# PERCEIVED AFFORDANCES FROM ICON SYMBOLS

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**Abstract**- When designing an icon symbol the right clue or signal is the success factor for a user to perceive the icon symbol correctly according to its function. This research studied the main problem related to icons that are difficult to perceive by users according to their functions or purposes. The objective of this research was to measure users' perception of existing and established icons that are available worldwide. The sample for this study involved 38 postgraduate students from University Utara Malaysia. The research studied four main icon symbols that are available on the Ministry of Human Resources' portal including home icon, about us icon, enquiries icon, and resources icon. To further explain the affordance of the icon theoretically, the researcher used the semiotic engineering approach to study the icons and used the quantitative research method to analyze users' perceptions of the icon symbols. The study identified the right icons that represent their functions accordingly by using the theory of semiotic approach and improve users' perceptions of the icon symbols according to their functionality.

**Index Terms**- Semiotics Engineering, Interaction Design, Usable Design, HCI, Perceived Affordances.

## I. INTRODUCTION

Affordances can be defined as a signal or a clue from the object or in specific icons that can be perceived by users [1]. The concept of affordances was originally proposed by James Gibson in 1977 and 1979 from ecological psychology that suggested any possible action provided to the actor based on the environment. Then it was followed by Norman in 1988 who suggested that affordances lead to design advantage [1].

Based on William Gaver, affordances are divided into three categories including false affordance, hidden affordance, and perceptible affordance [2]. False affordance means not having a real function and in terms of the icon symbol, the icon may be used for a wrong functionality [2]. Hidden affordance means there are possible functions but users are not able to perceive them, while perceptible affordance means users are able to perceive the affordances according to their functionality [2].
Perceive or perception could be defined as a development process to represent things in a real world which users can imagine and identify its action [3].

Icon refers to a pictogram display that represents a specific function [4]. For example, the "No Entry" icon. By looking at this icon users will understand the message of the icon. According to Saussure, symbols consist of objects or concepts that represent an idea, a visual image, a belief, an action, or material entity [4]. A red octagon is the best example to represent the symbol. By looking at this red octagon we can perceive it as a sign for stop [4].
Interaction design refers to any communication that happens between users and computers in all aspects or this term refers to the design based on user experience. To relate with the design of icon symbols many considerations are needed to be understood by the users and their environment in order to design an affordance icon symbol. So this niche explains interaction design in human computer interaction (HCI) [5,6,7].

Human computer interaction, in theoretical terms is the approach that is developed by using the *cognitive perspective ethnomethodology, anthropology, and sociology* [4]. Cognitive perspective refers to human behavior. Ethno methodology is understanding peoples' daily activities. Anthropology refers to the study of humanity in terms of human development, and sociology refers to the study of human social behavior [4]. It means the designers need to fully understand the real user in order to design quality, interactive affordance icon symbols, plus this strong perspective really helps the users in positive perception when they use certain applications or websites [4].

This paper was to study if users manage to perceive the affordances based on the icon symbols because the major problem is not all icons are perceived according to their functions or purposes. This study focused on four icons that are available on the websites of the *Ministry of Human Resources* which include home icon, about us icon, enquiries icon, and resources icon [8]. The scope of this research study was limited to postgraduate students from University Utara Malaysia and the total number of respondents was 38. This study focused on postgraduate students because based on their knowledge and experience, by right, they should be able to perceive correctly the icon symbols according to their functions. In addition, the researcher used the semiotic theory to prove that some

of the icons were designed and used for wrong functions.

At the end of this study the researcher l was able to prove that some of the icons from the Ministry of Human Resources' portal were difficult to be perceived by the respondents. This was based on the data collected from the questionnaire survey. After that by using the semiotic theory the researcher l was able to prove the affordance icon could replace the existing icon used by the Ministry of Human Resources. In addition, by using the semiotic theory, the researcher l proved the factor that led to the false affordance icon. In a nutshell, the researcher claimed that it is important to design the icon symbols with the principle of affordances in order to make sure all the icon symbol designs on the user interface are easy to be used and understood by users and finally users can complete their tasks without any issue.

