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Interface Designs Model of Location-Aware Mobile Commerce for Songket

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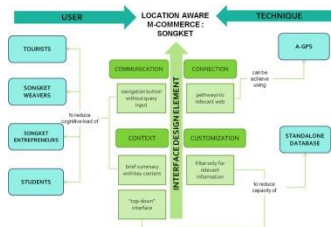
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Graphical abstract

Abstract

This paper centers on research of the user interface design of mobile commerce (m-commerce) focusing on the location of the songket business. The research is based on a comparison method between interfaces of location-aware m-commerce with different domains. The goal is to analyze the aspect of m-commerce interface design that has already been accepted by the user. 7C's interface design elements have been selected as the guideline of the analysis. The comparison analysis of localization technique showed that four out of the seven elements are suitable for the guideline; namely Context, Customization, Communication and Connection. Research proved A-GPS technique suitable for application of songket localization. The outcome of the research is the user interface of location aware m-commerce based on multi user mental model specific to songket localization using A-GPS technique.

Keywords: m-commerce; location aware; interface design model; songket

Abstrak

Kajian ini menjalankan penyelidikan terhadap reka bentuk antara muka m-komers untuk kegunaan multi-pengguna yang memfokus maklumat lokasi perusahaan songket. Metod yang digunakan dalam kajian ini ialah menggunakan kaedah perbandingan terhadap reka bentuk antara muka aplikasi kesedaran lokasi m-komers yang mempunyai domain berbeza. Tujuannya ialah untuk menganalisis aspek reka bentuk antara muka m-komers yang telah diterima oleh pengguna. Elemen reka bentuk 7C's telah diguna sebagai garis panduan analisis. Hasil analisis perbandingan terhadap teknik capaian lokasi dijalankan dan telah menunjukkan empat daripada tujuh elemen dijadikan sebagai panduan; iaitu Konteks, Pelanggan, Komunikasi dan Sambungan. Kajian telah menunjukkan teknik A-GPS adalah sesuai diaplikasi sebagai teknik capaian lokasi songket. Hasil kajian ini adalah reka bentuk antara muka aplikasi kesedaran lokasi m-komers berdasar model mental multi pengguna yang spesifik kepada capaian lokasi songket menggunakan teknik A-GPS.

Kata kunci: m-komers; kesedaran lokasi; model reka bentuk antara muka; songket

■1.0 INTRODUCTION

The textile industry is a major contributor to the Malaysian Economy especially the songket industry. As a premier exporter of ethnic songket, songket portrays the unique Malaysian trait which is known for its royalties and noblemen. Although Malaysian fabrics managed to penetrate the oversea market, local market distribution still faces many challenges. The most obvious problem is the public access to the business information and location that is hard and troublesome. According to Redzuan and Aref, tourists have played their part to promote the Malay heritage's craft products but songket is still lagging behind in term of sales and awareness. Only a few tour agencies have the up to date information of the songket business and their exact location. This is a great loss to the songket industry since the prospective customers do not know the existence of the myriad of high quality songket offered by the Malaysian entrepreneur. An average tourist spends 4.5 days in Malaysia, but since the lack of information and promotion, they do not have an ample time to discover the beauty and authenticity of the songket. This is worsened by the fact that most of the songket factories are located at the suburbs and distant villages [1].

To overcome this problem in today's market, Information and Communication Technology (ICT) marketing strategy should be implemented to keep up with the ever changing world. However, the immobility of the desktop computer and internet-based e-commerce application confined the user to their home or office only and render them inaccessible to the information once they are on the move [2]. Using mobile interface, this shortcoming can be addressed to deliver reliable information and fast access to the user who needs the service away from home [3]. Some of the drawbacks of the m-commerce includes slow

connection speed, high airtime charges, poor quality screens, awkward user interfaces and limited content and services, however the significant growth of the mobile user with the mobile data capability over the past few years leads to innovation of a more effective m-commerce interface [2][4].

The objective of the research is to develop a guideline in creating a user-friendly m-commerce interface solution for songket. The generated guideline will be applied to develop a multi-user m-commerce application targeted for prospect buyers, tourists, business owners and songket weavers.

