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Analysis of the current situation of mechatronics and electronic chips

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Abstract: *With the rapid development of technology, mechatronics engineering has evolved and progressed greatly in technology. Electrical automation is the use of electronic and computer-controlled equipment to undertake the control of processes. In these processes, no labor is needed because the computerized equipment does all the manufacturing and production. In most cases, automation has replaced labor. And in the past decade or two, the technology of chips has continued to innovate and solve many challenges. With the development of human technology, chips have managed to become irreplaceable in many areas. They are needed in many places because of their outstanding features and benefits. As a result, different kinds of chips have emerged that are needed in different situations and places. They have unique structures and functions that are perfectly suited to work in specific areas. So far, they have provided uncountable benefits to human society.*

Keywords: *electrical automation, rational applications, computing architecture, smart chips, future development*

1. Introduction

Mechatronics' aims to provide users with appropriate solutions that unite the subfields of robotics, electronics, and computers. [1]By using mechatronics, the whole process is made to work more efficiently and intelligently. For example, products including electronic chips, automotive anti-lock systems, and computer hard drives require computers and electronic control systems (mechatronics) to function.[2]Therefore, due to the goal of mechatronics, it has become an important basis for the expected growth of automation and manufacturing [3].

In the past, although only conventional machinery was used for industrial manufacturing, inefficient production and low-quality products were hardly enough to meet the demand. A new technology was needed to change this situation: mechatronics. With the help of mechatronics, manufacturing has been effectively improved through more efficient production, higher quality, and more diverse products. Currently, mechatronics has become almost a necessity for production and manufacturing. Therefore, mechatronics is the inevitable result of the current development of social productivity to a certain extent.

2. Analysis of mechatronics engineering

2.1. The characteristics and comparison of techniques in Mechatronics

Because mechatronics implies the development of technology, various advanced technologies are included in it and make it possible to enhance technologies such as information processing, sensing technology and mechanical ontology [4] are highly used in many fields and product manufacturing. They have greatly contributed to the development of mechatronics.

The basic meaning of mechatronics technology is to be able to preset guidance for mechanical engineering to achieve a more intelligent, automated and simplified mechanical control system, so as to ensure the comprehensive effect of lower and less consumption, more functions, less damage to the environment and higher production efficiency in the operation of mechanical engineering. Through the above elaboration, we can see that the realization of mechatronics technology re-optimizes the processes and steps of mechanical engineering. At the same time, the reasonable application of mechatronics technology to the field of intelligent manufacturing can give full play to its linear and non-linear advantages, which is the key technology to ensure that the operation of intelligent manufacturing systems

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is always maintained in a stable state and the accuracy of the control system. Analyzed from the overall reference level of mechatronics technology, it can continuously optimize and improve the functions of networked data exchange ability, intelligent manufacturing accuracy, manufacturing quality and efficiency, and data processing security of intelligent manufacturing technology.

Information processing technology has been closely related to mechatronics and electronics. It mainly represents the management of information by computer machines. This technology not only accelerates the speed of computer processing information, but also allows high precision processing of huge amount of information and data. The development of mechatronics cannot be achieved without highly reliable information processing equipment. Therefore, in order to further develop mechatronics, information processing is one of the necessary technologies, but there is still a long way to go. To solve some of the current problems, the speed of processing data and stable output should be improved. This technology has already achieved brilliant success in some fields and products. For example, the microcomputer is a unique product of this technology. It has benefited to a great extent from the information processing technology that has improved the speed of operation and structure. By developing mechatronics in the process of technology innovation, this has been widely used by people all over the world.

Mechatronics is based on mechanical ontology. Its main components are the construction and shape of machines and mechanical products. Since today's industrial machinery is mainly made of steel, the aim of this technology is to improve its performance and reduce its weight. With the development of mechatronics, heavy mechanical products need to be replaced by lighter and more flexible machines. The goal of improving efficiency, reducing energy consumption, and promoting mechatronics is achieved.