Based on the definition of perceived affordances of the icon symbols that has been defined previously, the researcher found that the semiotic engineering approach has connectivity with the HCI and the researcher strongly believed that by continuing research using this approach it would be able to define the result for the research question.

## II. ICON DESIGN AND HUMAN PERCEPTION

Semiotic can be defined as the learning of signs or symbols and their meaningful interactions [10,11]. According to the *Encyclopedia of Semiotic*, the sign or symbol can be interpreted in various perspectives. Based on the founder of semiotic, Ferdinand de Saussure's definition sign can be referred to as a *correlation of differences* and Charles Sanders Peirce states that the features of a sign depend on their capacity *to determine additional signs* [10,11]. The signs themselves have their respective definitions, Informally, signs easily exist based on the word that we usually use daily but in a formal way it is difficult to create a meaningful sign which satisfies and is easy to be understood by people [10,11]. According to the Peirce triadic model of the sign, the represent a men stands for somebody or something in some respects or capacity. It addresses somebody and creates in the mind of that person an equivalent, or perhaps a more developed sign [10,11]. The object is the actual thing the sign stands for [10,11].

A past study by Familiant and Detweiler in 1993 on *"Evolving perspectives and organizing framework"*, is about differentiating the relationship of the sign. They also did a research to study the *referent relationship* and finally compared it to the *referent relationship* and the *sign* [9]. In addition, Blakenberger and Hahn in their experiment in 1991 found that icon design would provide effects; so if the icon design is good, then it would provide a good effect and vice versa [10].

Barr, Biddle and Noble in 2000 posited that icon design may lead to success if the interpretant of the users match with the object that represents the right function or it may be unsuccessful [12].

In this study, the researcher focused on the perceived affordances test. The researcher distributed questionnaires to the respondents and they needed to perceive whether the icon symbols matched their functions. The International Organization for Standardization or ISO 9186, which refers to the graphical symbol test method, stated 66% as a level to determine the icon is affordance [13].

There was a case study of a hamburger icon being identified. That hamburger icon was confusing because the design of the hamburger icon was almost similar but every part of the icon represented a different meaning or function which made it difficult for people to perceive the affordances of the icon [14]. Figure 2.1 which show two hamburger icons. The author asked the reader, to observe the icons below to perceive the affordances.




**Figure 2.1: Hamburger Icon Test [14].**

The first icon was used in the Motorola hardware menu. The second icon was used in the Microsoft Office product for bullets and this icon was almost similar to the Apple Operating System that represents a notification icon [14].

In order to avoid the confusion in icon design, it is recommended to apply the theory of semiotic principle. First do not make a complex icon design. Second the icon that we design should be able to represent the *"thing"* and its functionality correctly, and third the icon design must be supported by good labeling or in the other words, a good design of an icon is "intuitive" [10,11].

## III. PERCEIVED AFFORDANCES TEST

Gibson's perspective of affordances explains that, firstly, action possibilities in the environment are in relationship to the action capabilities of an actor [1]. Secondly it is independent of the actor's experience, knowledge, culture, or ability to perceive, while finally

the existence is binary - an affordance exists or it does not exist [1].

Meanwhile, Norman's perspective of affordances, explains firstly that perceived properties may not actually exist [1]. Secondly, it suggests or provides clues as to how to use the properties [1]. Thirdly, it can be dependent on the experience, knowledge, or culture of the actor [1]. Finally it can make an action difficult or easy [1].

### 3.1. Aim

The method used was the questionnaire survey. The sample was limited to 38 postgraduate students from University Utara Malaysia. The aim of this questionnaire was to measure the respondents' perceptions of the existing icons available on the Ministry of Human Resources' portal and the established icons that are available worldwide. Figure 3.2 shows the existing four icons from the portal. The questionnaire was prepared to test the respondents, perceived affordances of the icon symbols. The data from the questionnaire was compared with the benchmark standard from ISO 9186 [13].

### 3.2. Quantitative Research Methodology

The specific method that was used for this analysis was a *"questionnaire survey"*. A *Google form* was the platform that e this study used to prepare the questionnaire [15].