Section 2 will discuss about previous study on m-commerce and interface design. Section 3 will elaborate on the method of element testing that can be applied to the user interface of m-commerce. Section 4 will explain about the results and its analysis while Section 5 will discuss and concludes the findings of this study.

■2.0 RELATED STUDIES

Context definition spans across multiple discipline such as data mining, private e-commerce, mobile context awareness system, database, information gathering, marketing and administration [5]. Biegel *et al.* pictured context awareness application as an important and crucial subset in computer application as it has an advantage in understanding surrounding environment [6]. Context can be described as any information gathered from surrounding object that can be used to define the condition of the identified object. Häkkilä & Mäntyjärvi agreed context is any data that can be used to classify an entity. Consequently, context awareness means a device is aware of its usage situation. Context awareness application can be divided into two categories; 'Pull' and 'Push'. 'Pull' application is where the user placed a request on context information or action while in 'Push' application, the device itself is self-aware of the situation and react accordingly by itself [7]. From the definition, it was not stated specifically the importance of location awareness in context but the location can be categorized as one of the information easily obtained from the surrounding object by an application; which is unique to the object itself.

According to Kaasinen, a system is considered context-aware if it utilizes the context to give the required information and service to its user, where its suitability depends on the task of the user [8]. The biggest drawback with context matching is the context itself is hard to identify and measure. As an example, the user location can be approximately determined based on existing positioning system. In this case, location-aware can be regarded as part of the element in context awareness application by definition. In accordance to that, location-aware services can be categorized as context-aware services that use the location of the user to deliver an appropriate service [8]. Location-based service is a service related to the content of the places or the location itself. Adomavicius & Tuzhilin supported this idea by listing down context as the location of the user, identity of the people around the user, surrounding object, change in the elements, date, season, temperature, physical and conceptual state of user, emotion, and any information that can be quantified and relevant to the interaction between user and application [5]. Han *et al.* also agreed to the idea by dividing context into three categories; physical, social and internal. They also named the location as the most important information in context which belongs to the physical group of context [9].

The terminology 'm-commerce' started to gain its popularity when e-commerce company; such as eBay, use mobile platform to attract their prospect consumer and expand its capabilities [10]. According to Georgadis and Athanasios, both m-commerce and e-commerce utilize computer and network access. But they have their own unique quality where e-commerce is mainly about support transaction while m-commerce aims to deliver a better information access to the end user [11]. They classify m-commerce and e-commerce as a different entity. Meanwhile, Ngai and Gunasekaran looks at m-commerce as a subset to e-commerce; referring to "any monetary transaction over mobile network" [12]. Steinfield define m-commerce as narrow and broadly; with narrow being an ability to complete the monetary transaction using wireless network while its broadly definition is an ever growing application set and services which enables user to access the information from any internet-enabled wireless device [2]. Essentially, it combines definition [11] and [12] which is any monetary transaction regardless whether it came from e-commerce or not; as long as it was done using a mobile device.

The same thought was popularized by Andreou *et al.* [3], which classify service and application of m-commerce whether it's a transaction-based; which deals with the service provider or directory-based; which provides information to the user. The information provided can either be a location or content and dependent on the user. It can also be localized and personalized to appeal for specific user. Cousins and Varshney [13] on the other hand, differentiate m-commerce application to user-driven, business-driven or state-driven. User-driven involve services that is initiated by individual user. Usually it's a binding contract between the user and the service provider. An example of user-driven m-commerce is product location, information about price quotation, banking and messaging. Business-driven usually started by business entity to smoothen their business process by integrating mobility with their database. The application was designed based on worker and function needed on the move to ensure the business's success. State-driven m-commerce is made by governments to inform and protect their citizens and achieve operational efficiency. For example, an application to detect the location of the caller once an emergency call is placed is beneficial to the states and user in general.

From these two research group, it is safe to conclude that location data plays a major role in m-commerce and definition from Andreou *et al.* considered the most suitable for this study since it mainly focuses on locating the songket businesses.

For m-commerce, there are many service options such as navigation, searchable directory, and tickets that tracked user location [2]. Another important factor for m-commerce growth is its ability to determine the user's exact current location, enabling endless opportunities of application based on this unique ability [14]. To calculate the location, some method and wireless technologies can be used such as infrared unit, Global Positioning System (GPS) and wireless network [15]. Hybrid technologies also being utilized which combines more than one technology such as Enhanced Observed Time Difference [E-OTD] and Assisted Global Positioning System [A-GPS]; the latter combined GPS and wireless network technologies to determine the location [16].

