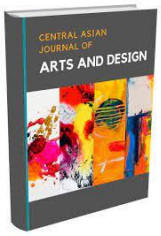

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Article

Interactive Design of Smart Products and Its Usability Implications

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Abstract: The research titled (Superior Interactive Design for Industrial Systems and Its Impact on the User) deals with the study of the impact of superior digital technologies on the design of industrial products and the process of interaction between industrial product systems through the overlap and sharing of the function of each system with other systems. The purpose of superior interactive design is the ability of the product to interact with Other products and the surrounding environment, and a reduction in the user's time and effort. The research problem was represented by the following question: To what extent does the superior interactive design of industrial systems reflect on the user? The importance of this study stems from enhancing the human experience by opening new horizons in the field of design and raising it to an advanced level, as it seeks to achieve comfort and luxury for humans through cultural products represented by industrial products.

Keywords: artificial intelligence, interactive design, smart products, product intelligence, product design

1. Introduction

One of the central goals of interaction design is to develop superior usable interactive products, this generally means ease of learning and optimal usability while providing an enjoyable user experience. The best place to start thinking about how to design superior, usable interactive products is by identifying the specific strengths and weaknesses of different interactive products.

Technological advancement has contributed greatly to human life and society. Technologies such as self-driving cars, artificial intelligence, and machine learning are advancing at a rapid pace. While the development of artificial intelligence has greatly contributed to the development of personal assistants, drones, smart home devices, etc., it has also raised questions about the long-awaited point of the future of superior interactive design for smart products and the extent to which these products can interact with the user as well as with other products, electronic and computer technology developed very rapidly during the first decade of the twenty-first century, electronic and computer technology developed very quickly, which opened new horizons in design that contributed to the development of the creative potential of designers and conveyed the interactive format between the industrial product and the recipient for more effective levels. Hence the following question arose:

To what extent does the superior interactive design of smart products reflect on the user?

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2. Materials and Methods

The researcher adopted the analytical method as the appropriate method to achieve comprehensive coverage of the content of the study and a desire to reach reliable scientific development results by describing the phenomenon and being able to find solutions to the research problem.

3. Theoretical framework

3.1. Concepts in superior interactive design (what is interactive design)

A new trend in design emerged at the hands of Bill Moggridge in 1990, who is the director of the design company (IDEO) and this new approach carries in its aspect's parts of the foundations of communications design, computer science and product design, but in general it is different from all of them as it was dominated by the idea of connecting individuals. with each other through the products and devices they use, Moggridge called this interaction design [1]. Interaction design refers to the design of interactive products that support the way people communicate and interact in their daily and working lives, that is, creating user experiences that enhance and increase the way people work, communicate and interact, and it is the art of facilitating interactions between people through products and services [2].

As designers do and innovators in the field of interaction design have long researched human-machine interaction, through artistic, intuitive, conceptual, social and critical projects in interaction and interactive interface design, and have shown how digital processes are essential elements in the process of artistic creation. However, none the less the resulting prototypes often reached beyond the technical arena into areas such as: smartphones, smart homes, smart architecture, modern technologies, widespread computing and games [3]. According to the Interaction Design Association (IxDA), interaction design is the structure and behavior of interactive systems, through which interaction designers seek to create meaningful relationships between people, products and services they use, such as: computers, mobile devices, and other products [4].

3.2. Interaction design goals

Many products are designed primarily with the user in mind. They are designed for him, and this requires the user to interact with those products. Many of them are easy and enjoyable to use. On the other hand, there are other products that may have been designed without keeping the user, his style of thinking, and his feelings in mind. Designed major system to perform a specific function, these products perform their function very efficiently, but without creating pleasure for the user as interaction with exceeds to his expectations [5]. One of the most prominent goals of interactive design is to enhance the positive aspects (enjoyment, immersion and connection), and reduce the negative aspects such as: frustration and annoyance. The primary goal of interactive design is to develop interactive products that are easy to use, effective and interactive enjoyable to use from the user's point of view, meaning that it aims primarily to develop products. That are characterized from a use standpoint by their ease of use, meaning ease of learning, its use is effective, and it provides the user with an enjoyable experience [2].

