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Designing for Emerging Aesthetics: Product Semantics Approach to the Design of Smartwatches

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Abstract

Current trends have shown a steep rise in the popularity of smart wearable devices. Inevitably, after mobile phones, the next technology revolution is expected to be in the field of smart wearables. As more and more startups and well-established corporations are venturing into the emerging field of smart wearables, the academic institutes have the responsibility to make students equipped with all the necessary knowledge and skills required to design these futuristic devices for the real world. Moreover, human beings are becoming increasingly dependent on smart devices for their day-to-day tasks. Therefore, a study would be beneficial to understand consumer preferences and perceptions about smart wearable devices. Words express consumers' product preferences, and in design, the terms used to express preferences can be studied using product semantics. The semantic product explorations can be carried out about the aesthetics of products that are to be worn on the body for a prolonged period. In this regard, a study is conducted through a semantic differential questionnaire to get responses from 16 volunteers (8 designers and 8 non-designers) when they are exposed to the images of smartwatches. The ratings obtained in the experimental setting are used to statistically analyze and interpret ordinary consumers' as well as designers' aesthetic preferences and perceptions. Design practitioners can quickly adopt the findings of the study for the smart wearable industry and design students to generate innovative wearable aesthetics.

Keywords: Smart Wearables, Design Semantics, Form Design, Aesthetics of Wearables, User-Centred Products.

1 Introduction

Smart wearables are one of those technology-driven products that will eventually become an integral part of human life. When looking at the current wearable market scenario, the companies in this domain appear to have a strong focus on technology-driven innovation. However, as the market enters the maturation phase, the technology penetration becomes high, and technically similar products co-exist (Gonzalez, Val, Justel, & Iriarte, 2017). In such a situation, technology starts to lose its potential to become a differentiator, and companies can no more rely only on technology to achieve a competitive advantage. Therefore, design directed by emotional content or 'emotional design' can be used as a product differentiation strategy in a saturated market with fierce competition (Barrena & Sánchez, 2009) (Vaidya & Kalita, 2021). Emotions play a crucial role in consumers' product choices. Moreover, research suggests that emotional aspects of product design are more critical in deciding a product's market success than mere functional characteristics of it (Norman, 2004), (Yang, Zhou, Zhu, Yu & Wu, 2021). Thus, designers could get benefited from gaining more insights into the consumer's emotional response to design and create products that connect with them at the emotional level.

Products communicate with the users at the emotional level through their appearance and visual features. The aspects of product features such as performance, ergonomics, quality of finish, and efficiency are conveyed to a certain degree through visual form (Crilly, Moultrie & Clarkson, 2004). The formal elements play a significant role in creating a perception of the product. This perception created in the minds of the people is conveyed through words they use to express their impression about the product (Alcántaraa, Artachob, Gonzáleza & Garcíaa, 2005). The study of human perception of products and the words they use for describing them can be effectively conducted through the technique of product semantics. In the present study, we explore the potential of product semantics in designing smart wearables to bring consumer-desired aesthetic expression to the product. This study investigates meanings inferred among consumers and designers from the physical design of smart wearables.

2 Literature Review

2.1 Smart Wearables: An Introduction

The word wearable implies the use of the human body as a supportive environment for the product (Gemperle, Kasabach, Stivoric, Bauer & Martin, 1998). Wearable technology devices are electronic gadgets that can be comfortably worn on the human body in the form of smartwatches, head mounted displays, smart jewelry, smart garments, etc. (Wright & Keith, 2014). Although these devices perform the same functions as smartphones and computers, they are much more advanced in tracking the real-time physiological functions of the body and analyzing them. In the literature, smart wearables are defined in several ways. For instance, Buenaflor and Kim (Buenaflor & Kim, 2013) described smart wearables as electronic devices having computational power that can be worn, carried, or connected to the body. For Park et al., a smart wearable device can be worn on the human body and can perform essential functions of sensing, processing, storing, transmitting, and utilizing (Park, Chung & Jayaraman, 2005). The literature suggests that the consumer wearable design must be done keeping one thing in mind that it should be physically and visually light weight. After all, wearable computing devices are fashion, and they must be designed as such. It should be desirable by the user to put on the device; the functionality it assures does not matter (Starner, 2014). This emphasis on aesthetics and visual differentiation is not surprising, given that visual information helps draw attention to the products in the store, assists in identifying and categorizing products, and provides a rich source of information (Crilly, Moultrie & Clarkson, 2004), (Creusen & Schoormans, 2004). In this study, a wearable device is defined as a body-worn device that has computing power, senses, and stores data in real-time from the user activities, communicates relevant information, and serves as fashion (fulfills the emotional need of the user).