Some scheme to pinpoint a mobile terminal within the cellular network has been proposed based on GPS or signal timing measurements [13]. Keikhosrokiani *et al.* [17] suggests a framework platform based on combination of GPS (to find location information) and cellular network (to find usable information) for mobile user. The mobile user will request the GPS satellite to calculate their location while sending the information to the server via cellular network (GPRS). The information gathered will then delivered to the mobile user using SMS or MMS via GPRS. A-GPS have a high operating cost since user need to be in line of sight and custom chip needs to be installed at the same time. Despite the drawbacks, A-GPS did not have a 'cold-start'; a common problem with GPS unit when not in

use, and can deliver a precise location faster than their GPS counterpart [18]. According to Steinfield [2], in location based service wireless concept, user location is automatically tracked without user providing it.

Location data information needs to be stored effectively to ease the user and deliver a more precise location. For mobile computing, there are two types of mobile business categorized by how the information is being processed. One variant obtained the required data from remote central server; known as web-enabled database. The other variant save and process the data on the device itself; known as standalone database [17].

Other than how the data is processed, the user interface also plays a major role in m-commerce because human aspect defines the usability and ease of use of the application to effectively deliver the required information.

One of the challenges to design the interface for m-commerce application is the nature of the mobile device itself. Mobile device generally have smaller screen, inferior processing unit (CPU) and limited access to broadband environment compared to their desktop counterpart [19].

Tarasewich [19] states that designing a successful m-commerce user interface is much harder when dealing with context. From his research, Tarasewich has suggested Context Model as a interface design model based on the three main categories of the context; Environment, Participant and Activity. Environment category is concerned with the properties of the objects in the physical environment. Participant category involves the status of the user and other participants in the environment. Personal characteristics such as age, gender, education level are included in this category. Activity category covers consumer activity, the activity of participant and environment activities. Example of an activity is the task of the participant, the goals of participant and events in the environment. This model also takes into account the interaction or relationship that may exist between the Environment, Participant and Activity. Time is also applied in this model, by allowing historical context to be used to predict the future context.

According to Nurul Zakiah Ayob *et al.* [22], several considerations must be addressed when designing mobile systems. The emphasis is to identify user needs when using mobile devices, understand the characteristics of the user, understand the environment, develop a system that meets the needs of user and to test whether the system meets the user satisfaction or not. These researchers developed a guideline that is divided into three phases: Analysis, Design and Testing. Each phase is represented by a different context. In the analysis phase or the Context of Use, the objective to be achieved is to identify the needs of specific user and organization. The second phase is the design phase or Context of Medium, is used as consideration for developers to deliver information on the small screen of a mobile device. Thus, the objective to be achieved in this phase is to produce design solutions that can meet the needs of user and organization. To produce a functional application, developer must meet user needs and ensure their satisfaction while using the application. In the testing phase or context of assessment, evaluation of the interface design must be done so that the application meets user and organization needs.

Adipat and Dongsong [4] introduce an innovative framework which combined four important components; context, information presentation, user and input mechanism. Each of these components is given suitable guidelines to solve interface design problems. The issue of context component is divided into two,

namely the perception of control and user privacy. The issue of control perception occurs when users have to divide their attention while performing multiple tasks simultaneously. Meanwhile, the user privacy issue occurs when users feel annoyed with unwanted information. In user component, designers must ensure that the interface design must be easy for user to use the application. So these researchers have focused on three issues of user which are user cognitive load, user preference and disability. Information presentation component is divided into three techniques; visualization, adaptive interface and multimodal display. Visualization is a technique of information presentation using advanced graphical presentation and is supported by the computer to display data in a meaningful and intelligent way. Adaptive interface is defined as an interface that is dynamically configured based on the user actions. Multimodal display describes how to present the information in various modalities due to the small size of screens in mobile environment. The issues of data entry method component are solved by providing innovative approaches to alleviate data entry problem. Some of the methods are soft keyboards and voice input.