3.3. Interaction in smart product design

Intelligent design refers to carefully designing products to provide comfort and ease of use. Intelligent user-centered product design can achieve sustainable living. Intelligent design-based integration of smart technology can support sustainable development and improve user satisfaction, happiness, and quality of life in general. Design researchers focus on the smart technology is based on a "people-oriented approach" by the designer to give users the ultimate interactive experience [6]. Smart technology is rapidly changing the

way we interact with the world through products. The trend has been decades toward smaller, better-designed technology that focuses more on user experience and lifestyle. Most designs are now available in multiple colors or finishes, offering different features between models or customizable to customer needs, Smart Product Design takes a look at the latest innovations in smart home, health and wellbeing, sports, fitness, business, travel and more [7].

Smart products are robotic (mechatronic) products that are additionally equipped with built-in systems that allow communication with other smart products using Internet technologies. which is an innovative approach to applying cyber-physical systems in mechatronic products. smart products are enabled to know their operating states, monitor and control their physical operations. Smart products gain awareness of their environment and operational states, interact with their environment by sending messages and triggering events, and are designed to draw decisions due to situational analysis and are enabled to act independently. The communication devices of these smart products consist of sensor systems, operating systems, and modules with built-in control software to process data [8]. Intelligent design is about designing products that have the ability to be used repairable, function, form, and even brand, emotion, and technology. The role of the industrial designer is to bring these aspects together and combine individual creative intelligence with the teamwork of experts in everything from physiology to electronics to create designs that do not only work. But it is can surprise and delight the user at the same time [9].

There are some characteristics of the product to be considered smart, which are:

1) A smart product must be uniquely identifiable.
2) To be able to communicate effectively with his environment.
3) A smart product keeps or stores data about itself.
4) A smart product deploys a language to display its features, production requirements, etc.
5) A smart product is able to participate or make decisions related to its fate [10].

Accordingly, a smart product is an independent object designed for self-organized embedding in different environments in the course of its life cycle and which allows natural interaction between the product and the human, as well as, smart products are able to proactively interact with the user using the sensing, input, and output capabilities of the environment and are therefore autonomous, situational, and context-sensitive.

3.4. Smart products and interactive superiority trends

Some experts believe that the shift from the industrial age to the information age is the beginning of what is called modern technology, as the revolution resulting from the development of the computer is one of the strongest factors affecting design in general and industrial design in particular, as it has brought about radical changes and is still occurring in the concept of design itself, which It has made the specialty of industrial design a specialty that tends to use technology directly and as a basis in most industrial product designs [11]. The technology in our current era has become of high value over other values in the field of products, such as tools, devices, and equipment in various fields, because of its importance through improving services directed to consumers, as they work to provide new products of high quality at competitive prices. Technological innovation of the product or production process can place the creative institution in a distinguished position in a market, which is characterized by a cost advantage over its competitors. Indeed, modern technologies have become a factor of attraction, as well as, it has the ability to greatly influence consumers, and the role of the technological factor was not limited to the functional use aspect that It not only meets utilitarian needs, but it has become a new aesthetic value added to designs [12].

Phil Baker stated that modern technologies have enabled producing companies to provide products through which they were able to penetrate the markets, and achieve superiority over products that rely on technologies that seemed like they are old. He says that Apple's production of the first smartphone that works with a touch keyboard instead of keyboard. the traditional was against the opinion of most technology experts, as they said that this new method it faces a serious obstacle, which is printing on glass, while the designers had another opinion regarding this new feature in the design, which is that it will allow the use of a wide screen that has its value for a number of other functions, such as: web Browsing, this view has proven successful [13].

Accordingly, modern and superior technologies have provided an environment various technologies have prompted investment in industrial products, which has led to the emergence of smart industrial products to achieve the desired goals, as well as achieving a type of attraction for the user.

3.5. Interaction design in a post-information society

Since the 1990s, digital technology has developed rapidly and has penetrated various fields. Applications and services based on computer systems have spread, with the continuous expansion of the Internet to include all aspects of life, including industrial products. Smart products are the result of the penetration of information technology and control technology into traditional products. Smart products have also attracted more and more attention as representatives of high-quality information life, and intelligent technology integration based on intelligent design can support sustainable development and improve user satisfaction, happiness and overall quality of life [6]. Experts believe that just as the first, second, and third industrial revolutions changed the nature of products through the use of steam energy, electrical energy, and automation, the fourth industrial revolution revolves around communication between electronic physical systems, and that developments in computing power, intelligent control, and communication do not only lead to the development of smart products, but also It also allows radical changes to be made in many other areas, thus supporting the creation of new business models and allowing the production of improved products, which influence customer usage and behaviors in new ways [14].

