

The Characteristics and Application of Anthropomorphic Interface: A Design Spectrum

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Abstract— This study discusses several designs of anthropomorphic computing to obtain a greater understanding of the use of anthropomorphism in the design of digital interfaces. It includes the use of avatars, interface agents, hybrid characters, and robots. This extends the links between anthropomorphism and animism in computing applications. As a result, a degree of anthropomorphism is proposed to ease the process of classifying the anthropomorphism when designing human and computer interactions. The use of anthropomorphic characters enables designers to develop more significant interactions between individuals in helping to promote a long-term relationship. In order to strengthen the interactions, a set of anthropomorphic characteristics is proposed to be emphasized in the design development. In addition, the directions for anthropomorphic designs are also discussed.

Keywords-Human Computer Interaction; Interface Design; Anthropomorphism.

I. INTRODUCTION

As the growth of more social mobile applications increases, hence, simulating a more interactive communication in a virtual environment becomes possible. In this approach, a human-like representation is used in the interface [4]-[6]. The human-like interface which is also known as anthropomorphism, helps users to get familiar with the functions, services or facilities embedded in an application. The design of human-like representation is also useful when applied to various games in areas such as health and education. Many potential applications can benefit from this type of interface design. Most studies in anthropomorphic interfaces, such as [2]-[14], focused more on usability, acceptance and users' preferences in several software or application contexts. Noticeably, anthropomorphic interfaces are preferable as compared to interfaces without anthropomorphic character [6][12]. However, the preferences are not conclusive. The experimental setting, application environment and the design itself, play an important role in shaping the users' preferences. Therefore, the diversity in anthropomorphic design and application has led to further explorations of this study. The designs range from a simple smiley face to a combination of human form with other objects or in abstract form. Different forms of anthropomorphic designs have led to a certain extent of confusion, particularly in determining the users' preferred type of anthropomorphic interfaces rather than mainly examining the

differences between anthropomorphic and non-anthropomorphic interfaces. Therefore, the type of anthropomorphic interfaces indicates that human qualities and characteristics will be applied to a certain degree in anthropomorphic designs. The exertion of this study will explore the anthropomorphic form of designs and applications. At the end, an anthropomorphism spectrum is developed to indicate how different aspects of anthropomorphism can be utilised in the human-computer interaction. This study outlines the following: In Section 1, the anthropomorphic interface is briefly explained, particularly in the context of human-computer interaction. In Section 2, the type of anthropomorphism in designs is discussed. In Section 3, the characteristics of anthropomorphism are described in detail, and in Section 4, the possible applications of anthropomorphism are explained with several examples. With the characteristics of anthropomorphism in mind, the anthropomorphism spectrum will represent the fundamental guidelines for designing anthropomorphic applications for human and computer interfaces.

II. ANTHROPOMORPHIC COMPUTING INTERFACES

Over the last decade, the application of anthropomorphism has been developed in various areas such as in education [1], healthcare [2], and e-commerce [3]. The involvement has diversified the designs in accordance to the purpose of application. Anthropomorphism is defined by the use of an object that imitates human qualities and features within an inanimate object [4]. Zlotowski [5] further extended anthropomorphism as the designation of human life to a non-living object through designs. Anthropomorphism in designs allows designers to create tools that help users to comprehend the representation perspective without any difficulty [6]. For example, a human agent representation helps in online shopping, assists users in paying bills, becomes an online help desk, and acts as a personal tutor as well as other different characters and roles. The human agent is sometimes represented in different design forms such as a paperclip, any animal oriented design or even a simple car. The designs evolve according to the anthropomorphism characteristics.