Lee and Benbasat [20] on the other hand develop m-commerce interface based on e-commerce elements and suggested the 7C element; namely context, content, community, customization, communication, connection and commerce. All elements account for mobile setting aspect and mobile device constraints aspect. The issues in mobile setting need to be resolved to support the limited attention of users and it consists of three aspects; spatiality, temporality and contextuality. Mobile constraints are the issues surrounding the mobile devices which include their limitation. Lee and Benbasat finding is suitable for this research since it incorporate all design aspects of m-commerce used in this study such as using location as mobile context, A-GPS as location retrieval technique and standalone database to store data. Georgiadis and Manitsas did use three of the said element (content, context and commerce) for their research [6]. Table 1 shows the detail of the interface design model of m-commerce developed by Lee and Benbasat.

■**3.0 METHOD**

This study is done by comparing the interface design of 15 m-commerce applications based on Lee and Benbasat's m-commerce interface design model. These applications were selected based on the popular features in the mobile tourism such as maps and guides, transportation, point of view information, safety and health, search engines and directories and also reservations [21]. This method was selected to identify the important design elements of location aware m-commerce to display the songket enterprise location. Each of the application is categorized according to their domain. Table 2 shows the domain and the applications. Some application is a mobile version of the e-commerce application and indicated in the table. Then, the applications were tested for their interface suitability using guidelines set by Lee and Benbasat [20]. Each of the 7C elements was evaluated for suitability in mobile settings and mobile constraints. Application that conforms to every interface design elements was ticked as 'yes', tabulated and calculated in percentages. For example, only Truly Asia application have multimedia mix to utilize both visual and audio channels so it was ticked as 'yes' for content element in mobile constraint environment.

Table 1 Elements category, mobile setting and mobile constraints

ELEMENTS	MOBILE SETTINGS	MOBILE CONSTRAINTS
Context How web sites are developed, consisting of functionality and aesthetics	Linking structure that connects pages seamlessly but efficiently	Section breakdown that organizes information in separate pages.
Content Focuses on what a site presents, comprising the offering, appeal, multimedia mix and content type.	The adaptive supply of product information and promotional messages to user's setting.	Multimedia mix to utilize both visual and audio channels.
Community Concerns interaction between users, including interactive and non-interactive communication.	Interactive communication by connecting the people with similar needs.	To accelerate interactive information exchange despite inferior/output devices.
Customization Site's ability to tailor itself (tailoring) or to be tailored by users (personalization).	Tailoring enhanced by information on users' mobile setting.	Filtering unnecessary information, so that a small screen contains only information that is highly useful.
Communication A dialogue between sites and users: broadcast, interactive, and hybrid.	Broadcast messages relevant to a consumer's environment.	Alternative methods for interactive communication that overcome text typing with awkward input devices.
Connection Refers to the extent of formal linkages between sites, consisting of outsourced content, percentage of home site content, and pathways of connection.	Pathways that present web sites relevant to users' changing environment.	To reduce the probability of feeling lost given pathways provided.
Commerce Concerned with interfaces related to sales of good and product services.	Secure payment method demanding minimal cognitive attention.	Condensed checkout process.

Table 2 Domain classifications

DOMAIN	APPLICATION	FEATURE	E-COMMERCE SUBSET
Tourist attraction	Truly Asia Malaysia Maps	Maps and guides Maps and guides	No Yes
Mosque	World Wide Mosque Finder Masjid & Halal Finder	Point of view information Point of view information	No No
Bank and ATM	Banks Finder ATM	Search engines and directories Search engines and directories	No No
Food and Beverage	Coffee Fix Find Food Fast	Search engines and directories Search engines and directories	No No
Health	Hospital Finder Drugstore Finder	Safety and health Safety and health	No No
Accomodation and Facility	Agoda Toilet Finder	Reservations Search engines and directories	Yes No
Transportation	Shell Motorists	Transportation	Yes
Shopping	Ikea Catalogue	Point of view information	Yes
Pet	Pet Finder	Search engines and directories	Yes

■4.0 RESULTS AND ANALYSIS

Figure 1 shows percentage from observation on 15 mobile applications. Elements with over 50% are selected as indications of strong preferences [23]. As per Figure 1, context, content and connection element from mobile settings and mobile constraints, showed a 100% percentage. From context element, every application showed a needed feature to solve the mobile setting and mobile constraints issues which is a smooth flow between pages and efficient section that separate the varying information. In the content element, every application has adaptive information on product information and promotional message towards user environment. In the connection element, all application shows a relevant web to mobile environmental change. Communication element from mobile constraints aspect shows 80% percentage

and proved most of the application provides an alternative means to overcome the awkwardness of key in text into mobile device. Customization element only shows 60% percentage to indicate some application filtered the unnecessary information; leaving the mobile screen with useful information only and less cluttered.