Sensing technology is another important technology for mechatronics. It is a technology that obtains and converts into readable signals by sensors that detect physical, chemical or biological properties.[5] Detecting or transmitting signals quickly and accurately is a challenge for mechatronics. Problems such as interference have hindered the development of mechatronics. However, due to the development of this technology the quality and quantity of information transmission comedy has improved simultaneously. A clear example of the results of this improvement. Robots can react and respond more sensitively to external stimuli. Thus, advances in sensing technology can even facilitate the development of mechatronics.

Mechanical engineering involves the production of a component, machine, system or process by using the laws of motion, energy and force. It is primarily about the machine itself and its production. Moreover, the field of mechanical engineering affects almost every area of life today [6], including our own, and it is a very complex mechanism of machines. On the other hand, Mechatronics is a multidisciplinary engineering field that concentrates on the engineering of mechanical and electrical products and systems. It integrates the laws of mechanics, electronics and computing to improve technological systems and create new devices [7]. New developments include products such as automated guided vehicles and robots, all of which require primarily mechatronic technology.

In addition, the control operations of traditional mechanical technology are mainly implemented through various electrical appliances[6]. During the design process, it rarely considers the connections and relationships between appliances. It is common to not use computational machinery. For mechatronics, the process emphasizes the interaction and influence between mechanical parts and bodies. It becomes more intelligent and stable when the whole process has a computer as the control center.

2.2. Advantages of techniques

Mechatronics technology is closely related to computer operation technology. The use of computer technology can be used to indicate the technical operation of mechatronics technology, or self-testing and correction. In view of the retrieval of program errors and abnormal situations in the operation process, mechatronics technology uses computer technology calculation to formulate corresponding response plans. The situation of alarm and early warning is transmitted to the outside world so that the operator can find and deal with it. Mechanical manufacturing under the management of mechatronic technology, the overall manufacturing process is more secure, stable and easy to operate.

Eventually, Mechatronics techniques also have the advantage of low loss. In fact, the old-style engineering construction process, due to the lack of accurate control of the computer, cannot manage the construction information in time. As a result, when problems occur in the actual construction, professional technicians are required to conduct technical testing on each operation link. This working mode not only wastes labor costs, but also cannot fully guarantee the quality of its testing, and the operation efficiency is inefficient. Under the computer technology, the project construction is carried out

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through the minimum loss amount of immediate use, which minimizes the material and construction cost loss.

With the existence of these advantages in techniques, Mechatronics has widely been utilized in situations such as production and construction. As it embodies its properties in a variety of fields, it supports and promotes modern techniques in areas.

2.3. Future development

Mechatronics is undergoing rapid change, driven in large part by progressively more powerful processor technology. It has now made great achievements in many fields, including some recently emerged industries. It is clear that mechatronics will be greatly developed more areas can be further developed by taking advantage of its advanced technology.

The chip is the masterpiece of human industrial civilization and the symbol of the human being towards the age of intelligence. Under the development of mechatronics, the field of electronic chip production has made great progress in technology. The main direction of improving electronic chips in the future is intelligence through the core technology of sensors and data acquisition[8]. In order to improve the quality and produce sufficient number of chips, the whole production process is mostly done by mechatronics technology. In the future, the production of electronic chips will rely on these technologies to increase the accuracy and efficiency. The development of mechatronics technologies is necessary to obtain further growth of chips.

The robotics industry has been benefiting from mechatronics. However, the technology for special robots that have many applications in the future is maturing, such as drones. Over the years, improvements in drones have been made in terms of safety and functionality. Due to the continuous development of mechanics, drones have overcome many technical problems. There are already many drones used in people's production life, such as agricultural plant protection drones and agricultural by-product pickers. The application of drones in agricultural plant conservation has greatly reduced the labor intensity of farmers, while also allowing large-scale insecticide spraying and real-time monitoring of crops; picking is the last and most important part of agricultural production, and the emergence of picking drones in large area planting The presence of picking drones ensures the integrity, beauty and quality of agricultural by-products. In the future, they may be used in several different contexts, such as daily service, military and rescue. The core technologies of mechatronics will continue to support drones, making information processing and sensing and detection technologies better.

