

# **Research Review on Artificial Intelligence Technology to Provide Design of Man-machine Interaction in Industry and Product Design**

*(Full Paper)*

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## **ABSTRACT**

This paper discusses the "human-computer interaction medium", "interactive object", "application of artificial intelligence" and "human-computer relationship" in the era of artificial intelligence in the recent years. It's focused on "human-computer interaction of artificial intelligence", based on the in-depth research and insight into advanced technologies, products and designs in the field of artificial intelligence over the past year and combined with the experience of industry and academia. The development trend has formed the design insight in this field, and summarized eight trends of artificial intelligence human-computer interaction. The application of artificial intelligence human-computer interaction design in universities and enterprises related to specific projects of industrial design provides important theoretical support and practical verification for the teaching and scientific research work of industrial design specialty and the further development and growth of industrial design industry in universities and colleges of our country. The application of artificial intelligence technology in universities and enterprises is also demonstrated.

*Keywords:* Artificial Intelligence, human-computer interaction, industry and product design, interactive design

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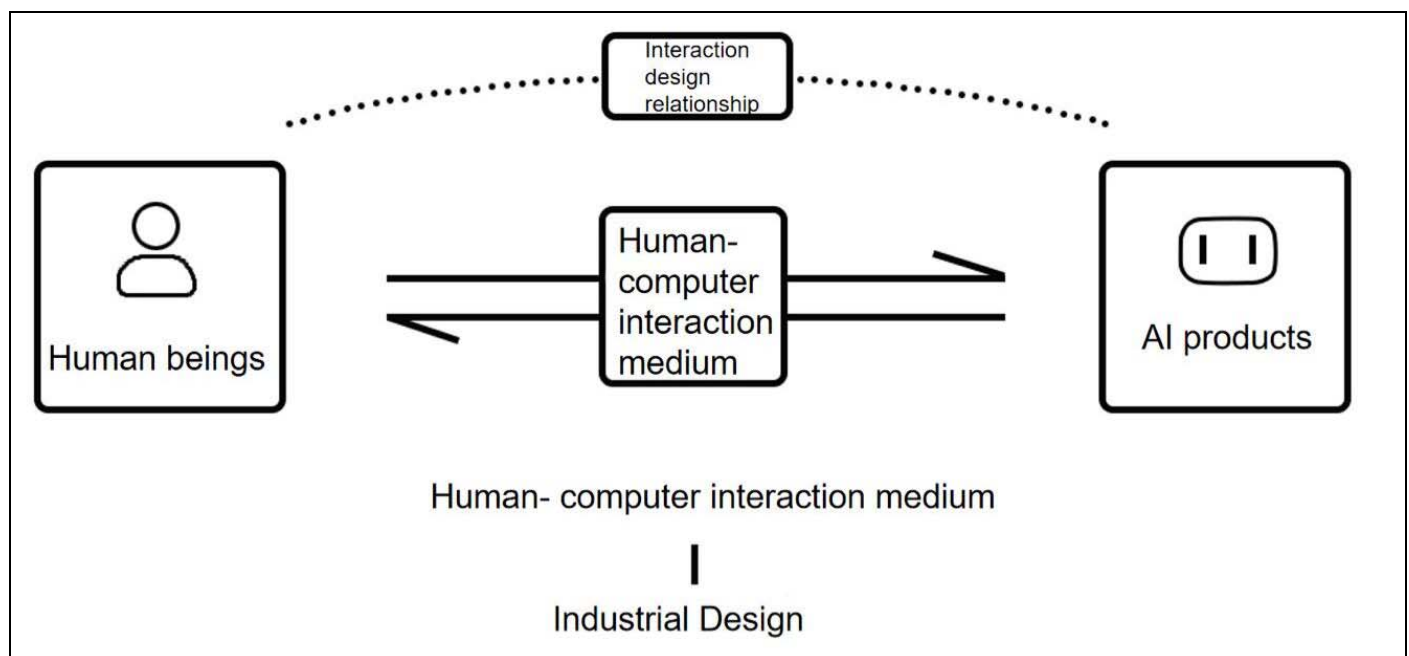
## **INTRODUCTION**

In recent years, the Ministry of Industry and Information Technology has emphasized the deep integration of Artificial Intelligence (AI) with the real economy and manufacturing industry, the development of intelligent products and equipment, and the promotion of the overall upgrading of China's manufacturing products and equipment to "intelligent generation", which is one of the keys to the implementation of Made in China 2025 (Lu, 2015). Under the background of AI, the research of human-computer interaction in industrial design based on AI technology is of great significance to the further development of intelligent design, industrial design transformation, humanized design, interactive design and design services.

