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A Review of a E-Commerce Website Based on Its Usability Elements

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Abstract: With the rapid development of electronic commerce, websites have become a common thing for casual users. Electronic commerce, especially commercial websites have received rapid development in the past decade and cashless shopping online is now a widespread practice among consumers. Although the popularity has increased, there are many e-commerce websites which are not up to users expectations. Most importantly, first-time users can be potential converted consumer and loyal only when they had a friendly experience with the website. This paper will build an e-commerce website, by comparing the languages, structure and database development tools used in establishing a website and prioritize best practice to develop with established usability heuristics.

1. Introduction

With the rise of the internet and its extensive usage, website usability studies have garnered a lot of interest. "Usability" is defined as "the amount of effectiveness, efficiency, and user satisfaction when a given product is utilized to achieve a specified goal by a specific user in a specific usage context," based on ISO9241-11 standard. The usability of a website pertains to how simple it is for a visitor to use it. The outcome of user testing should be able to measure if the goal of the website visitor has been met, its effectiveness and user satisfaction [3]. The effectiveness and usability depend on the structure and language used in implementing the website. The problem is that in past evaluations, the most popular method to evaluate the usability of the website is through questionnaires and interviews. Few frameworks and development languages are used to evaluate the usability of a website. The suggested e-commerce website was build based on the result of research on various development languages and frameworks and most importantly study on the strength and weakness of types of usability study and adapting it into the website.

2. Literature Review

2.1 Technology

The technology section will be mainly based on the discussions about back-end development. The technology chosen will be reviewed and the implementation language, model, and plan will be discussed. Backend will mainly process data from the database to the model and from the model to the database as well as perform functions to return the data from the model to the user interface. PHP Laravel framework, Ruby on Rails, ASP.NET MVC, and any other server-side web development tools included will be reviewed.

2.2 Implementation Language

No single programming language can adapt to all fields (operating systems, hardware drivers, office software, games, web servers, databases, search engines, big data processing, high-frequency trading, machine learning, numerical computing, etc.) at the same time. Therefore, it is particularly important to choose the most suitable programming language according to the application scenario. A perfect programming language can not only improve the maintainability of the code but also save computing resources. Improve the usability of the software. The programming languages and tools used in the system will be further explained below.

2.2.1 PHP

From the past years, the PHP programming language has emerged as the scripting language of choice for most developers; there has been an explosion of new PHP frameworks. These frameworks for PHP development have multiple benefits and are one of the most significant advancements in the design and IT development practices of the last 20 years [2]. In the research of Prokofyeva and [2], because the built-in functions of the framework can complete hundreds of lines of code within a few minutes, the PHP framework can effectively improve programming efficiency. At the same time, users can quickly get answers from PHP's support team. According to the latest research, users of PHP frameworks become long-term users, so they have huge security advantages. When a user finds a problem, just contact the developer to get a good solution[9]. Therefore, the PHP framework can meet most web development requirements, and it is safe and easy to use. When selecting the framework, we considered the risks posed by technical factors and solutions and developed enough dynamics to control the risks. The study of Benmoussa[2], compared the technical adaptability of the selected frameworks. As shown in Table 1.

Table 1. Technical Adaptability Comparison [2].

Technical Adaptability	Laravel	Symfony	Zend Framework	Code Igniter
<i>Modularity</i>				
Modularité	2	2 plugins	2 extensions	2
<i>Derivative works</i>				
Technical ease of modification of the existing code	2	2	1	2
Easy code extension	2 ability to use components, templates and plugins additional	2 possibility to use additional plugins	2 possibility to use extensions	2 possibility to add plugins

The study by Benmoussa[2] also proposed the technical framework standards for the evaluation framework, as shown in Table 2.2.

Table 2. Comparison of the Technical Architecture Benmoussa et al. [2].

	Laravel	Symfony	Zend	Codeigniter
PHP version	5	5	5	4/5
Documentation	2	3	1	2
Community	3	3	3	3
Tutorials	3	3	3	2
Automated unit tests	yes	yes	yes	yes
Rights management	yes	yes	yes	yes
Architecture model	MVC	MVC	MVC	MVC
Integrated ORM	Eloquent	Doctrine or Propel	Doctrine	Doctrine
Template	blade	PHP or smarty	PHP	PHP
Size of tool library	3	3	3	2
AJAX	yes	yes	No	No
code generator	yes	yes	No	No

PHP can support various databases. It is very simple to write web pages that support the database using any extension of the database (such as MySQL). PHP also supports services that use countless protocols, such as IMAP, LDAP, NNTP, SNMP, HTTP, POP3, COM (Windows environment), etc. You can also open the original network port so that any other protocol can be used together.