The ability that the products will possess such that they operate and make decisions without the need for human intervention will be provided by a specialty called machine learning, which is a branch of artificial intelligence that refers to giving machines the ability to learn and make decisions on their own without the need for them to be programmed by humans. So that it can learn from previous actions and store data to benefit from it and improve its performance in any future work [15].

The concept of deep learning has also emerged, which is also a form of artificial intelligence and is derived from machine learning. It is based on a set of algorithms that include several techniques such as artificial neural networks, which simulate nerve cells in the human body, and whose principle was inspired by the way the human brain works. It consists of several artificial nerve cells linked together, and the greater their number, the deeper the network. Deep learning requires a complex structure to imitate the neural networks in the human brain in order to understand different patterns and behaviors and eliminate them in natural situations or even with different sources of noise such as: the presence of noise, the presence of missing details or other sources of interference [16]. Figure 1 shows us a model of a self-driving car, explaining the systems installed on the vehicle in order to read and study the environment in which it operates.

Accordingly, the concept of interaction in smart products is linked to the ability of those products to avoid the problems they encounter and try to correct their paths of work through their ability to learn and deep learning, which provides them with information about the environment in which they operate, as well as benefiting from information that represents feedback that is stored in the system for future use in similar situations.

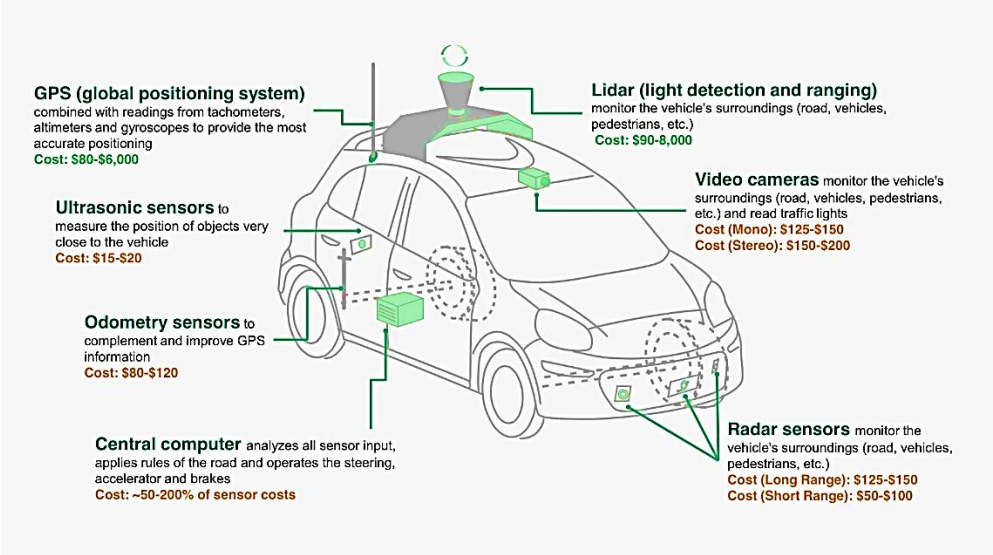

Figure 1. Model of a self-driving car

3.6. Intelligent products and achieve the role of superiority

A number of experts believe that the products that are called smart today are in fact not smart, but rather have been programmed to perform actions that we have specified for them, for example when writing a chatbot to help customers when using artificial intelligence algorithms, or using regular conditional code, In the case of regular conditional instructions, the program will follow a clear path drawn for it consisting of a few specific questions and answers. Accordingly, intelligent systems cannot be built without human intelligence and logic. They are dependent on human intelligence. Therefore, neuroscience is of great importance for artificial intelligence [17]. The rapid development that has occurred in computer systems, and the increase in the power of processors to process information at great speeds had a major impact on many areas of life. For example, we notice how this development has helped in the medical fields, whether in diagnosing diseases or even in treating them, as well as the tremendous development that has occurred in the world of Robotics, where robots will be able making decisions in the moment, and automated drones are among the most sold and traded related things in recent years, as their sales have increased at a rate of (30%), and these devices are able to fly at reasonable distances with the ability to photograph. record and send real-time information. In fact, it has been in the military field, but they entered the civilian use arena only a few years ago, and self-piloted aircraft are often associated with bad or dangerous uses, such as espionage or using them as weapons, but in reality, good-purposes civil applications increase and multiply with time, Such as first aid, security control in smart cities, or managing natural disaster by providing humanitarian aid, and the reality of industrial development puts the first generation of these aircraft at the forefront of sales, but the second generation, which is saturated with it to behavioral self-adaptation, learning, and self-learning, would be able to discover people who need help and provide it to them [18].