In the "Industrial 4.0" era, the global scale of industrial wisdom development is increasing day by day, and its impact on the contemporary cultural industry can't be underestimated. It is mainly based on nine digital industrial technologies, such as Internet of Things, Cloud Computing, Industrial Big Data, Industrial Robot, 3D Printing, Virtual Reality and Artificial Intelligence. Driven by the technology of big data, artificial intelligence and virtual reality, the innovative ability of traditional design industry is constantly improving (Lu, 2012). In the face of unprecedented subversive changes brought about by emerging technologies, the future development of industrial design has ushered in tremendous opportunities for development. The core of "Industrial 4.0" is the value creation of high and new technology. China is not only a big manufacturing country, but also a big using country. The development of intelligent design is growing in China. China is expected to become one of the biggest beneficiaries under the wave of "Industrial 4.0". As a national development strategy, under the background of "Industry 4.0", China's industrial design industry is facing the opportunity of change of the times.

The term "artificial intelligence" was first proposed at the Dartmouth Society in 1956. Artificial Intelligence (AI) is a branch of computer science. It explores the nature of intelligence and creates human intelligence that can respond in a way similar to the purpose of intelligent machines (Pu, 2018). Artificial intelligence is the closest relationship between scientific and philosophical topics. Its research results gather knowledge from psychology, linguistic neuroscience, logic, mathematics, computer science, robotics, economics, sociology and other disciplines. Artificial intelligence research not only enables machines to solve problems, but also pays attention to the self-learning ability of machine research, so that machines can accumulate life experience and wisdom like intelligent creatures, constantly sum up lessons, correct mistakes, improve performance, adapt to changing environment, and also have the ability to discover and invent. This has also become the main content of AI and intelligent design.

Whether it is the definition of industrial design given by the International Industrial Design Association (ICSID) in 1980 or the latest explanation of "design" by ICSID, the importance of "human-computer interaction" in the field of industrial design is clearly stated. With the development and maturity of computer network technology, based on the application of computer-aided industrial design (CAID), interactive design mode based on software design research has also been studied and applied to achieve the goal of usability and user experience humanized design. The research of product human-computer interaction technology model involves the fields limited by cognitive psychology and computer science, often. It embodies the concepts of user interface design (Chen, 2017), information visualization technology flow (Tan, 2018), mobile applications and technology consumption mode theory (Yang, Ma & Sun, 2017), etc. Especially since the 1970s, due to the development of AI based on knowledge acquisition, the research of human-computer interaction in AI is particularly important. In the past two years, AI has developed rapidly. Technically, from the application of single-point technology such as voice control and face recognition, to the development of multi-modal computing that integrates vision, voice and semantics; in application, the force of historical change of artificial intelligence is accelerating the penetration of all walks of life, from product services, to production, operation, to decision-making, in terms of reducing costs, risks, shortening processes, bringing in value-added income and improving production efficiency. In terms of policy, AI has also risen to the strategic position of the country, and related policies have been frequently adopted to encourage industrial development at the national level (Shan, 2017). Technology development, application landing and policy support drive the rapid development of artificial intelligence. Artificial intelligence has changed the way we interact with machines, affected our lives, and redefined our relationship with machines. In the era of artificial intelligence, the change of interactive design is not an evolution, but a reconstruction. It will reconstruct the tools, productivity, life and even aesthetics around us. The relationship between Human-computer interaction and Product Design is shown in Figure 1.



Source: This study.