The advantages of the PHP framework provide good operability, The technical integration framework offers application, data, and communication platforms and tools to run and develop software systems as well as enterprise applications.[10] This makes it easy for technicians to build websites. But with the development of the technological age, The scope of the E-business Interoperability Framework mainly extends over business-to-business (B2B) and cross-business. The research results of Dias show that

B2B buyers have diversified procurement systems, such as those provided by Ariba, Commerce One, and SAP. These procurement systems use a different B2B protocol to interact with the seller's system[6]. Many of these agreements are proprietary and specific to the procurement system.

With the continuous improvement of customer needs of e-commerce websites, the development of the website has to try to meet the scalability needs of customers. Almost all technical teams are committed to enhancing the scalability of the website. Web-based shopping sites must have adequate capacity to support peak loads.[5] Improving the performance and scalability of Web servers can enhance user experience and reduce the cost of providing Web-based services. Hashemian's team believes that "out-of-the-box" Web server configurations can cause the system to scale poorly with increasing core counts.[6], but we have to consider server processing performance under static conditions. Therefore, the method proposed by Hashemian's team to enhance web server scalability by reducing communication between sockets may not be suitable for workloads with dynamic requests. But it turns out that performance scaling on commercial web servers is out of reach. PHP is a popular dynamic programming language for online applications, according to Notification. It offers a number of add-ons that give it a wide variety of capabilities. To achieve high availability and scalability, PHP OCI8 can take advantage of sophisticated Oracle RAC (Oracle's real application cluster) features. PHP builds efficient and reliable extensions of database applications.

2.3 Database Management Tool

A database management tool (DBMS) is software used to store and retrieve user data. The database is an important requirement of the development process. So we must first determine the database development tools. The daily database development tools mainly include the following: SQLite, PostgreSQL, and MySQL. So we compared these data and created a table.

Table 3. Comparison Of The Database Tools.

Features	MySQL	PostgreSQL	SQLite
Server-Side Scripts	Yes	User-defined functions	No
Data Scheme	Yes	Yes	Yes
Replication Methods	Master-master replication Master-slave replication	Master-slave replication	-
Consistency Concepts	Immediate consistency	Immediate consistency	-

Based on the definition and the table above, we can conclude that the most suitable database. The tool is a PostgreSQL database.

2.4 Usability Criteria

2.4.1 Nielsen's Heuristics

Nielsen's Heuristics [14], has been an effective usability heuristic applied across the world because it is easily adaptable, and the outcome of the websites applying them has been such a user friendly and usable websites. Another research by author [1], proposed a usability model for a website based on QUIM (Quality in Use Integrated Measurement) model. It is a model where it combines a variety of model and standards such as ISO 9126 and ISO 9241 and combined into a single consolidated model. It explains how to create quality requirements, as well as how to identify, develop, analyze, and validate product and process quality measurements. The QUIM model has ten components, which are further broken into 26 criteria or measurable criteria, and lastly into 127 different metrics. The 10 factors consist of Effectiveness, Efficiency, Satisfaction, Learnability, Productivity, Safety, Trustfulness Accessibility, Usefulness, and Universality. The approach is intended to evaluate the real use of a functioning website and to pinpoint the issue. The QUIM model clearly and consistently correlates elements with criteria and measurements. This study has adopted the element from the prominent usability criteria defined by Nielsen usability principles.

2.4.2 Conduct Our Own Heuristics Evaluation

We use Nielsen's Heuristics as the basis to conduct our own Heuristics evaluation. Choose evaluators, and briefly describe our website to the evaluator, and then the evaluator will run the website. Evaluators will record the problems they encounter while performing various tasks. We will summarize the problems encountered by the evaluators and propose potential solutions based on these problems.

2.5 Website Guidelines

In order to design a good website, a website designer needs a website design guide. They can follow these guidelines to create a good website. We will follow the following five suggestions to create our website :

- Immediate loading of web pages: No user has the patience to wait for a web page to load. If a website takes a long time to load, it is not a good website.
- Compatibility: Ensure that the website can be used on different systems, such as Android and Mac.
- Online security: to ensure that users' data will not be leaked when they are online, and to protect users' privacy.
- Content management system: You can publish unique and attractive content on the website in order to attract customers.
- Impressive homepage: The homepage of the website should be impressive and attractive. So that users can see the purpose of the website at a glance.

3 Methodology

Different authors have measured usability in various ways. A quantitative approach has been utilized by using the taxonomy of usability evaluation method, 11 models have been researched to find out which usability evaluation model is the best part. The figure shown below would be the 11 evaluation models that will be analyzed and discussed further based on Nielsen principles in this paper.