In consolidating the anthropomorphic designs, anthropomorphism is also associated with the definition of animism to a certain degree of design [1][4]. Animism also gives human qualities and essences to non-human objects [7][8]. Haber [7] described animism as "the attribution of life to a non-living object". Animism refers to a design of things that make them seem alive and pleasurable to interact with. However, the previous

discussions of animism normally involved a psychological perspective, for example in [7][8], where people relate the object used in their religious practices such as a cult-statue or cult tools. The design of animism can exist in the form of human, animal, insect, plant or a combination of all mentioned. The term ‘animism’ is minimally utilised in computing applications. A study by Schmitz [4] associated animism with as a life-likeness design concepts in designing a usable and tangible interface. Schmitz referred it to a robot or humanoid design in relation to the animism concept. Another study by Kallery and Psillos [1] referred to animism and anthropomorphism as other types of personification. They discussed the use of animism and anthropomorphic objects from a learning perspective among young students with different ages. They found that animism and anthropomorphism help in attracting the young students’ attention towards cognitive development. According to Kallery and Psillos, animism and anthropomorphism have to be installed with emotion and expression. Notably, anthropomorphism and animism are rooted from the same fundamental description, however, their usage in computing interface designs is inconsistent, depending on the domain in which the user interfaces are designed. Anthropomorphic computing refers to a representation of human with a large number of human-like features, and the design varied through the use of face, part or whole body. For example, in the Simpsons, a stylised human character is used, while in Monster Inc., a different utilisation of animal character was manipulated in the story. In animism, the degree of human form is decreased but the attribution of life remains the same. The design could be a mix of human form with others. Therefore, it becomes more abstract and hybrid such as those games characters in Angry Birds, Mickey Mouse, Pac-Man and others.

TABLE 1. DESCRIPTION OF ANTHROPOMORPHISM & ANIMISM

<i>Anthropomorphism</i>	
<i>J. Zlotowski [5]</i>	<i>Designation of human life to the non-living object through designs.</i>
<i>M. Schmitz [4]</i>	<i>The use of an object that imitates human qualities and features within an inanimate object.</i>
<i>E. Perry and J. Donath [33]</i>	<i>A description of an abstract of the humanoid depiction of a person.</i>
<i>Animism</i>	
<i>F. Haber [7]</i>	<i>The attribution of life to a non-living object.</i>
<i>M. Kallery and D. Psillos [1]</i>	<i>A type of personification.</i>
<i>L. A. Brown and W. H. Walker [8]</i>	<i>It provides a non-human object with human qualities and essences.</i>

The association of human-like representation within human-computer interactions evolves in many ways. One of the human or animal character personalisations is applied commonly in a virtual world or in games environment known as an avatar. It enables the mix of human or animal features. Avatar is described as a form of human representation to signify the users’ character in the virtual environment [9][32]. The application of avatar can be customised based on users’ preferences and specific role [9][29]. Besides, the

avatar is designed to encourage a better social interaction [11][29][32]. In most studies, such as [3][10][11], the avatar was designed with real human depiction.

The human representation is also known as Embodied Agent or Embodied Conversational Agent (ECA). ECA is an interface agent that provides users with help and direction within the application [19][20][24]. It can be a smart assistant and also a companion agent. It can also be designed in various forms such as real human, animal, non-figurative character, simulation of faces, and others. Usually, ECA is coded with a scripted answer to provide a standard level of confidence within the interaction. Either avatar or ECA, both are commonly applied with specific roles and purposes. It is noticed that the Avatar and ECA design could exist in between anthropomorphism and animism at some degree of human qualities and likeliness. Table 1 summarises the description of anthropomorphism and animism.

Nonetheless, anthropomorphism and animism are also used in designing tangible interfaces [1][4] such as mechanical devices that imitate a human or a robot, as well as intangible products such as vases, and dolls. Therefore, there is a range of possible characters that can be used in computing which makes enough sense to formulate a scale ranging from almost human to inanimate in interface designs.

