploading and installing the application on a server and getting it online so the application could be accessed by people worldwide.

The implementation processes are described in Figure 6.

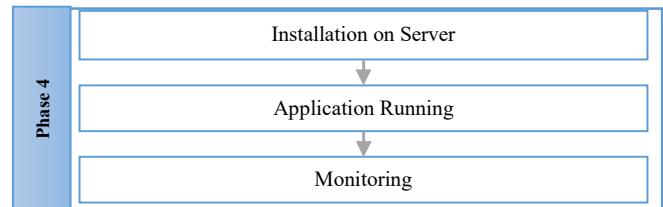


Fig. 6. Implementation Phase Activities

VI. CONCEPTUAL MODEL

Each essential concept and element discussed previously was used as input in producing a conceptual design framework for the study. This section discusses the web-based megalithic cultural information visualization conceptual framework, as illustrated in Figure 7. The conceptual framework provides an understanding of information visualization of the Negeri Sembilan megalithic cultural domain.

This framework consists of three main parts. The first part consists of theories and techniques used during the visualization development process. The second part comprises the interface of the content generated during the development process. The final part consists of an evaluation process to test the usability of the application.

In this study, the proximity, similarity and common region principles of the Gestalt theory of visual perception were applied based on the type of megalithic cultural data. The Gestalt principle presents an important idea that designers could apply to enhance the design aesthetics and functionality and provide a user-friendly design [18]. Therefore, the Gestalt theory is adopted in each interface design phase so that the web application aligns with users' visual perception and provides a satisfactory experience.

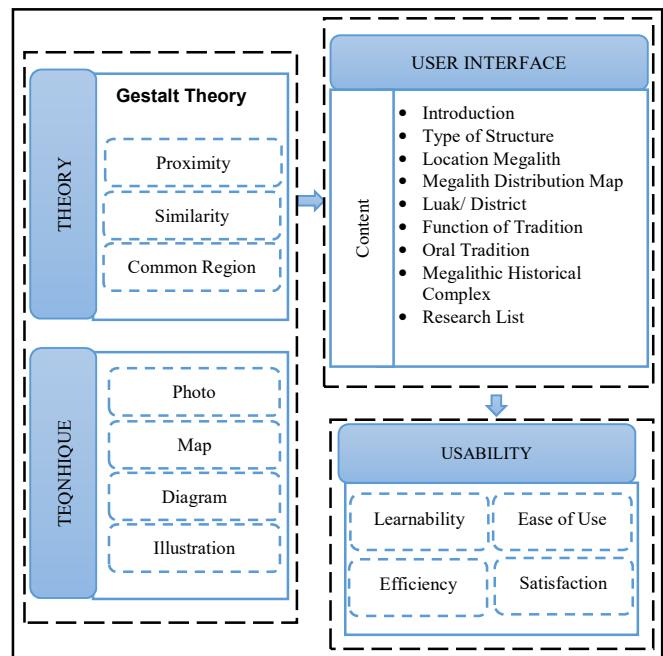


Fig. 7. Conceptual framework of Negeri Sembilan megalithic cultural information visualisation

Visualisation techniques in a visual representation could attract users and clarify the messages presented. The visual

techniques used in this study are photo, map, diagram and panting illustration. Other than text-based information, visual elements could improve users' understanding and help them interpret the information and contents conveyed [27]. This paper discusses the concepts and theories involved, and this conceptual model will be used in developing web site which will be undergo in the next phase. In addition, development validation is subject to other papers as the website is incomplete and is in the process of development.

The web application interface will be developed based on the findings on the megalithic culture in Negeri Sembilan. Users can access information and contents, including the introduction of megalithic culture, the type of stone structures, the location of the megalith stone found and a map of megalith sites distribution, the 'Luak' or the district in Negeri Sembilan where the sites were found the traditional function of megalith stones, oral traditions related to megaliths, information on the megalithic historical complex of Negeri Sembilan and a list of megalithic related research conducted in Negeri Sembilan.

The application will also go through an evaluation phase where feedback from users regarding the usability of the developed application will be collected. In this light, usability is one of the quality attributes in evaluating websites to measure how easily the user interface can be used [24]. The application's usability will be tested based on quality components, including learnability, ease of use, efficiency, and user satisfaction. This evaluation phase is conducted to ensure the end product could operate properly, smoothly and meet users' requirements. In addition, usability is a necessary condition for a website or system to survive longer [25].

VII. CONCLUSION

In conclusion, the paper discussed the design of a megalithic cultural information visualisation web application focusing on the megalithic culture in Negeri Sembilan. The design was used to develop web-based information applications that are accessible to the public. Hopefully, the web-based system developed could help deliver information on the megalithic culture in Negeri Sembilan effectively to the public and, at the same time, preserve the country's heritage.

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