Models	Usability and Security Attributes Measured
1. E-satisfaction Model Szymanski and Hise (2000)	Innovations, benefit offered, item offered, security, product information, design of website
2. McKnight <i>et al.</i> , (2002)	Trusting behaviour
3. Devaraj <i>et al.</i> , (2002)	User friendliness, functionality
4. McCloskey (2003, 2004)	Ease of use, usefulness, Safety
5. The 'Direct Impact' model, Pikkarainen <i>et al.</i> , (2004)	Perceived security, perceived ease of use, usefulness,
6. Lim <i>et al.</i> , (2005)	Safety, user friendliness, perceived functionality, enjoyment
7. Dwairi and Kamala (2009)	Privacy, satisfaction, propensity to trust, online experience, demographics, security, design, content, risk
8. Green and Pearson (2010)	Download time, interactivity, user-friendliness and functionality, download delay, interface credibility, content, navigability, responsiveness, satisfaction, threat, customers believe, intent to purchase
9. Chong <i>et al.</i> , (2010)	Quality of information, system and service, perceived value, intention to repeat use, satisfaction
10. Safa and Ismai (2013)	System and information quality, usefulness, perceived ease of use
11. Ali <i>et al.</i> , (2018)	Satisfaction, trust, privacy, system and service quality.

Figure.1. Taxonomy of usability evaluation model bt Mohd & Zaaba, [3].

This quantitative approach was chosen because this method of taxonomy allows the mapping of the strengths and flaws of each model. Each of the elements that each model measures have been defined after a comprehensive investigation and analysis of the available literature. Based on each measure provided by Nielsen, each element is matched to a usability dimension.[3]

4. Results and Findings

The figure 2 presents a review of each model whether the models can fulfill all of the dimensions of usability following the Nielsen principle of usability. While all of the models are not able to fulfill all of the dimensions of usability, It can be seen from the figure shown above, most models only have the learnability and satisfaction measured properly beforehand. Chong et al evaluated the most usability elements while McKnight et.al only has one usability element measured properly following the Nielsen principle of usability. Meanwhile, the others have either two or three elements of usability listed properly. Following these researches, this paper has proposed a flowchart of the e-commerce website system.

4.1 Results

Model	Usability Attributes Measured				
	Learnability	Efficiency	Memorability	Error	Satisfaction
Szymanski and Hise [27]	✓				✓
McKnight et al. [28]					✓
Devaraj et al. [29]	✓	✓			✓
McCloskey [30]	✓	✓			✓
Safa and Ismail [31]	✓	✓			
Lim et al. [32]	✓				✓
Al-Dwairi and Kamala [33]	✓				✓
Green and Pearson [34]	✓			✓	✓
Pikkarainen et al. [35], and Dillon and Reif [36]	✓	✓			
Chong et al. [37]	✓	✓	✓		✓
Ali and Raza [38]	✓	✓	✓		

Figure.2. Strength And Weakness Of Existing Usability Model Bt Mohd & Zaaba, [3].