Connection element for mobile constraints (40%), community element for mobile settings (13%), customization element for mobile settings (13%), content element for mobile constraints (7%), communication element for mobile settings (7%), commerce element for both mobile settings and mobile constraints (7%), community element for mobile constraint (0%); all fall below 50% percentages. These results show no application expedite the change of interactive information despite inferior input/output devices. Through commerce element, there is only

one application that offers payment method through minimal cognitive attention and condensed checkout process. Only one application combined audio and visual to deliver the content for mobile constraints. Broadcast message relevant to user's environment only available on one application in communication element for mobile settings. Only two applications offer interactive communication between user with the same needs through community element and tailoring enhanced by information on user's mobile setting through communication element. Not all application suggests a solution from mobile constraints in connection element; which reduce probability of feeling lost given pathways provided.
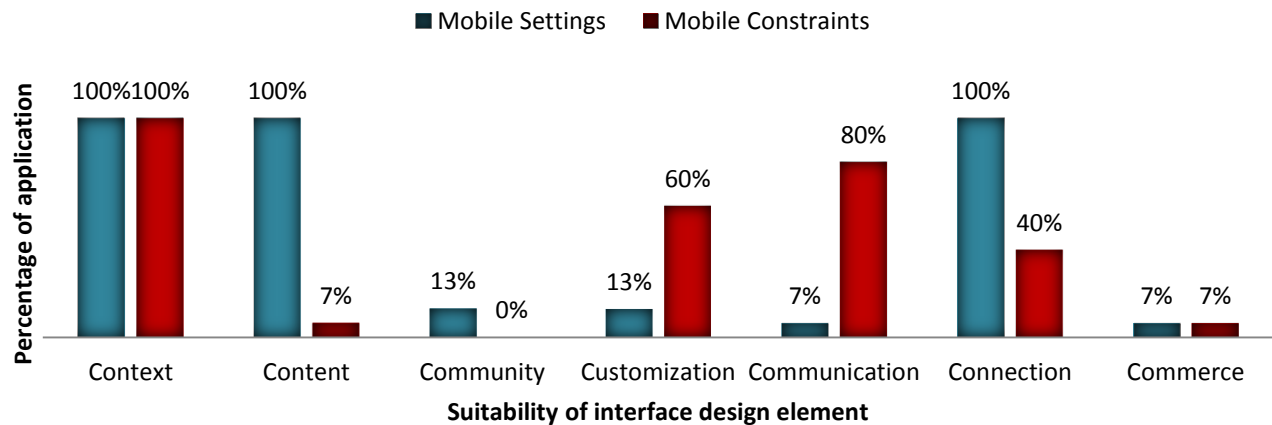

Figure 1 Percentages of m-commerce interface's elements

▪5.0 DISCUSSION

Interface design model for location-aware m-commerce for songket enterprise for this research is develop for the use of prospect buyers, tourists, business owners and songket weavers. The techniques used to retrieve songket sales locations is A-GPS and data is stored in a standalone database. The model was developed by applying design elements of context, customization, connection and communication. Content element found to be irrelevant in this study since adaptive supply of product information and promotional message won't be displayed in the design because it did not present in the scope of study.

Biegel *et al*. [6] stated three set of main components in developing a context-awareness application; set of sensors to capture data context, set of rules to control behavior of the context and set of actuators to generate responses. For this research, a set of sensors used is a A-GPS, which would continue to track the location and coordinates of sales center when requested by the user. Standalone database acts as the behaviour controller as songket sales location address is been stored in the standalone database. It can prevent users to be linked to a location that does not sell songket hence save users' time. Actuator set is the application interface design where users used to connect with the application to identify the locations that they want to retrieve.