III. DESIGN OF ANTHROPOMORPHISM

A. The Degree of Anthropomorphism

At this point, to systemise the spectrum of anthropomorphism and animism, one may classify the types involved as illustrated in Table 1 and visualise the degree of anthropomorphism as shown in Figure 1. The degree of anthropomorphism is indirectly affected by animism. A recent study by Zlotowski, [5] explained the dimension of anthropomorphism in human-robot interaction (HRI), particularly in categorising the level of humanness in anthropomorphism into uniquely human (UH) or human nature (HN). Zlotowski looked into the elements of humanness such as curiosity, friendliness, and sociability (HN). Subsequently, if it comes with politeness, humility, and organisational elements, then it is uniquely human (UH). The degree of anthropomorphism shows a collection of human-lifelikeness at a different stage of design. This design is shaped from computer interfaces to tangible interfaces and from anthropomorphism (highly human-lifelikeness) to animism (lesser human-lifelikeness). With this scale, users’ preferences can be cultivated on various application domains with different setting.

Developing a scale for anthropomorphism helps in designing a more preferable and acceptable application. At different points of the scale, the interpretation will not be the same and will influence the users’ preferences. Catrambone et al. [10] and Power et al. [14] used various degrees of anthropomorphism in comparing different characters in the same application. They [10] developed three different anthropomorphic characters ranging from human, cartoons, and iconic to observe how users perceived those designs in terms of intelligence, friendliness, pleasantness, and attractiveness. Meanwhile, the study by Power et al. [14] used two different anthropomorphic characters, lifelike and iconic, to validate their framework on how these two characters could affect users’ performance during the interaction. This study further expanded the defined characters in [10][14] into a scale of human-likeness and its relation towards animism and anthropomorphism. Other studies did not mention specifically or measure in particular which degree of anthropomorphism is preferred by the users.

Nevertheless, the position of human voice and text in the degree of anthropomorphism and animism is debatable. It is like listening to a radio or reading a book, the communication or message and the sense of being together may create the same context by having an anthropomorphic interface. With several tones of human voice, it offers a different perception towards anthropomorphic interface. This indicates that voice and text can be part of anthropomorphism or animism. However, the arguments are not strong because voice and text are only used to strengthen the effect of human-like presentation. Gong [21] and Lee [23] in their study showed that human voice is important in designing a preferable and trustworthy anthropomorphism. In a recent study by Schmitz [31], wave sound was used to identify which emotion, expression or effect resulted from it. The expression is projected using human faces.

Another study conducted by Murano and Holt [12], differentiated the effect of anthropomorphic interface towards users' preferences using only anthropomorphic interface on its own, anthropomorphic interface with text and anthropomorphic interface with voice. Murano & Holt found that the addition of voice significantly affected the users' preferences. Again, it shows that the voice plays an important role in deploying a credible anthropomorphic character. For text features, apart from being an experimental controlled condition [6][12], the text plays an important role in supporting a clear voice as well as conveying a clear information. It shows that the voice and text elements are not independently designed to evaluate the human characteristics at a certain degree of anthropomorphism, but it is rather important as part of the interface for better effects. Therefore, the human-likeness form is translated into a design scale ranging from anthropomorphism to animism, as shown in Figure 1.

TABLE 2. TYPES OF ANTHROPOMORPHISM

Types of Anthropomorphism	Description
1) AVATAR	Highly human life-likeness form.
2) INTERFACE AGENT / SOFTWARE AGENT	An agent with various forms of design and could be at a higher, middle or lower attribution of life.
3) HYBRID CHARACTER	A combination of human form and abstract character at a lower attribution of life.
4) ROBOTIC	A mechanical device designed in a physical form.
5) PRODUCT ANIMATE	Any physical product that uses a human in its design.

Table 2 explains each design scale of anthropomorphism. Hence, mapping the anthropomorphism and animism to the degree of human-likeness may strengthen the interaction designs. Looking into a better interaction and relationship with anthropomorphic characters, it is important to determine the characteristics and elements of the anthropomorphic designs. It makes the designs look more persuasive and engaging.