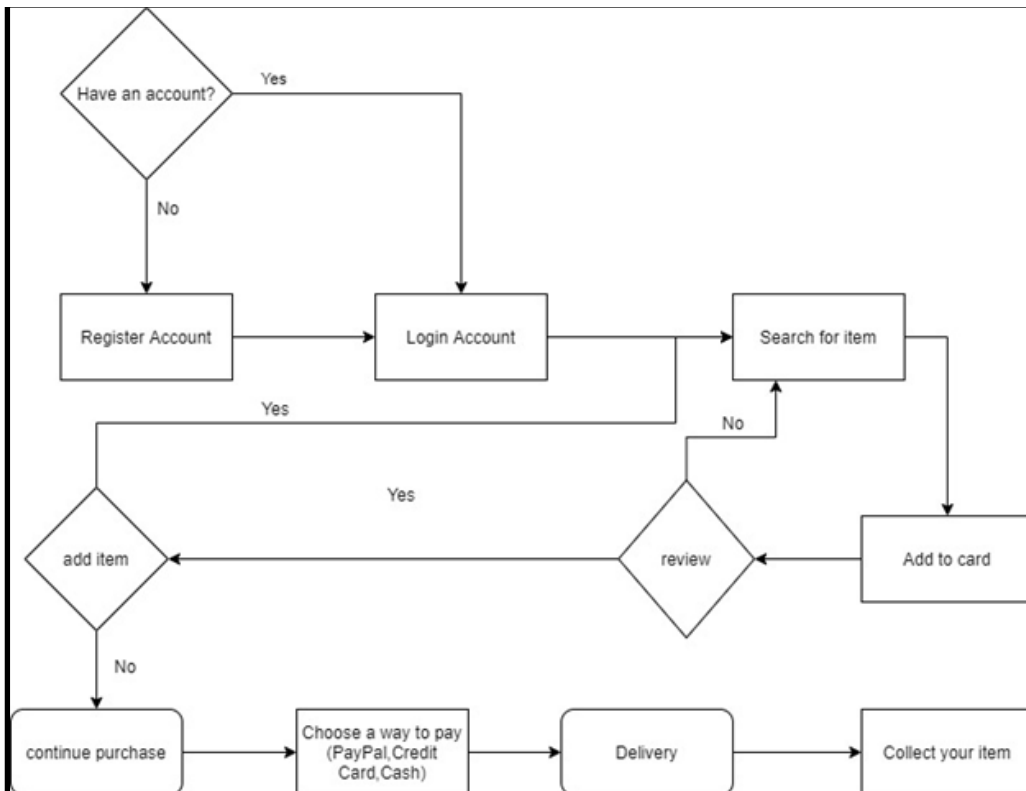


Figure.3. Flowchart Of The Proposed System

For new users, the user must register an account to be able to log in to the website. Once the user logged into the account, the user can access the website, searching for items in the website that the users want to buy. If a user wishes to buy it, the user can add the item to the cart and review the item in the cart. Should the user change his/her mind, the user can drop the item from the cart. Then, the user can continue the purchase and choose the payment way. After the payment, the item will be delivered via delivery and the user can collect his/her item.

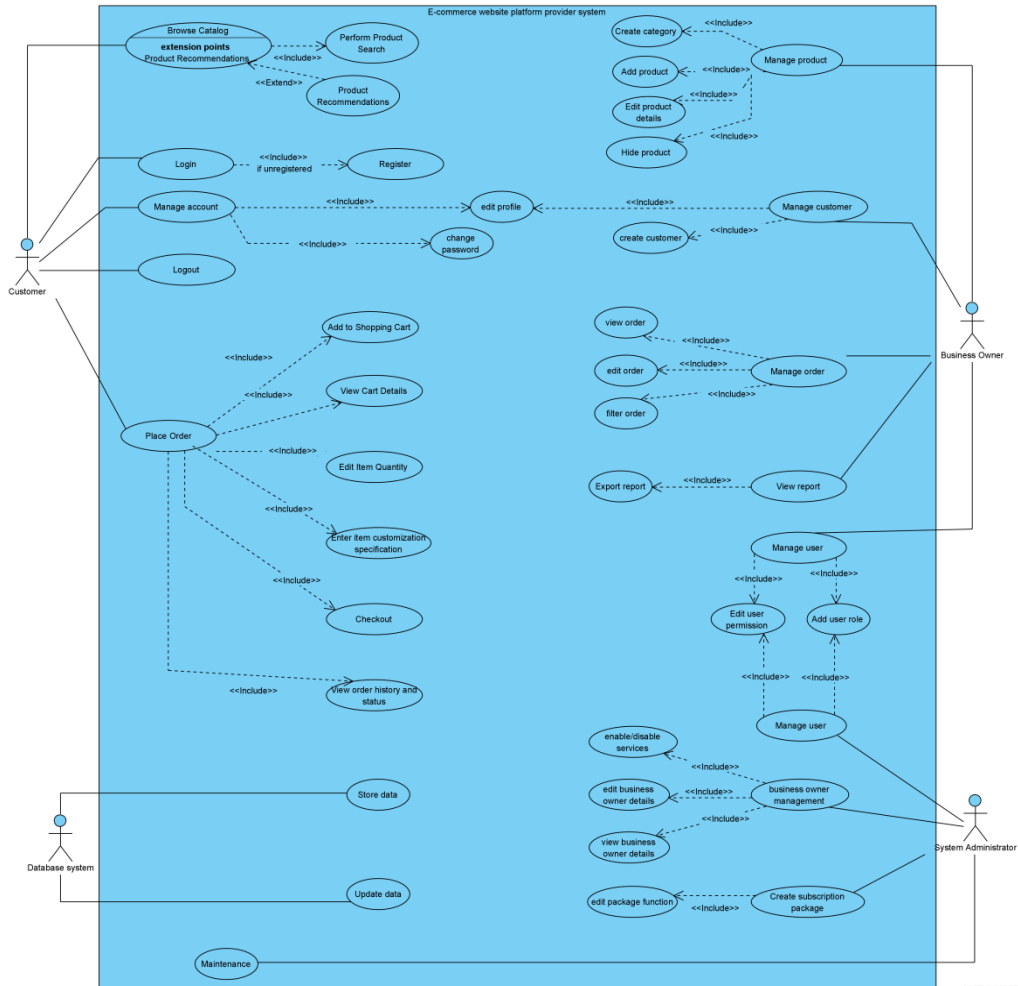


Figure.4. Use Case Diagram Of The Proposed System

The figure above would be the use case diagram of the proposed system where the diagram describes how the e-commerce website system functions. The figure below would be the result of our e-commerce website system by applying the usability element to the website. 10 Nielsen heuristics design principles are applied to the system.