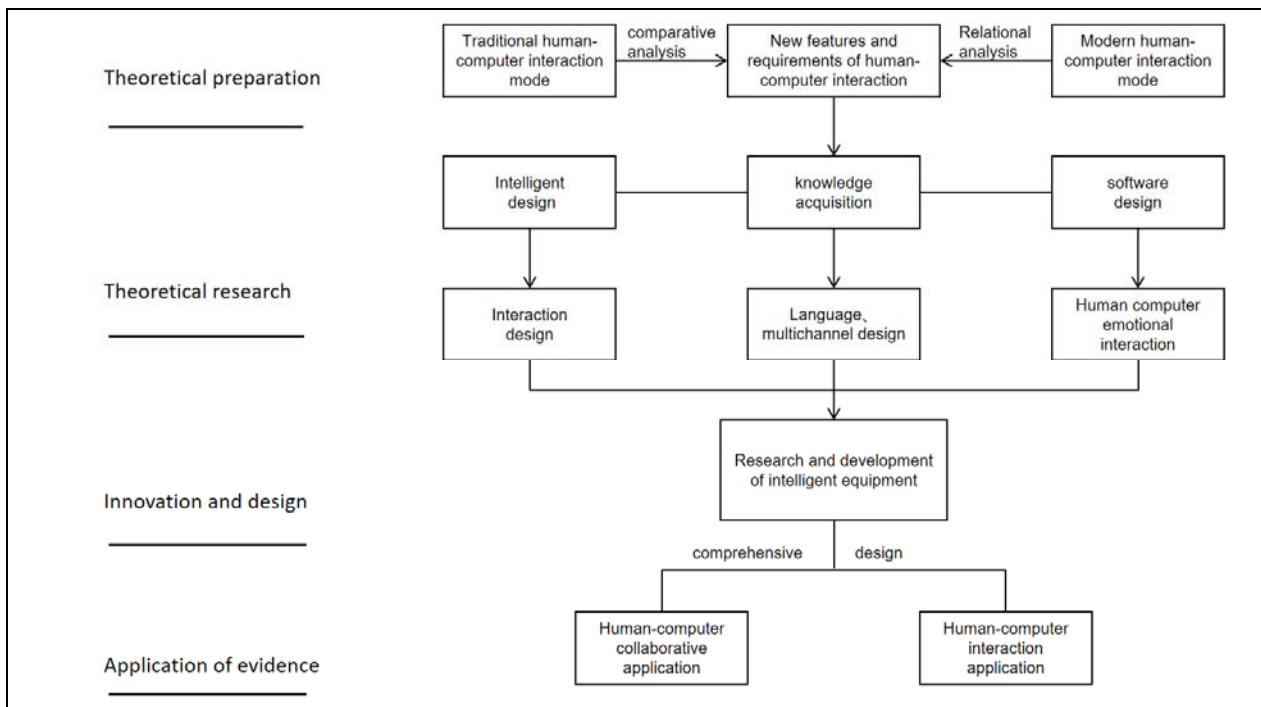
Figure 1: Relationship between Human-computer interaction and Product Design.

### THEORETICAL RESEARCH AND PRACTICAL APPLICATION OF RESEARCH

Artificial intelligence (AI) technology has developed rapidly in recent years, but it belongs to a new field after all. The development time is relatively short and there are many technical problems. All along, the machine learning ability of AI is a "bottleneck" in the field of AI. On the one hand, machine learning restricts the development of artificial intelligence and machine learning; on the other hand, in view of the close relationship with other fields, it requires researchers to work on machine learning, while the development of other fields can be found in new learning algorithms and other areas of learning institutions, thus promoting the new development of machine learning. In view of this, on the basis of the application of the existing artificial intelligence technology, this topic intends to make up for the lack of research on related issues, try to establish an analytical framework for the study of human-computer interaction in industrial design, clarify the analytical methods and technical routes, and make a comprehensive study of human-computer interaction in industrial design from a new perspective. Then, it is necessary to implement the artificial intelligence technology in universities. Empirical research is carried out in enterprises.