There is a new trend in artificial intelligence called the cross-fertilization of the three revolutions, and this cross-fertilization is based on biology, the “bottom-up” school. The inspiration for this trend comes from the rich diversity of simple structures found in the

field of biology and physics. The many trends in the bottom-up school share one characteristic, which is: they leave machines to learn from scratch, just as living organisms do, and like a newborn child, they learn from their own experience, and this philosophy can be summarized in almost one phrase: Learning is everything, while logic and programming are nothing. First, a machine is created it can learn, and then this machine learns the laws of logic and physics on its own by dealing with the real world. The intense interaction between quantum physics, molecular biology, and computers will launched scientific progress in the future. After years of stagnation in the field of artificial intelligence, our revolution in quantum physics and molecular biology has begun to provide a wealth of rich new models for research [11]. Autonomous smart products are classified into five levels, where level (1-3) is represented as being autonomous but with limited capabilities, meaning that the product at this level cannot be 100% autonomous or have the ability to learn. As for the products that are in level (4- 5) She has the ability to make decisions on her own. Figure 2 shows the robot (Attila), developed by the Massachusetts Institute of Technology, which has the ability to learn from its own experience.

Accordingly, the development in computer systems and the increase in their ability to process information has enabled them to make decisions in the moment and avoid risks, as well as the trend towards integrating quantum physics, molecular biology and computer science to enable smart products with their ability to learn and then outperform other products.

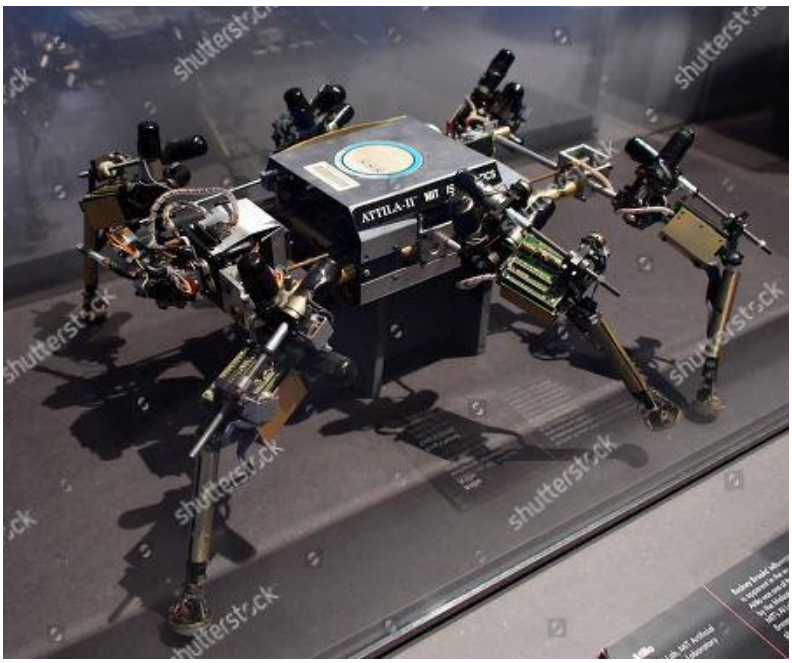

Figure 2. The robot (Attila)

3.7. Level of User reception and their connections to smart products

The user constitutes an important part in the interactive design process, as he is part of the interaction mechanism, where it is based, Interactive design is at its care on the user, and therefore, it is necessary to identify and get to know the user before starting the design process, and technological progress, with the capabilities and possibilities it provides, undoubtedly works to direct thinking centers to benefit from what technology provides in various fields, as technology greatly affects human thinking and vision and his future. The change in the vision of reality is a result of the change in the cognitive model due to scientific revolutions [19]. The series of qualitative change and improvement in recent years, and due to technological development at the level of industrial products, has led to continuous transformations from smart products to interactive smart products, and from interactive smart products to superior interactive smart products, and this upward trend and

the synergy between different technologies in their designs continues their designs, a clear reflection of technological progress and its effects in our contemporary world, in which change is accelerating to the point where borders disappear the dividing line between time and space, reality and the tangible and the virtual dream of new structural patterns and contents [20].