4.2 Evaluation

Evaluating the website based on the 10 Nielsen Heuristics principle design, the 10 principles design has been embedded into the e-commerce website system.

4.2.1 Visibility Of System Status

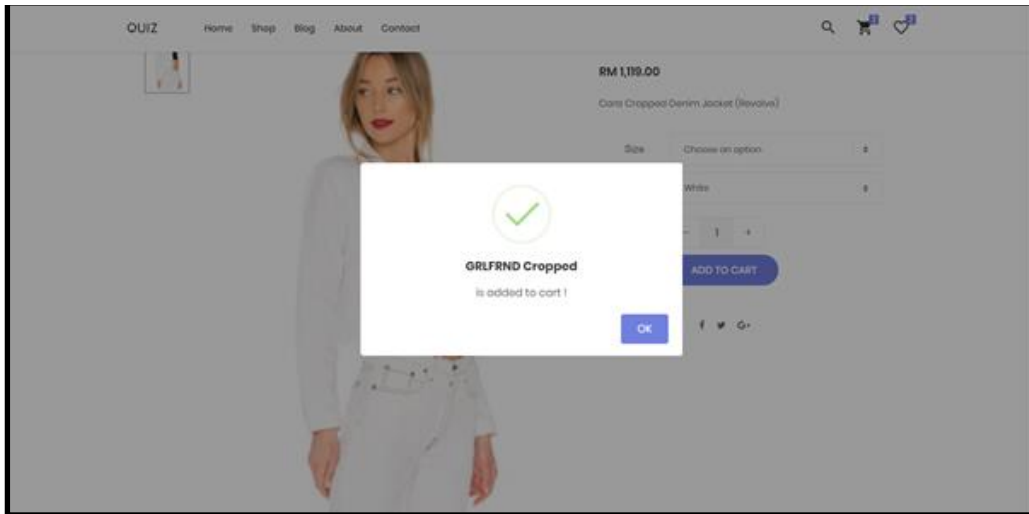


Figure.5. Item Added Into The Cart

The e-commerce website system must be able to show a visible status of each action that has been taken by a user. The figure above shows a pop-up that the item that the user added has been successfully been added into the cart.

4.2.2 Match Between System And The Real World

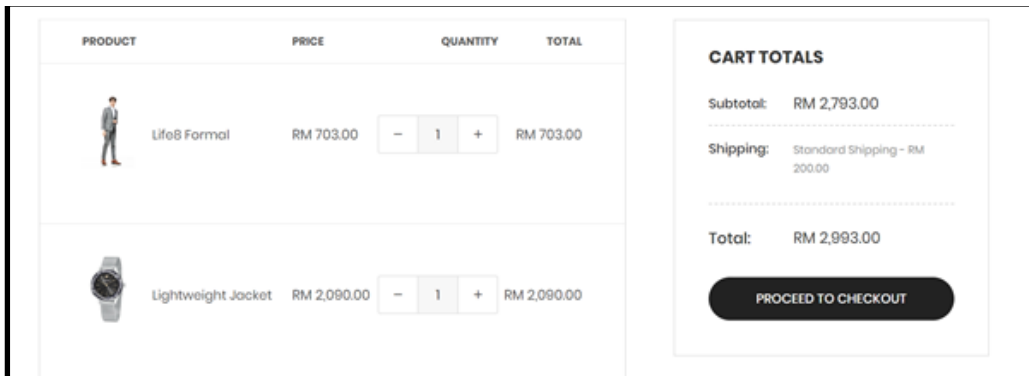
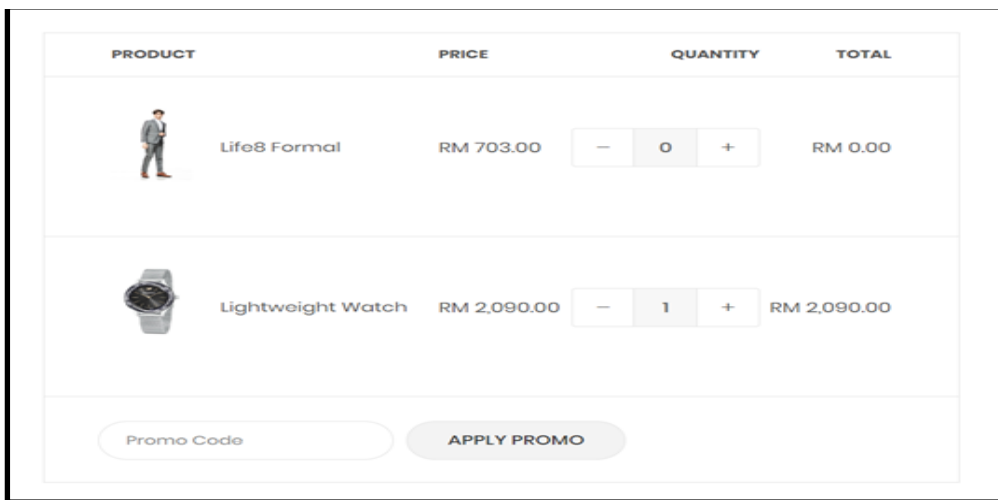




Figure.6. E-commerce website system cart feature

The e-commerce website system design should be able to speak the user language where the system should use concepts or words familiar to the user rather than jargon or confusing words that the user may have never heard before. The figure above shows that instead of using the 'checkout' word which is a system-term oriented for the checkout button, the system use 'proceed to checkout' to make the system look more familiar to the user.