The basic research idea of this study is to study the difference between human intelligence and artificial intelligence from the new features and new requirements of the man-machine interaction in the artificial intelligence times through the literature review of the development history of artificial intelligence. The difference and disadvantage of the traditional man-machine interaction mode and the modern man-machine interaction mode are analyzed and compared, the interactive design pattern

based on the intelligent design is studied, and the voice interaction and the multi-channel fusion interaction are realized based on the knowledge acquisition technology, And based on the software design study, the human design and the form of emotional interaction have laid a theoretical foundation for the research of the ability of the intelligent body and the intelligent body to start to have the emotion judgment and the feedback intelligence. Through the research of the intelligent equipment from the man-machine direction to the depth, the building of the trust becomes the first point of the analysis, and then the design of the human-computer interaction application which can realize the humanized and personalized human-computer interaction application of the intelligent product in the artificial intelligence time is explored. The basic research framework is shown in Figure 2.



Source: This study.

Figure 2: Research ideas and methods between Human-computer interaction and Product Design.

Based on the application of existing artificial intelligence technology, starting from the research progress of voice interaction technology, it tends to the perspective of human natural dialogue experience:

- (a) Researching more mediums such as face, gesture and other channels, multi-channel fusion interaction becomes the mainstream interactive form. Research on how intelligent agents begin to have clear human relationships;
- (b) Research agents begin to take active interactions outside passive interactions;
- (c) Study how intelligent agents begin to have emotional judgments and feedback intelligence;
- (d) Rapid development and application of artificial intelligence to specific populations Research on the interoperability of smart devices, multi-scenario convergence;
- (e) From human-machine to deep coordination, trust construction has become the primary breakthrough point.

Establish an analytical framework for researching human-computer interaction in industrial design, clarify analytical methods and technical routes, and study the human-comp.

### HOW TO COMBINE ARTIFICIAL INTELLIGENCE WITH DESIGN

The main goal of artificial intelligence is to machine human intelligence. Once it is implemented, it will produce revolutionary changes, because the characteristics of machines are fast and tireless, which is superior to human beings. If people's intelligence is mechanized, machines will judge, analyze and choose like people. Creative activities can also be carried out. Now some people use artificial intelligence to analyze lottery tickets, and some people have carried out man-machine war. The results prove the feasibility of artificial intelligence. This can also prove its broad prospects in the field of design. Using artificial intelligence, product design can be carried out quickly, omitting some bedding links, and making design a procedural process (Chen, 2017). So far, substantial progress has been made in this work. From the perspective of development trend, artificial intelligence has entered a period of rapid development. For design, intelligent conceptual design software has entered the practical operation stage and is in the process of continuous improvement. We have reason to believe that with the joint efforts of computer experts and new designers, the combination of design and artificial intelligence is not far off.

Application of artificial intelligence in product design: With the development of artificial intelligence, it has been widely used, and has become the core driving force of industrial transformation, which has a profound impact on the development of world

economy, social progress and the improvement of human living standards. In the field of design, combined with the research of related products, it is found that the application of existing intelligent products mainly has the following directions:

### Smart Home Products

With the development of Internet of things technology, smart home has been implemented and applied. Relevant enterprises have designed smart home products around smart phone app. The smart ecosystem is developed by Xiaomi company, through the way of creating typical practical products - Investment Enterprises - multi field cooperation, creates the smart ecosystem of Mijia, and takes the lead in establishing the business model of "hardware platform – crowd-funding - shopping mall". Under this model, the R & D, landing and promotion of smart home products are more smooth, which also ensures that Xiaomi company is the leader in smart home The status of the domain. At the same time, Xiaomi company has developed smart speakers, sweeper robots, smart home cameras and other products to create a rich and comprehensive smart ecosystem. In addition, Alibaba has also established an open platform for smart life, and launched small smart speaker in 2017, marking that it has gradually started the hardware layout of smart home. Google developed the Google home speaker and Amazon launched the echo speaker. The development of smart home platform is also constantly stimulating the transformation and development of traditional home appliance enterprises such as Haier and Midea, and actively promoting the intelligent transformation of their products to build their own smart home platform. The Smart home products – Xiaomi “Tmall Eif” is shown in Figure 3.



Source: Baidu pictures.