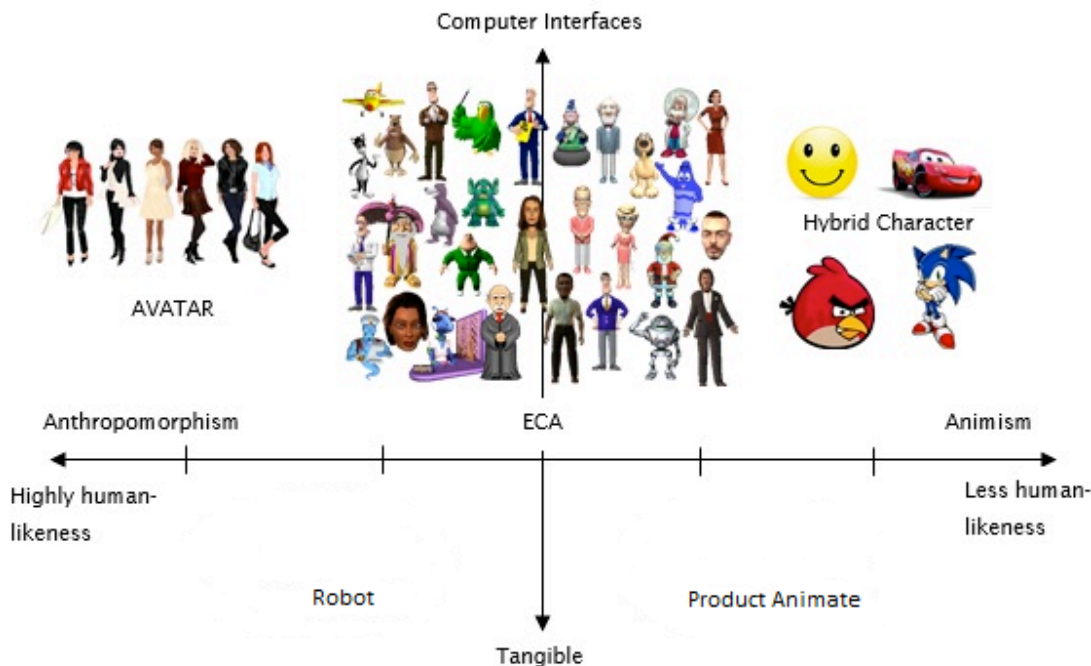


Figure 1. Degree of Anthropomorphism

B. Anthropomorphic Characteristics

The characteristics of anthropomorphism define the strength of the design. Questions have been raised about the realism of anthropomorphism and how anthropomorphism can have a better persuasive effect on human-computer interaction. The application of anthropomorphism as interface element has considerably shown a convincing social response and social presence to the users [5][16][20]. Social response elicits psychological and cognitive processes, in which the users apply and accept the social rules when interacting with the computer [16][21]. One aspect of social responses is perceived through non-verbal behaviours such as eye contact, facial expression, gesture and posture [22]. Anthropomorphism with a close-up facial shows the most affected interfaces. Facial expression [21] and flattery effect [23] could also exhibit persuasiveness through the interface. However, a better match between facial expression, voice over and flattery effect may bring a more persuasive interface. Besides, the anthropomorphic facial expression is also displayed in respond to its emotional state [5].

Power et al. [14], Prada and Paiva [20] and Forlizzi [24] indicated that an intelligence aspect also yielded a persuasive element on the anthropomorphic interface. They found that human-like interfaces were perceived to be more intelligent than other anthropomorphic interfaces. The intelligence aspect can be seen through the way anthropomorphic interface gave its feedback or responses. Meanwhile, social presence is about the users' perception and feeling in perceiving the sense of being connected with others in the virtual world [20][25]. A social presence can be interpreted by demographic (gender, ethnicity, age) and physical appearance (attractiveness). The demographic factors play an important role based on the application's purpose and functionality. Gender consideration was found to be more significantly affected by female users than male users in choosing which anthropomorphic interface types they prefer to interact more [24][26]. Female users prefer to talk to an agent that is more human-like and within the same gender. However, a different result was obtained by Qiu and Benbasat [3] and Cowell and Stanney [22], in which no significant differences were found in terms of gender preferences. Thus, gender preferences either of the same gender or the opposite are not conclusive and suggesting towards a specific domain of study that may improve its impact.