4.2.3 User Control And Freedom



PRODUCT	PRICE	QUANTITY	TOTAL
 Life8 Formal	RM 703.00	- 0 +	RM 0.00
 Lightweight Watch	RM 2,090.00	- 1 +	RM 2,090.00

Promo Code

Figure.7. List Of Products That Have Been Added Into The Cart Tab

The e-commerce website system design should be able to give users control and freedom over the system. The figure above showing the shopping cart tab where the user can easily remove or add a quantity of an item, should the user wishes to do so.

4.2.4 Consistency and Standard

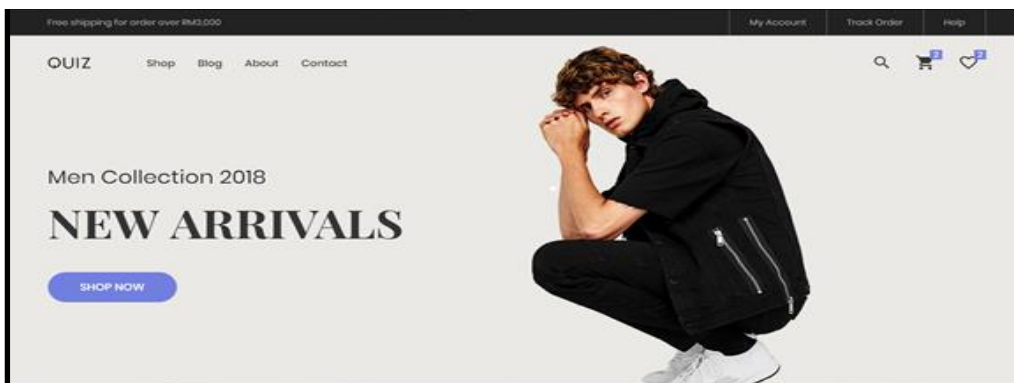
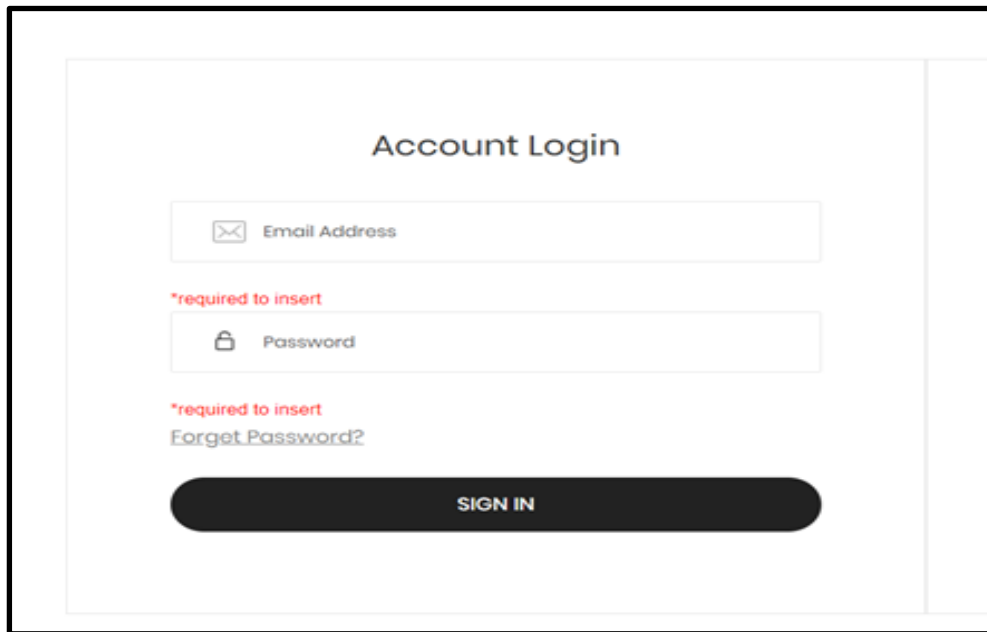


Figure.8. E-Commerce Website System Homepage

Users should not have to think and wonder whether different words, icons, or actions mean the same thing. Failing to maintain consistency could force users to learn something new which some users would not prefer. The figure above shows that the home page has a similar page compared to other similar e-commerce systems from its section position, cart icons, search icons, and wishlist icons. Furthermore, the navbar will be always on the top with the 'my account' and 'help' buttons on the top right side of the webpage. It is on the place where users expect these buttons are located.