Figure 3: Smart home products – Xiaomi “Tmall Eif”

Application of artificial Intelligence in the Design of small Household Appliances: Xiao Ya sound box - focus on experience and service, technology and content, from point to face to connect the small appliances in the environment. iFLYTEK, a small translation translator, has realized the function of real-time speech input and translation, and has become a travel helper for more than a dozen Mandarin languages and more than a dozen national translators. Google clip-ai camera, which uses artificial intelligence technology to take photos, actively screen scenes, video according to the host preferences, and so on, to help users record those meaningful moments. The camera learns to use AI to automatically look for "interesting" scenes, and by constantly analyzing users undefined preferences to independently judge the content of the shot, so that each AI model in the machine learns the trend of a large amount of data through the feedback of the host, and finally constructs a model to meet the needs of the user.

### Smart Wearable Device

Intelligent wearable devices, that is, products are worn on the body, and information can be more easily and directly presented to users, users can also interact with them directly. As far as the current market is concerned, the existing intelligent wearable devices are mainly smart watches and related accessories. At present, apple, Samsung, Huawei, Xiaomi and other enterprises have launched smart watches / bracelets. In addition to the traditional watch functions, these products can also carry out health monitoring and management, real-time SMS and mobile phone calls, as well as rich entertainment functions. Among them, apple recently released the apple watch - Series 4 product, which provides a more accurate and humanized fall detection function. The smart watch extends from the front intelligent life service to a more detailed security service.

Intelligent wearable products are the key fields of artificial intelligence applications. The changes brought about by their development can be extended to the unlimited expansion of human individual capabilities, the transformation of human world communication and existence forms. The Smart wearable device – smart Watch – Series is shown in Figure 4.



Source: Baidu pictures.

Figure 4: Smart wearable device – smart Watch – Series

#### *The use of artificial Intelligence in Medical products*

Watson Oncology solution-learn about the latest developments in the subject through a wealth of research, medical records, and clinical trials. Now, through the cooperation between IBM and MSK, Watson uses the expertise of the world-renowned MSK company to assess and analyze the specific situation of each patient in depth. Watson Clinical trial matching-helps identify potential candidates for clinical trial matching. By using cognitive calculation, Watson can analyze the characteristics of potential candidates in clinical trials, and help clinicians to select suitable candidates for clinical trials more quickly and effectively by evaluating the extent to which these candidates meet the relevant conditions.

#### **Other Smart Devices**

The generation of intelligent devices relies on the development of intelligent technology. The application of artificial intelligence mentioned above is mostly the design of intelligent products, and intelligent robots are also widely developed devices. The reasonable application of different technologies has produced a variety of intelligent robots suitable for various environments. The intelligent robot shows the understanding and communication ability of artificial intelligence incisively and vividly, and through the analysis of its own environment, it can actively make actions to meet the operator's requirements, and even can make intelligent activities such as judgment, logical analysis, understanding, etc. The product application of intelligent robots is still dominated by service robots, such as service robots in restaurants and shopping malls, as well as home-work robots and children's companion robots. Although it is rarely used in daily life, the position of intelligent robot is particularly important in today's society, and the heat of related technology research is rising.

#### *Application of artificial Intelligence in Traffic Travel products*

Waymo-- reduces the error rate of driverless car through the intervention of AI, grasps the learning result of neural network through the study of artificial intelligence, enables the unmanned vehicle to predict some emergencies or emergencies quickly, and gradually improves the overall level of automobile intelligence, such as: auxiliary, partially automatic, highly automatic and completely self-driving four different application modes. Combined with the pedestrian recognition, vehicle recognition, obstacle recognition, there are three major environmental awareness technologies.

### **HOW AI SUPPORTED PRODUCT DESIGN AND EMBEDDED IN SMART PRODUCT FOR INTERACTING WITH USERS**

#### **Innovation of Product Design Thinking**

The most important thing in production design is thinking innovation. Under the influence of artificial intelligence technology, production, the change of product design thinking is the highlight of innovation (Tan, 2017). The biggest pursuit of AI is to realize.

People's thinking ability and judgment ability, but judging from the current technological development, artificial intelligence has wisdom Strength without the smart, intelligence without Eq. AI can replace many parts of production design. But it has not been involved in reasoning, thinking, overall planning and cultural integration (Huang, 2016). Therefore, under the influence of artificial intelligence, product design should focus on emotion and humanity; In addition, the current artificial intelligence is not separated from human intelligence, which is always designed under human intervention. When the two cooperate, people should pay more attention to the interaction with artificial intelligence in product design. The artificial intelligence in product design can be regarded as a collection of the great achievements of human product design in the past, so our thinking in product design should be creative, original and open Finally, the thinking innovation of product design is more likely under the support of artificial intelligence, while eliminating the theoretical research of tedious literature, making the design thinking stand on the shoulder of artificial intelligence.