3.8. The interaction of the user with the product through reception

The user's first interaction with the product is through receiving. That is, realizing the essence of the artistic work through deconstructing the material (the work), analyzing it, and extracting its components that could not have been revealed without effort and analysis. Therefore, we find that the theory of reception is based on two main pillars, the first is perception and the second is in creation. The first means the users awareness of the essence of the design in front of him and his contribution in his discovery, and with this discovery, he forms an initial position that later leads him to artistic creation, that is, his creation and composition of what has been read in a new guise. The recipient works to bring what he has read into the world of existence thanks to his evaluations and opinions [21]. Wolfang Iser sees that the work is divided into two poles: the artistic pole and the aesthetic pole. The first is the author's text (the artistic work) and the second is the verification achieved by the recipient. In light of this polarity, it becomes clear that the work itself cannot be identical either to the text or to its verification, must be located somewhere in between" [22]. Through this, it becomes clear that the pillars of the process formed by the artistic work and the recipient occur through interaction between them, so that the work achieves what is called the artistic pole, while the recipient achieves the aesthetic pole as a result of the interaction. The process of reading the artistic work passes through three stages, and these stages are considered a basic condition for understanding any work, whatever it may be its type because it what was ambiguous becomes clear, and through it what was understand. Therefore, reading is considered the key to accessing any work of art [23].

Accordingly, when the recipient approaches the work (the product), he initially uses his experiences that he has acquired as a result of his contact with previous artistic works, and then absorbs and justifies the impressions that have been presented, after which an interactive relationship occurs between the recipient and the product as a result of influence and being affected.

3.9. Ease of use of the smart product and its impact on the user

Smart products have a lot of capabilities in which they differ from other non-smart products. This can cause consumers to have another idea about smart products, which again can be considered important areas of focus from a designer's perspective, as it is also difficult to find a comprehensive perception of the user about superior smart products. Because this concept still lies in the future [24]. A study was conducted on consumers' perceptions of what they are eating as the smart products of tomorrow. However, they use another definition of smart products. The definition is less technical, and does not use characteristics such as context awareness and proactiveness. However, remains relevant in the nature of smart products, as many the basic elements are the same, and they found that consumers perceived products with higher levels of (product autonomy) as more difficult to understand and use than products with lower levels of autonomy. In addition, consumers considered products with higher levels of autonomy to be susceptible to system malfunctions [25].

Others argue that product intelligence has advantages, but important disadvantages are increased levels of complexity and perceived risks. Multiple functionalities and the ability to interact with other products are also a problem as it may face trouble operating

products that fulfill many different functions and there is a complexity issue involved. When bundled with other products, it may also have its advantages if the user fully understands how to use these functions. Although this can also increase the functionality of the product, these functions must be viewed in the context of their importance and technical insight to the target group [25]. Also, some functions of the product remain unused until the end of the product's life. This is partly because there are many functions, and some users do not even recognize these functions. However, in many cases, the main reason is that he has given up using them after Several experiences because it is difficult to learn and use, as users become more and more intolerant of a product that is difficult to use, since user interaction with controls is of fundamental importance from the point of view of user performance, efforts should be made to make products easy to use and learn, not to mention satisfactory from aesthetic aspect [26]

Mühlhäuser also identified two main goals for smart products: First, there is a need to increase simplicity (increase interaction between the product and the user). As smart products become more complex, increasing product intelligence needs to hide irrelevant features and help the user with the actual relevant features. It is also important to simplify the user's interaction with the product, and product interaction is usually something that requires the user to focus on that specific task [27]. For example, while driving a car and trying to adjust the stereo volume, the interaction between the hands and eyes is not enough, because it forces the user to take his eyes off the road, and speech-based interaction in this context would be a safer and better way to adjust the volume, this is of course if the program Voice recognition is smart enough, otherwise it may cause user dissatisfaction, and the driver will lose focus on the road. This result is expected when new technology is implemented before it has matured and is well tested. The second goal identified by Mühlhäuser was to increase the interaction between product and product, and he states that it is fair to say that in a given case, the actual usefulness and suitability of a product can only be exploited in the context of its environment. Focusing on the technology of the product's interaction with other products and the infrastructure that enables the product from communicating efficiently with a smart environment, The smart product will grant many advantages in the context of usability [27].