4.2.5 Help Users Recognize, Diagnose And Recover From Errors



The image shows a web form titled "Account Login". It contains two input fields: "Email Address" with an envelope icon and "Password" with a lock icon. Below each field is a red error message: "*required to insert". Below the password field is a link "Forget Password?". At the bottom of the form is a black button with the text "SIGN IN".

Figure.9. Account Login Page

The system should be able to help users recognize, diagnose and recover from errors by themselves. The figure above shows that text prompt if a user forget to insert the details for account login which is (*required to insert). It helps users recover from errors easily without any consequences occur to the user.

4.2.6 Error Prevention

Error messages are necessary, but a good e-commerce website system should be able to prevent a user from making mistakes first. The figure above shows that there's error prevention for users on account login by saying that there are details that are required for users to input. The system also makes it recognizable by making the font color red. Thus, this prevents errors from being made.

4.2.7 Recognition Rather Than Recall

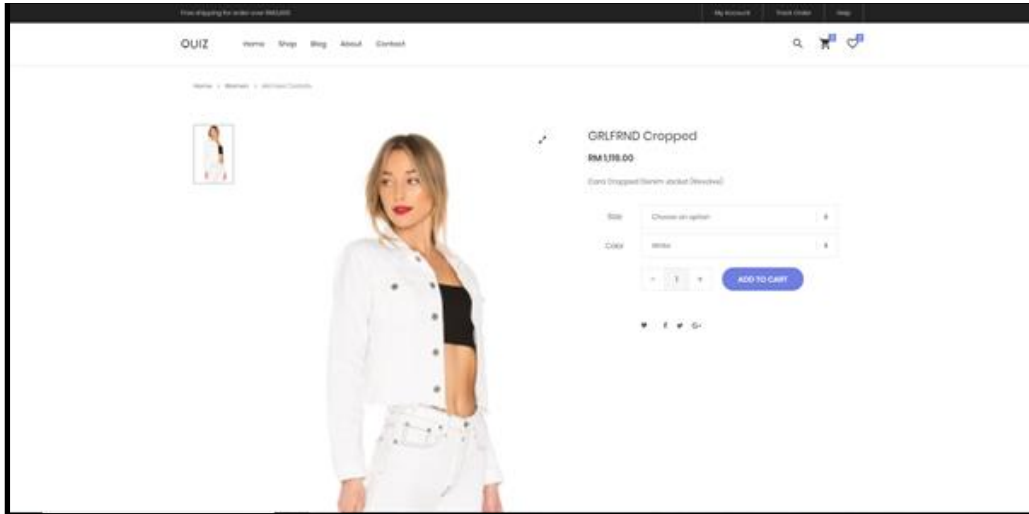


Figure.10. Item Details Page

The system should be able to lessen the user memory load burden by making actions, options, and elements visible. Users should not have to remember the user interface part by part. Information needed to use the system should be easily fetched when necessary. From the figure shown above, a user can instantly recognize where to choose size, color, quantity, and especially the 'add to cart' button options. The distraction are reduced.

4.2.8 Flexibility and Efficiency Of Use

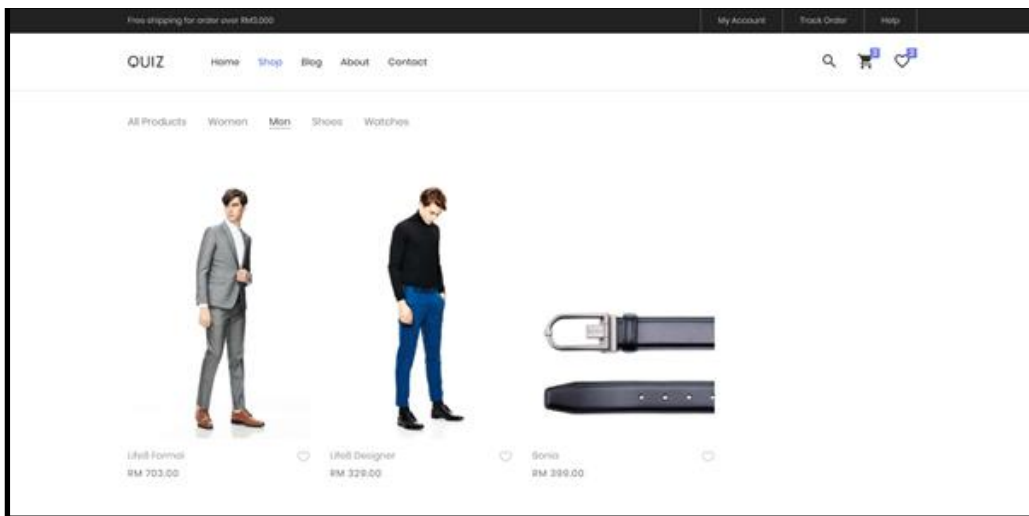


Figure.11. Product Section Of The E-Commerce Website System

A system shortcut, hidden from inexperienced users, should be made available for an experienced user to speed up interactions between a system and a user. By doing it this way, the website system can cater to both novice and expert users. The figure 11, advanced users can choose over other categories such as men instead of looking for all products in the 'all products' categories for novice users. Thus, it makes advanced users carry out tasks faster.