#### **Innovation of Product Design Method**

Artificial intelligence technology can replace and assist human designers in product design. At present, AI has not completely changed the process of product design, but in product design. The method has been innovated. Specifically, there are the following aspects: Firstly, by interacting with designers, AI Only the investigation results of similar design in the past can be obtained, and the success of such design can be more analyzed and judged in the research stage of product design. The advantages and disadvantages are available for designers to choose from. Second, On the one hand, artificial intelligence can select the past for designers in the design stage. On the other hand, it can make the design idea intuitive, through the cognitive model construction and processing of design analysis, the potential design ideas are simulated, Let the vision, technicality and feasibility of the design idea be presented through VR, 3D printing technology, etc. Column, assist the designer to analyze several design ideas and provide solutions to each idea. In order to make the design more targeted, advanced, original and feasible, we should eliminate the interference as much as possible. Third, the design prototype can be tested and optimized in the artificial intelligence environment by using artificial intelligence software to test function and mature calculation in the design stage. The intelligent debugging function includes several major modules such as vision, language, language, interaction, knowledge, search and so on. It carries out design inspection, model detection, voice interaction, emotional analysis and so on for product design. Under the operation of the designer, artificial intelligence presents the optimization results directly, and its advantages, disadvantages, characteristics and so on are clear at a glance. Fourthly, the verification stage of the thinking and requirements of product design are constantly updated iteratively. The solutions in the design may become the starting point of design update. The results of product design optimization are tested and verified to make the feedback of product design more accurate and more conducive to the improvement and perfection of designers. In the traditional design process, this step is tedious and time-consuming. In the artificial intelligence environment, it can shield the previous unilateral defects of verification, not only from the macro perspective, but also from the micro perspective (Liu & Gao 2016). For example, A / B test is carried out on the verification algorithm, and at the same time, it is compared with the design in the database to get the approval degree, so that the product design of the success rate is higher.

### **Innovation of Product Design Requirements and Objectives**

Under the influence of artificial intelligence technology, product design is closer to industrialization, and it is easier to mass produce after design. After thousands of years of evolution, the requirements of product design in the artificial intelligence environment, including function, shape, material, color, ease of use, uniqueness, culture and so on, have changed. Under the demand innovation, the design goal is more complex, more hierarchical and inclusive. In terms of function, from single to overlay, from single, heavy to diverse, light and thin, materials from only to diverse, colors from simple to diverse and then to simple. These design goals are the requirements of the times, the talents given to designers by artificial intelligence, and also higher requirements for designers.

### **WHAT ARE THE FUTURE PERSPECTIVES IN THE ABOVE TWO ASPECTS**

The development of artificial intelligence has gone through more than 60 years, and its overall development level is still in the initial stage (Tan, Zhang & Xu, 2016). Especially, in the field of product design, the research and application of artificial intelligence still has a long way to go. As far as the current situation is concerned, its development trend can be roughly analyzed as follows:

#### **The Design of AI Products Should be Guided by "Human Characteristics".**

Human brain is a general-purpose intelligent system, which can draw inferences from one example and make a comprehensive understanding. It can flexibly handle a variety of feelings and perceptions, and can learn, reason, judge, think, plan, design and other issues. At the same time, human is unpredictable and capricious. The premise of intelligent product application is human needs, but these machines can only provide some speed, power or consistent operation that human cannot achieve, and lack of social, imagination and empathy. Machines do not know the impact of their behavior on the surrounding. In other words, in the current artificial intelligence, there is intelligence without intelligence (unconsciousness and comprehension, lack of comprehensive decision-making ability), intelligence without emotional intelligence (lack of emotional understanding and communication ability of machines), accounting can't "calculate", there are experts without generalists. Therefore, although the current intelligent products are practical, there is still a long way to go before they are "easy to use".