Accordingly, the user experience and the brightness that experience leaves behind the user has a major impact on the way the user accepts the product and the ability to deal with it, as well as, the availability of smart technologies that facilitate this experience and make the user interact with the product, taking into account that it is possible that increasing the number of these technologies is not beneficial to the user as the product often ends up being used without having the user try these functions.

3.10. Superior smart products and dissatisfaction

Another consequence that may occur when products use advanced technology intended to increase their intelligence or superiority, is that users can feel that they are losing control over the product or the tasks they want to do, given the product is able to “think” and “act” on its own. The user may feel that he does not have the ability to fully control it. Therefore, there may be a limit to how smart product is, and how independent the product is, and Meyer believes that users at the present time are not ready or interested in interacting or being taken care of by robots, However, some of them are accepting smart daily devices that make their lives easier. So, the human versus AI aspect is something to take into consideration when designing smart products [28]. There are also a number of arguments that indicate that new capabilities made possible by smart products have both negative and positive effects. This effect depends mainly on how well these features are implemented and whether they are appropriate for the user in a particular situation. For example: Well, implemented has advantages when it is able to correct the expected user needs, but if this is not the result, it will lead to a negative effect, and for this to work, it

depends on other features and products of the smart environment, so it can be concluded that the idea of smart products does not depend only on the smart product itself, but also on other systems and products in the environment [24].

Accordingly, most of the user's fears of superior smart products are the inability to deal with the product as a result of the increase in smart technologies, as well as, the product's reactions to a specific situation and the possibility of making the wrong decision, which in turn will lead to harm to the user, as well as the possibility of using inefficient technologies, which makes poor user experience with the product.

4. Results and Discussion

Superior interactive design led to an improvement in the process of understanding, experience, and functionality associated with the user. The ease of using the product and its effectiveness appeared through the use of modern technologies, as well as understanding the needs of the users and understanding and identifying the environmental contexts in which the product operates, which consequently led to achieving an enjoyable experience for the user. The employment of modern technologies led to and digital technologies in the industrial product, which made it a robotic product capable of awareness of its environment, which was reflected in achieving interaction between the superior interactive product and the user, and the superior modern technology and techniques employed in the design of the industrial product achieved a high value in the use aspect of those products, which thus became an element of attraction for the user. In addition, the use of superior interactive technologies in industrial products has made the products able to communicate and interact with each other.

5. Conclusion

Interactive design aims to achieve interaction between the product and the user by enhancing the positive aspects and reducing the negative aspects so as to achieve the user's connection to the product, which in turn leads to the user's understanding of the product and enhancing his user experience. Adopting superior digital technologies has helped create a generation of products capable of confronting the problems and obstacles to which the product is exposed and thus finding solutions to those problems independently without the need for user intervention. Most of the modern digital technologies employed in industrial product design that rely on artificial intelligence, such as: voice commands, camera, radar, and sensors, contribute to achieving interaction between the product and the user. Industrial products that are characterized by ease of use, effectiveness of use, the ability to identify and understand the environmental contexts in which they operate, and understanding the user's needs have contributed to providing an enjoyable experience for the user by interacting with them. In addition, the use of modern technologies in industrial products has led to achieving the role of superiority for these products in terms of the functional performance required from the product, which in turn was reflected in achieving an element of attraction for the user. The user tends towards products that achieve ease of use as well as effective performance. Employing artificial intelligence algorithms in products has also contributed to the product's ability to make its own decisions regarding the problems encounters, and thus it has the ability to learn and adapt in the context of its environment in which it operates. Thus, modern technologies and artificial intelligence have contributed to making smart industrial products superior in their functional performance. The product has become able to interact with other products and communicate with each other and the adoption of superior modern technologies in industrial products has generated transformations in the designs of these products, whether these transformations are apparent in the formal appearance of the product or are implicit and not apparent. Therefore, the user looks forward to dealing with smart products that have superior capabilities due to the satisfaction of his needs and the desire to deal with the product

and interact with it. He is in a constant search towards possessing the product of all the technologies that perform its function.

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