**Figure 3.2: Ministry of Human Resources portal icon symbols [8].**

The researcher prepared two sets of questionnaires. In the first questionnaire the researcher focused on the icon perceived affordances test for the existing icons used in the Ministry of Human Resources' portal. The data from the first questionnaire was checked with the benchmark standard of ISO 9186. Then, by using the semiotic theory the researcher chose the best icon from the established icons that are available worldwide that represent the right function. Right after that the second questionnaire was distributed to the same respondents and this time it focused on the icon perceived affordances test to prove it was easy for the respondents to perceive accordingly by applying the right icon for the right purpose according to the semiotic approach.

### 3.3. Expected Result

The researcher expected the final result of the icon perceived affordances test using the questionnaire survey to overcome the problem statement.

## IV. RESULT

**Table 4.1: Perceived Affordances Test Results of Icons Used in Ministry Of Human Resources Portal.**

| PERCEIVED AFFORDANCES TEST RESULTS OF ICONS USED IN MINISTRY OF HUMAN RESOURCE PORTAL | | | | | |
|---|---|---|---|---|---|
| Ministry Of Human Resource Icon | | Perceived By User | | | |
| | Home | Home Icon | | | University Icon |
| | Respondents | 37 (97.4%) | | | 1 (2.6%) |
| | About Us | Favourite Icon | | | Notification Icon |
| | Respondents | 36 (94.7%) | | | 2 (5.3%) |
| | Enquiries | Chat Icon | | | Enquiries Icon |
| | Respondents | 31 (81.6%) | | | 7 (18.4%) |
| | Resources | Upload Icon | Maximize Icon | Download Icon | Open New Tab Icon |
| | Respondents | 32 (84.2%) | 1 (2.6%) | 4 (10.5%) | 1 (2.6%) |

The questionnaire survey, based on the icon perceived affordances test was distributed to 38 respondents 55.3 percent or 21 respondents were male and 44.7 percent or 17 respondents were female. According to the respondents' ages, 6 respondents were 25 years old, followed by 5 respondents who were 33 years old and 5 respondents were 40 years old while the other respondents were in the lower age range.

78.9 percent or 30 respondents were Malays 13.2 percent or 5 respondents were from *Suluk, Tanzania, and Iraq* Indians made up5.3 percent or 2 respondents, and Chinese formed 2.6 percent or 1 respondent.

Table 4.1 shows the overall perception of all the 38 respondents of the existing icon symbols.. As mentioned before this study focused on four icon symbols which were *home icon, about us icon, enquiries icon, and resources icon* as shown in Figure 3.2.

For the home icon category, 37 respondents or 97.4 percent perceived correctly the icon symbols according to their functions and only 1 respondent or 2.6 percent perceived the university icon. This means the existing home icon is affordance because it exceeded the benchmark standard of ISO 9186.

Regarding the second icon, the us icon category, 36 respondents or 94.7 percent perceived this second icon symbol as the favorite icon and 2 respondents or 5.3 percent perceived it as the notification icon. Overall, all respondents provided wrong perceptions which

were not the same as the existing icon symbols that represented the us icon. So this second icon symbol was not affordance, plus the result was below the benchmark standard of ISO 9186.

For the third icon category, which was the enquiries icon symbol,. 31 respondents or 81.6 percent perceived it as the chat icon and only 7 respondents or 18.4 percent perceived it as the enquiries icon. This means that the existing enquiries icon design is not affordance because the majority of the respondent provided wrong perceptions and did not meet the requirement of ISO 9186.

The fourth icon category was the resources icon. 32 respondents or 84.2 percent perceived it as the upload icon and 4 respondents or 10.5 percent perceived it as the download icon. While 1 respondent or 2.6 percent perceived it as the maximize icon, the other 1 respondent or 2.6 percent perceived it as the open new tab icon. It means that the entire group of respondents provided a wrong perception and this fourth icon proved not affordance. In addition the result did not meet the standard of ISO 9186.