To create a free-flow interface for effective information deliverance across multiple sections, a "top-down" interface can

be used as a basis of the context element [22]. Top-down design can also bear the capacity load of the standalone database since not much data or user information need to be stored and user can quickly make navigation decisions. Provide a brief summary with key content can give users better understanding of the application. From the mobile setting for the connection element, pathways to web relevant to user's changing environment can be applied. For instance, user can access the business owners' web page based on website available from the location information.

Communication element from mobile constraints aspects can be assimilated through alternative ways such as navigation button to display another page or multiple choice answers without user inputting any keyword. Customization element shows a need for a filter to allow only important and relevant information so the small mobile screen is not cluttered by irrelevant data. According to Nurul Zakiah *et al.* [22] mobile device itself possess a different challenge from desktop and mobile application designer must consider these challenges to effectively deliver information on a smaller screen. So, if only relevant information is set, it can reduce a standalone database capacity.

Figure 2 shows the conceptual model of design interface. It outlines the importance of accessing information instantly. This model will be translated by a development of location aware m-commerce application which uses songket as its domain.
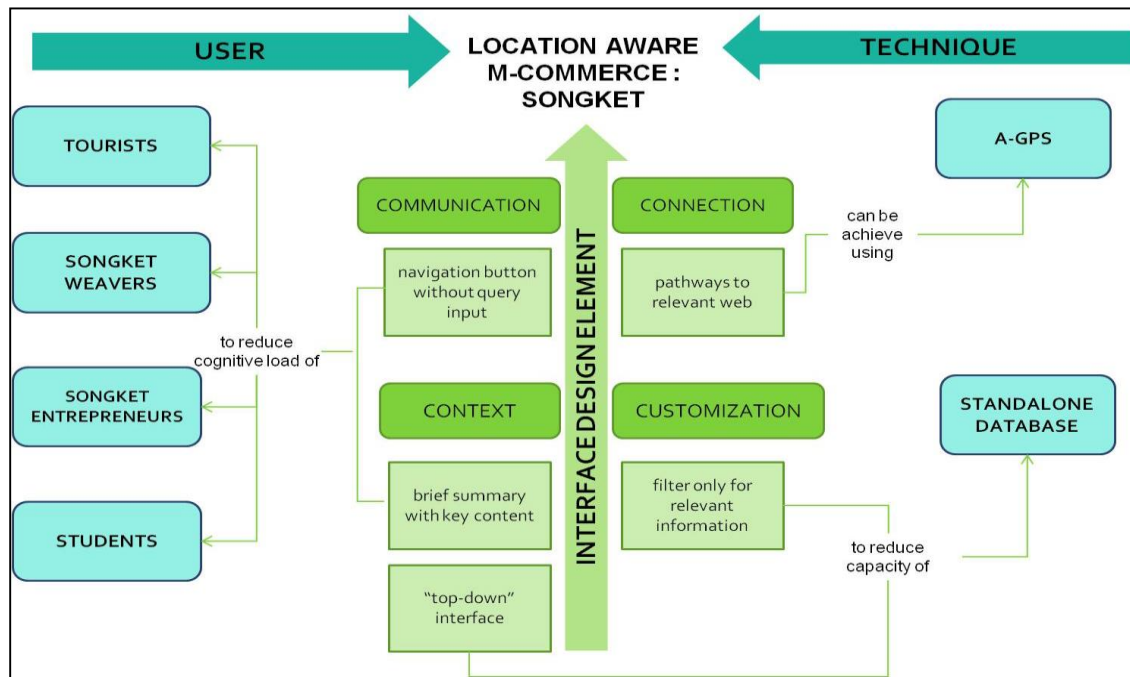
Figure 2 Conceptual design model of location aware m-commerce in songket domain

■6.0 CONCLUSION

This study addresses the user problem of retrieving songket locations through mobile devices. 7C's elements set by Lee and Benbasat is used as a guideline for comparison between applications. Elements to design m-commerce application for location retrieval; context, customization, communication and connection are selected to suit the songket domain. Considering this study is for directory-oriented m-commerce, this model is hoped to be a baseline or reference for future research on different m-commerce category.

Acknowledgement

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