2.2 The Case of Smartwatches for Semantic Evaluation

Smart wearable devices are still in their early phase of use and adoption. Among smart wearables, one of the most popular devices is the smartwatch (IDC, 2020), yet very little is known about why people prefer certain smartwatches over others. Thus a study in the area of smartwatches is needed to comprehensively understand the notion of the users and the question of how aesthetics of smartwatches influence in shaping the user perception. The existing studies mainly have categorized almost all the wrist-worn devices as one group while assessing various factors about them; however, it is clearly observed that there is a recognizable difference between fitness trackers, wrist bands, and smartwatches when looked at from aesthetics, functionality as well as technology perspective. When appearance is considered the parameter for differentiation, a smartwatch generally has larger displays, closely resembling traditional watches. In contrast, fitness trackers and smart wristbands look more like fashion accessories. Therefore, we define a smartwatch as 'a wrist-worn device that aesthetically resembles more like a traditional watch. It allows collection and representation of relevant data to the user due to its computation capability.'

2.3 Semantic Differential (SD) Method

Semantic Differential (SD) method, developed by Osgood (Osgood, 1957), has been widely accepted as a quantitative technique to study semantic structures and affective meanings of things. It has been successfully used in studies to design telephone, car interior, office chairs, footwear. However, in spite of the increasing popularity of smart wearables in the market, no study has been identified in the literature so far that demonstrates the use of SD in the design of smartwatches. In this regard, the current research is conducted to determine the semantic space of smartwatches by applying differential semantics. Moreover, a statistical analysis has been undertaken to assess the influence of subjects' backgrounds on semantic perception.

3 Methodology

The work was carried out in three phases as follows:
3.1 Identification of Semantic Extent (SE) for smartwatches
3.2 Selection of imagery for getting responses from subjects and choosing sub-jects
3.3 Analysis of responses given by subjects for the selected imagery

3.1 Identification of Semantic Extent (SE) for smartwatches

This phase started with identifying and collecting as many words and expressions as possible that people use to describe smartwatches. The set of words used for expressing smartwatches is called Semantic Extent. For generating this preliminary Semantic Extent (SE) of adjectives, words, and expression, sources utilized: (i) Interviews of users of smartwatches and users aspiring to use smartwatches (6 Design professionals, 3 ordinary users), (ii) journals and magazines related to smartwatches technology and manufacturing (6 journals and 5 online magazines), (iii) web pages of five leading smartwatch manufacturers, (iv) words used in print and web advertisements of smartwatches, (v) words and expressions used by online tech reviewers.

The collection of words and expressions was decided to be concluded when similar or synonyms words started appearing in the process. One hundred and thirty-five adjectives and expressions were collected in total to form a preliminary SE. As the collected set of adjectives and expressions created a large SE, it was decided to decrease the number of words to such a number which would be easier for collecting responses from the subjects during the evaluation phase. This reduced collection of words forms a Limited Semantic Extent (LSE).

The criteria for the establishment of LSE were: (i) Choose the adjectives which are most commonly used to describe the physical form and quality of appearance, (ii) exclude adjectives that describe the functionality, material, or a particular technology or method used for manufacturing, (iii) include most appropriate word for a bunch of synonyms, (iv) choose most appropriate polar opposite adjectives for the selected adjectives in LSE so that they can be evaluated on a seven-point semantic differential scale. At the end of this phase, the LSE formed consisted of 24 polar opposite adjectives, which formed a set as given in Table 1.

Table 1. Limited Semantic Extent (LSE) of smartwatches.

Modern	Classic
Sophisticated	Simple
Stylish	Conventional
Millennial	Traditional
Intelligent	Non-intelligent
Urban	Rustic
High Performance	Low Performance
Expensive	Cheap
Precise	Imprecise
Natural	Raw
Professional	Amateur
Authentic	Unreliable

Comfortable	Uncomfortable
Everyday Use	Occasional Use
Personal	General
Customizable	Non-customizable
User Friendly	Inconvenient
Sharp	Soft/Subtle
Masculine	Feminine
Sporty	Formal
Elegant	Messy
Slim	Heavy
Energetic	Gentle
Delicate	Rugged

3.2 Selection of imagery for getting responses from subjects and choosing subjects

Twelve wrist-worn devices from leading watch brands were selected for evaluation. The chosen images consisted of six smartwatches and six digital/analog watches. This was done to ensure that there is a good mix of shapes (forms) of watches and subjects are exposed randomly to the selected imagery. Also, as discussed in 2.2, the smartwatch design aesthetically resembles more like a traditional watch; hence in later stages of the research, an analysis could be performed based on the type of watch as well. A criterion for selecting these images was that there must be at least two views available for the chosen watch. Moreover, the images were converted to greyscale to avoid the effect of color on the perception of the subjects.