Overall, as for the four existing icons which are available on the Ministry of Human Resources' portal, only the home icon is affordance because the majority of the respondents provided correct perceptions but the other three icons are not affordance because most of the respondents did not perceive correctly the icons that represented their functions and the result for these three icons were below the benchmark standard of ISO 9186. In the discussion section, the researcher will discuss why the three existing icons are not affordance according to the semiotic engineering approach and by using the same approach the researcher will identify the best or affordance icons to replace the existing icons. The second set of questionnaires would then be distributed to the same respondents to execute again the icon perceived affordances test in order to prove that applying the semiotic approach helps users generally, or respondents specifically, to perceive correctly the icons according to their purposes.

## V. DISCUSSION

According to Charles Sanders Peirce, the semiotic approach explains that the star icon is not affordance to represent the about us function [10,11]. The best symbol to represent the star is to bookmark it as a favorite item such as bookmark webpages, It is because "start" represents something special which promotes the idiomatic meaning [10,11]. So it is not effective to represent the about us icon.

The next icon is the enquiries icon. Referring to Charles Sanders Peirce, based on their semiotic approach, the chat symbols are not accurate to represent the enquiries purpose [10,11].

The last icon is the resources icon. Based on Charles Sanders Peirce the sign that is used for this icon does not totally represent the resources action but it is more likely to expand the screen or represent the upload or download functions [10,11].

The researcher will apply the diagram of the Peircean Triad to to the about us, enquiries, and resources icons. What the researcher is trying to achieve from this diagram is to define the meaning and how to convey each meaning. The Pierce, Triadic view is composed of the object, the representamen, and the interpretant [10,11]. The object means the actual thing that will be represented, the representamen refers to what does the representing, and the interpretant defines the result of an interpreter's encounter with a sign.

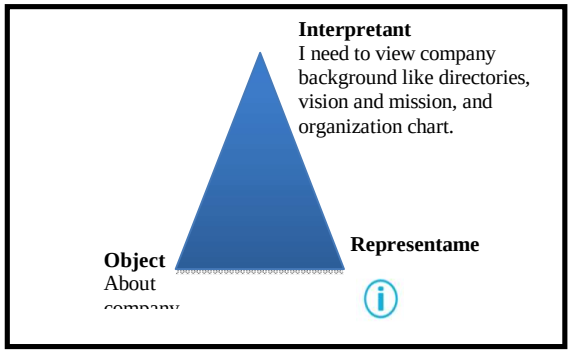


**Figure 5.1: A diagram of the Peircean Triad as applied to "About Us" Icon.**

The best representamen for about us icon is "i" icon because it refers to information in a real world. The action means user can get various information.

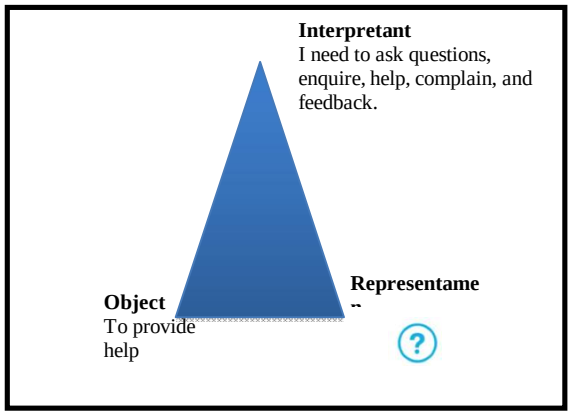


**Figure 5.2: A diagram of the Peircean Triad as applied to "Enquiries" Icon.**

The best representamen for the enquiries icon is "?" or question mark which represents any question, any help, or any guidance. So by looking at this sign the user will be able to perceive that this sign represents enquiries.

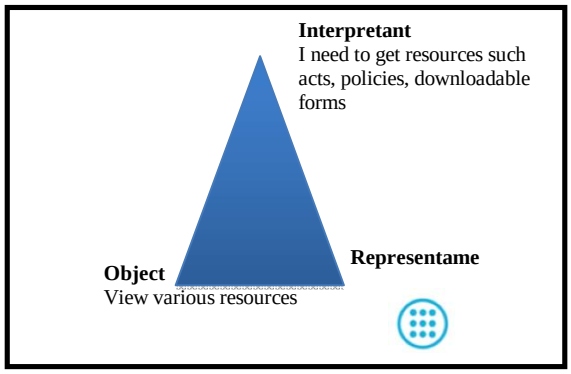


**Figure 5.3: A diagram of the Peircean Triad as applied to "Resources" Icon.**

Figure 5.3 shows the best representament for the resources icon. The sign represents various resources or applications that can be retrieved by users.