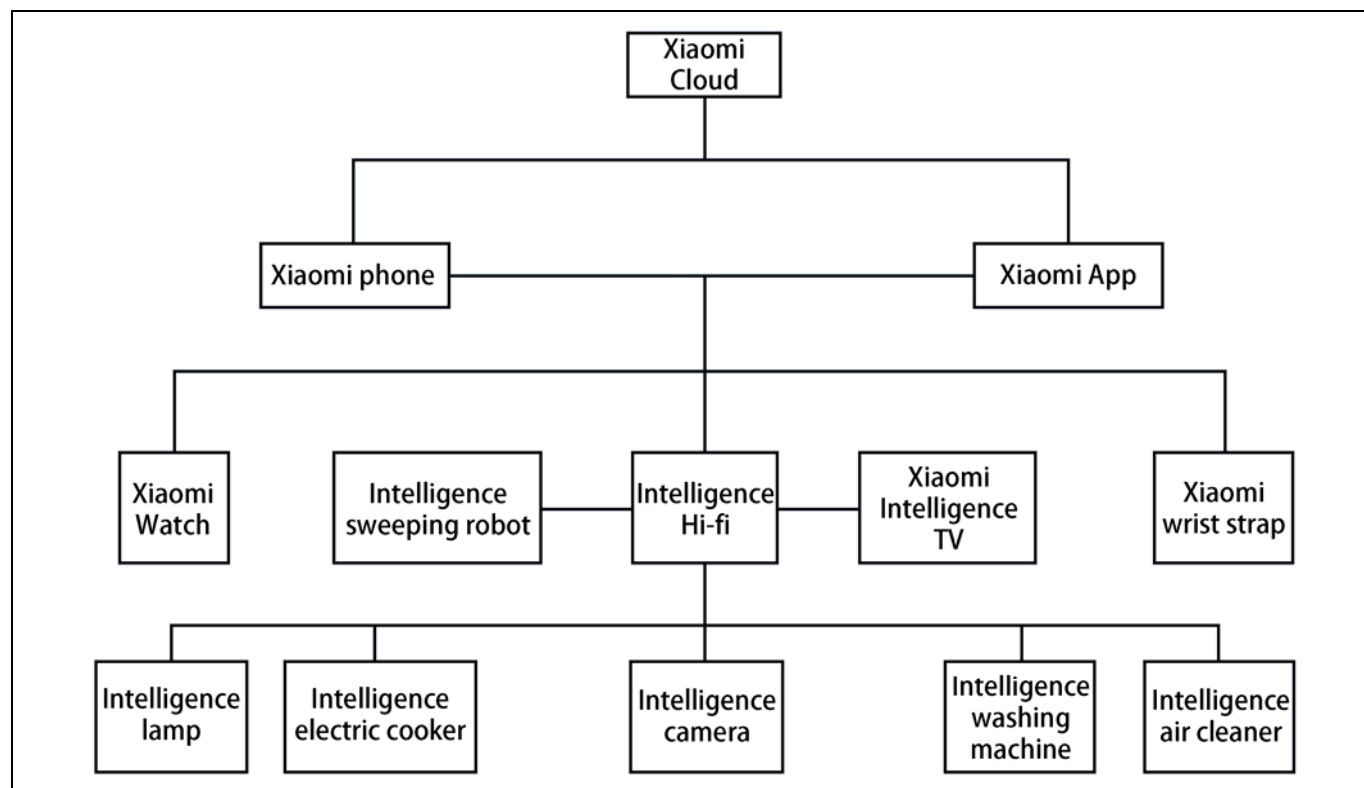
#### **Artificial Intelligence Products Should Aim at "Human-Machine Integration" and Pay Attention to "Intelligence".**

At present, artificial intelligence is still inseparable from the word "artificial". Xie, Xia and Pan (2019) said that most products in the market are in the era of semi-automatic and semi intelligent. When users use the product, they should not only hand over the work to the product to complete, but also have to pay attention to its working state to avoid unexpected situations, which is also the performance of the current artificial intelligence application is not perfect. To realize real intelligence, we need to overcome the gap between people and machines, realize the human-machine community, and complement each other. At the same time, when giving machine (product) and multi Initiative (intelligence, even emotion and personality), the interaction between human and computer is more important, so the intelligent product must have good interaction design support.