Figure 1. Watch imagery selected for the experiment.

All the watches were evaluated by 16 volunteers (age range: 21 to 44 years, mean age: 31 years, Males: 9, Females: 7) on the basis of the questionnaire, which included words from LSE. The questionnaire consisted of a seven-point semantic differential scale with polar opposite adjectives taken randomly from LSE. The subjects chosen for the evaluation consisted of 8 people from a design background (design professionals/ design students) and eight people who did not have any formal education or experience in design. Subjects rated each watch by looking at the photo on the computer screen, and the order of the questionnaire was maintained random.

Figure 2. Experimental Setup for Getting Responses from Subjects.

3.3 Analysis of responses given by subjects for the selected imagery

The One-Way ANOVA was applied using IBM SPSS Statistics 20 to determine whether there are any statistically significant differences between the means of independent groups. Here, the variables considered were Watch Design, Type of the Watch, Profession of the Respondent, and 5 Categories of semantic adjectives used in LSE. The Categories of the adjectives in LSE formed were as follows:

A1. Innovativeness: This category included features of the watch related to appearance, making it look innovative, new, and novel (modern, stylish, sophisticated, millennial, urban, and contemporary). It also includes factors that create a perception of performance (high performance and intelligence).
A2. Quality: This factor combines aspects related to the finish and detailing of the watch, which refers directly to an impression of its quality (expensive, precise, natural, neat, professional, authentic).
A3. Ergonomics: This factor groups the qualities which have more to do with the notion of ergonomics (comfortable, everyday use, user-friendly, sharp) as well as the perception of a personalized watch (customizable, personal).
A4. Masculine/Feminine: This factor is related to the aspects that create an impression about the intended user of the watch (male/female).
A5. Lightness: This group consists of adjectives creating a notion of the visual weight of the watch (sporty, elegant, slim, energetic, and delicate).

4 Result and Discussion

A one-way between subjects ANOVA was run with respondent's professional/academic background as the independent variable and the perception of aesthetics of smartwatches as the dependent variable. Results of the ANOVA showed a significant difference between respondent's background (designer and non-designer) on the four factors representing innovativeness, i.e., sophisticated-simple $F(2,189) = 4.20$, $p = 0.042$; stylish-conventional $F(2,189) = 5.16$, $p = 0.024$; millennial-traditional $F(2,189) = 3.97$, $p = 0.048$; and high performance-low performance $F(2,189) = 5.07$, $p = 0.025$. Therefore, it can be inferred that the perception of innovativeness of watch design is non-identical between ordinary users and design professional/students. Similarly, there is a significant difference between respondent's background on all the six factors representing ergonomics, i.e., comfortable-uncomfortable $F(2,189) = 8.38$, $p = 0.004$; everyday use-occasional $F(2,189) = 7.58$, $p = 0.006$; personal-general $F(2,189) = 6.76$, $p = 0.010$; customizable-non customizable $F(2,189) = 19.77$, $p = 0.001$; user friendly-inconvenient $F(2,189) = 16.14$, $p = 0.001$; and sharp-subtle $F(2,189) = 7.59$, $p = 0.006$. The statistical test showed no significant difference between respond-ent's background (designer and non-designer) on the four out of five factors representing quality ($p > 0.05$). Thus, the perception of Quality based on aesthetics of the watch is not so much affected in case of normal users and design professional/design student. Furthermore, it was also found that there is no significant difference of ratings on variables representing masculine/feminine and lightness with the profession/academic background of the respondent ($p > 0.05$ for all factors representing masculine/feminine and lightness).

5 Conclusion

In this paper, we investigated the influence of the subject's professional/academic background on the perception of aesthetics of smartwatches. A set of experiments was performed using the semantic differential method to assess the effect of professional/academic background. The conducted experiments clearly showed that the perception of aesthetics of smartwatches was greatly affected by the subject's background on several factors representing innovativeness and visual ergonomics. The analysis comprehensibly infers that there is an opportunity in smart wearable form design to address this disconnect between this perception which would clearly communicate the designer's perception of innovativeness and ergonomics of watch design to the ordinary users. We also found no significant effect of the subject's background on perceived quality, lightness, and masculine/feminine attributes of the smartwatches. As future work, experiments could include the impact of color, visual texture, etc., on the perception of aesthetics of a different category of a smart wearable device. The smart wearables industry, which is currently in the infancy stage, would find the utility of this study to introduce the human emotional component in designing wearable aesthetics. It would also aid the design decisions process to transform the product's acceptance based on consumer preference and perception analysis.

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