According to the researcher's wide observation and investigation of various icons, the best icons that the best represent the functions that can replace the existing icons can be retrieved from the *Icon Archive* portal [16].




**Figure 5.4: Selected set of established icons worldwide [16].**

The research was continued with the researcher designing a prototype for the Ministry of Human Resources' portal by using the UX-App tools. Right after that the researcher prepared the second set of questionnaires and distributed them to the same respondents who had participated in the first survey [17]. The reason for the second survey was to prove that by studying the icons and applying the theory of semiotic approach, the respondents should be able to perceive the affordances of the icon symbols according to their functions and all the four icons would be able to meet and exceed the benchmark standard of ISO 9186. Figure 5.5 below shows the set of icons used in the prototype design for the Ministry of Human Resources' portal.




**Figure 5.5:** The prototype icon symbols [17].

**Table 5.1: Perceived Affordances Test Results of Established Icons Available Worldwide.**

| PERCEIVED AFFORDANCES TEST RESULTS OF ESTABLISHED ICONS AVAILABLE WORLDWIDE | | | |
|---|---|---|---|
| Ministry Of Human Resource | | Perceived By User | |
| Icon | | | |
| | Home | Home Icon | |
| | Respondents | 38 (100%) | |
| | About Us | About Us Icon | Information Icon |
| | Respondents | 36 (94.7%) | 2 (5.3%) |
| | Enquiries | Help Icon | Enquiries Icon |
| | Respondents | 3 (7.9%) | 35 (92.1%) |
| | Resources | Resources Icon | Application Icon |
| | Respondents | 36 (94.7%) | 2 (5.3%) |

According to the second survey results that are shown in Table 5.1, 38 respondents or 100 percent perceived correctly the home icon 36 respondents or 94.7 percent perceived correctly the about us icon but still 2 respondents or 5.3 percent perceived it wrongly as the information icon. The result for the enquiries icon was 35 respondents or 92.1 percent perceived it correctly while 3 respondents or 7.9 percent perceived it as the help icon. Finally, for the resources icon, the result showed that 36 respondents or 94.7 percent perceived it correctly as the resources icon, while 2 respondents or 5.3 percent perceived it as the application icon. Overall, the results for the four worldwide established icons proved that the respondents' perception now had improved where the majority of the respondents were able to perceive all the affordances from the icon symbols. In addition all the perception results for the four icons had achieved the benchmark standard of ISO 9186.

Now the researcher wants the readers to realize and be able to compare the perceived icons that they saw before applying the semiotic theory and after applying the semiotic theory. It is proved that with a proper icon design which follows all the principles, approaches, and rules will help users to perceive the icon symbols according to their purposes. The main factor that leads the respondents to perceive the icons as false affordances is a wrong signal or clue designed for specific icon symbols. It means that the icon symbol is not correctly representing its functionality. For example the star sign is not appropriate to represent the us icon.

## VI. FINAL REMARK

This research has been explained using the semiotic engineering approach to further study why the existing icons symbols were not affordance, and using

the same theory the researcher continued the research to finally find the most suitable icons from the icons available worldwide to replace and represent correctly their functions. A study of past research also helped the researcher a lot in this paper. In addition the quantitative research method helped the researcher to analyze the existing and established icons that are available worldwide and the researcher was able to compare the results of the tests on the existing icons and the established icon symbols. The results of the first survey on the icons showed perceived affordances. The test showed that three out of four icon symbols of the existing icons did not achieve the benchmark standard of ISO 9186 while the second survey results f of the icons showed perceived affordances. The test on selected icon symbols established worldwide proved that the percentage of respondents' perception improved a lot and exceeded the benchmark standard of ISO 9186.

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