#### *Application of artificial Intelligence in APP Product Design*

Artificial intelligence visual is recognition and speech recognition industry. The software product Mail-- can screen spam, and the new version of Mail adds the function of "Smart Compose" (Tan, 2017). By learning the language habits of users, entering words in the process of sending mail will automatically help users generate recommended possible phrases and sentences. Google News-- uses AI to intervene in the way people read news, and you watch an interesting piece of news that pushes other

relevant news. A new generation of Google assistants-intelligent assistants who can call. Using Wavelet technology of Deep Mind, six kinds of voice can be provided (Lu, 2015). For example, Xiaomi smart home system is actually around Xiaomi smart phone as the center, by Xiaomi TV, Xiaomi routing, Xiaomi air purifier, Xiaomi camera, Xiaomi smart lamps, Xiaomi body weight scale, Xiaomi bracelet and other Xiaomi ecological smart hardware composition of a smart home system. Through the linkage between each intelligent device form a certain application scene, so as to achieve intelligent home control. The Xiaomi intelligent ecosystem is shown in Figure 5.



Source: This study.

Figure 5: Xiaomi intelligent ecosystem

**"Intelligent Technology" is the Main Driving Force for the Design and Development of Artificial Intelligence Products.**

The development of artificial intelligence technology is the key factor of intelligent design. It attempts to understand the essence of intelligence with various principles and means, and simulate a system similar to human intelligence. Yin, Ren and He (2008) said the content of intelligent technology is diverse and highly complex, including reasoning, language recognition, natural language processing, image recognition and expert system. Since the birth of artificial intelligence, its related theory and application technology are increasingly mature, and its application field is also expanding. As mentioned above, the application of various intelligent systems and intelligent products explores people's new life style. In addition, the application of artificial intelligence in product design should not only meet the basic functions, but also pay attention to its emotional design to improve the user experience and improve the user's quality of life (Liu, Yan & Chen 2016). This century is a new era of technology development and innovation, artificial intelligence products will become more and more common. The future trend of product design is humanization, emotion and intelligence.

*Five artificial Intelligence Innovation platforms in China*

Baidu -- self-driving: Apollo self-driving taxi fleet; Alibaba - City Brain (Concept); Tencent -- medical imaging: tencent search, ai-assisted open platform (aggregation of the ability of a number of top artificial intelligence teams, using image recognition, big data processing, deep learning and other leading technology, and medical cross-border integration of research and development, can assist doctors in disease screening and diagnosis, improve the diagnostic accuracy and efficiency of clinicians. ); iFLYTEK, HKUST - Smart Voice: Full House Smart Voice Panel; Shang Tang - Intelligent Vision: Sense Engine AI Visual Module. By the end of 2018, more than 20 provinces in China have issued more than 30 artificial intelligence special support policies. The three artificial intelligence industry agglomeration areas represented by Beijing, Guangdong and Yangtze River Delta were initially formed, accounting for 86% of the total number of artificial intelligence enterprises in the country. There are more than 1000 artificial intelligence enterprises in China. Baidu, Ali, Tencent and other technology giants have taken the lead in stepping into full-scale application, business soup, cloud from, broad view, Yitu and other head startups such as commercial competition.

**CONCLUSION**

In summary, with the development of new technology in the "industrial 4.0" era, the development and wide application of artificial intelligence technology, as the closest relationship between science and philosophy, its research results gather the knowledge from psychology, linguistic neuroscience, logic, mathematics, computer science, robotics, economics, sociology and other disciplines, and in the field of future industrial design. Artificial intelligence is in full swing in the current society, the application prospect of related technology in product design is very broad. In the 21st century, human beings are planning, science is studying, technology is cooperating, with the development of Internet of things, Internet of things technology, cloud space and big data application, artificial intelligence will participate in people overturn life more and more, change or even subvert people overturn life and mode of production. The process and method pattern of human-computer interaction design will change. The research on the interaction of intelligent design under the application of artificial intelligence, especially the comprehensive research on the human-computer interaction service of new industrial design, is still rare. With the development of artificial intelligence technology, the integration of intelligent elements into product design has become a mainstream direction of contemporary design. It has shown great application prospect in many fields.

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