4.2.9 Aesthetic and Minimalistic Design

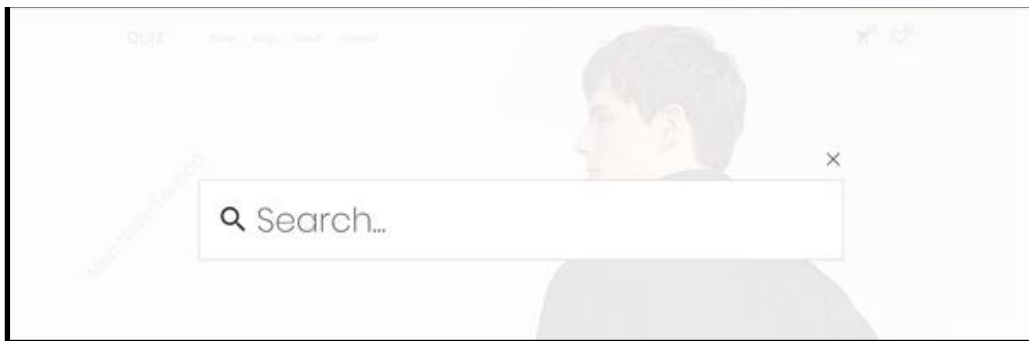


Figure.12.Search Feature Tab

The system interface should be able to keep only relevant information. It should not contain any unnecessary information on the interface. The figure shown above shows when the user clicks on the search icon located on the right side of the navbar, it will pop up only the search option and cover the whole page which makes the minimalistic yet aesthetic design for the user. No other element needed for this feature may be wasteful.

4.2.10 Help and documentation

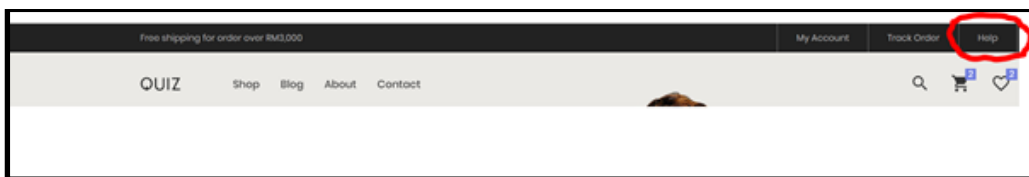


Figure.13. User Help Page Of The E-Commerce Website System

The best system should not need any additional information about the website. However, it may be important to prepare documentation to help users on how to do things on the website. The figure shown above shows that there is a dedicated help tab in the right top corner of the webpage to help users if they need help on a specific problem.

5. Discussion

Neilsen's Heuristics can be used by non-usability experts but it proves to be a successful approach for this many years since its establishment in 1990. By taking this approach, there is some e-commerce website usability goals that may be mission. It is clear that there has been a lack of one comprehensive model that can analyze all elements of usability of an e-commerce website.

The existing models do not accomplish this goal as the existing models only evaluate all usability elements rather than specific usability elements in an e-commerce website. Thus, there's a gap that can be researched further on by developing a comprehensive model that can satisfy this goal which is to be able to detect all usability elements of an e-commerce website. In the future, there can also be compare and contrast of more established website which are classified as e-commerce based on usability heuristics.

6. Conclusion

With the continuous innovation of science and technology, website construction technology and system functions are constantly improving. Many e-commerce websites have appeared in recent years. Provide customers with Internet advantages in information dissemination and product promotion. This article attempts to improve the usability of the website from two aspects: structural optimization and web page response time. The technical methods provided in this article will help greatly improve the usability of e-commerce websites. The findings of this article help to raise people's awareness of the usability of the website.

7. Limitations and Suggestion for Future Research

This article only attempts to improve the usability of e-commerce networks from the aspects of technical architecture and optimization of web page response time, which has great limitations. It is recommended to consider the system architecture design from the aspects of the business split, application cluster, multi-layer cache, single sign-on, database cluster, server, message queue, etc., and then carry out the most reasonable system architecture design. Future research can start from two aspects of data service and application service, adjust the architecture design of the website to improve the usability of the website.

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