Other than gender preferences, ethnicity of anthropomorphism also showed that users prefer to interact with anthropomorphic interfaces that matches their ethnicity [3], [22][26]. Among the experimental ethnicity are Caucasian, African American, Asian and Oriental group. In Qiu and Benbasat [3], female users were significantly affected by the same ethnicity interfaces than male users. However, Angeli and Khan [26] argued that designing an interface agent with an ethnocentric approach will limit the application or interface acceptance in general. Ethnic similarity helps the users to build up their confidence because interacting with the same ethnic background provides more comfort and support during the interaction. Age and facial attractiveness of anthropomorphic interface are other preferred characteristics. Previous research showed that users prefer a young interface agent [22] with attractive interfaces [3][26] because the interface was perceived as more convincing and content. Measuring young or old is easy however, facial attractiveness is subjective and it is very challenging to be measured.

The characteristics of anthropomorphism are not conclusive. There is a need for further verification on each of the discussed

characteristics. However, suggesting a set of characteristics consisting of social response and social presence may strengthen the design effects of anthropomorphism. Therefore, it will bring a more persuasive application that one may interact.

IV. ANTHROPOMORPHIC APPLICATION

The degree of anthropomorphic and its characteristics can be applied in several applications. One that can be further explored is gamification – the implementation of game designs, elements, and mechanics into a non-gaming application, facility, and product [27]. There is a plausible employment of anthropomorphism in gamification and it can be seen through the utilisation of avatar [27]-[30]. Through the use of avatar, the anthropomorphism becomes the users' identification that can be personalised based on points and levels [28][29] as well as part of the application or game storyline [30]. It is foreseen that gamification can be a motivation factor towards users' engagement [27][29], and anthropomorphism is part of it. However, in gamification, other than the avatar, little consideration has been paid to other degree of anthropomorphism.

Besides, the disaggregation of anthropomorphism into a certain human-likeness scale is beneficial, if it is implemented for a specific purpose. For example, it can be applied to e-learning environment, in which different students may have different preferences on the degree of anthropomorphism that can be presented as their personal identifiers. Another example would be the health care context, in which patients may have distinctive propensities on the degree of anthropomorphism that is convincing enough for them to interact, or in the e-commerce application, on the degree of anthropomorphism that should be applied for the customer service characters and other related applications. However, the application of anthropomorphism is not limited to these areas only. It could also be extended into social media applications or in text-based communication such as Twitter, Messenger, and WhatsApp.

Therefore, the application of anthropomorphism at various scales of human-likeness may extensively enable its role in the human-computer interaction

V. CONCLUSIONS

Anthropomorphism in the human-computer interaction is not just a tool to facilitate users in completing their tasks. Anthropomorphism is beyond just an interaction, which involves designing an anthropomorphic interface varying from simple abstract character to full human body imitation. This variation leads to further classification on which anthropomorphism should be used, thus, nurturing anthropomorphism in a specific context of design. This helps the designer to understand the reasons why anthropomorphism is used. One of the reasons is for better engagement, interaction, and relationship within the application. The persuasive elements such as how anthropomorphic computing gives response physically and emotionally, and/or how the anthropomorphic interface delivers the sense of being there during the interaction were discussed to suggest a set of elements that should be implemented when designing an anthropomorphic interface. This paper indicates a way forward in the use of anthropomorphic elements in the interface design, taking into account a range of possibilities based on the scale that has been proposed. In reality, this scale would be useful, depending on the demographic of the users. For instance, younger children may prefer more animistic or object/human type interfaces, while older people may prefer avatars of some sort. Further study should

focus on the design development or framework development by considering the degree and the characteristics of anthropomorphism into a specific application.

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