3. Electrical automation

3.1. Type of engineering

Electrical automation is the use of electronic and computer-controlled equipment to control processes. In these processes, comprehensive monitoring of electrical equipment is achieved through the cooperation of various information technology tools and intelligent management tools, which, with the help of relevant instruments and equipment, separate the equipment from human monitoring and management and realize the effects of automatic monitoring and control. Sensors in electrical automation control are primarily responsible for acquiring information, monitoring equipment operating processes in real time, and transferring data to computers, which in turn issue instructions to maintain normal operation of the equipment. Electrical automation technology can form a more stable management system with greater integration and control.

The term "manufacturing" refers to the transformation of raw materials and components into finished products, usually on a large scale in a factory, which is usually done by labor. However, in many manufacturing plants today, robotic assembly lines are gradually replacing the humans who used to stand on the production lines [9]. The manufacturing industry has benefited from the development of electrical automation technology. In fact, the purpose of electrical automation is to increase efficiency and reliability. It is certain that electrical automation is leading the way in many fields.

3.2. Application characteristics

Electrical automation technology in general includes a complex and diverse range of technologies. The three main technologies in electrical engineering applications are centralized monitoring, remote

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monitoring and fieldbus monitoring, which provide the necessary help for the development of electrical automation.

Centralized monitoring technology mainly uses a centralized system to achieve overall monitoring. It mainly replaces the traditional complex monitoring model and improves efficiency. In the past, all the items that needed to be monitored stayed in individual parts and it was difficult for the staff to monitor them. However, the current technology can centralize all the parts into one monitoring system so that there is no need to worry about the connection between all the machines. It is useful for most industrial and manufacturing industries. For example, a large factory is producing a great many products. This may seem like a daunting task to accomplish. However, centralized monitoring allows the monitoring personnel to sit in one place, which makes this technology very useful.

Fieldbus monitoring technology is the most effective and widespread application in electrical engineering. It is used to establish connections between monitoring systems and electrical devices. Due to the characteristics of fieldbus monitoring, it can be designed according to the spacing between devices when it is actually used. It can be highly positioned for its actual spacing. In addition, with the continuous development of modern network technology, each electronic engineering in the fieldbus monitoring system is interconnected using a communication network, which realizes the mobility and independence of the fieldbus monitoring technology. The communication network solves the problem that the whole system in electrical engineering is difficult to operate if one device is wrong.

3.3. Comparison of advantages and disadvantages

As an important technology in many fields, electrical automation has many advantages and disadvantages in its core technology.

Firstly, electrical automation has no labor problems, which is a clear advantage of its automation properties. As a result, it reduces production costs because people do not need to pay wages this will boost manufacturing more importantly, there are some tasks that may not be a good idea to be handled by humans. However, machines with electrical automation technology can solve these problems independently and with high efficiency and accuracy, such as moving heavy products from one place to another.

Another benefit of applying electrical automation technology is the reduced wear and tear and cost of the machine. The centralized monitoring technology in electrical automation mixes all the items in one system. The connections between devices become stronger and more stable. As a result, the number of cables and processors required is rapidly decreasing. This technology reduces the operating costs of the whole system and increases its reliability and safety of operation at the same time.

The advantages of electric automation technology in electrical engineering are undisputed and can be widely used in electrical engineering. At present, electrical automation technology is widely used in electrical engineering, especially in the optimal configuration of electrical equipment automation, bus control system optimization, substation automation management and remote monitoring and control play an important role in these areas. It can be said that the application of electric automation technology in electrical engineering is very strong practicality and applicability, with the increase of the field of electrical engineering, the application of electric automation technology is becoming more and more extensive, so we must further increase the research of electric automation technology to play a good role in the advantages and role of electric automation technology.

3.4. Rational application

Although the electrical automation technology can operate the whole operation process by itself, it still has some safety problems. In fact, some problems are caused by over-reliance on automation. In order to prevent accidents, people need to take into account some unexpected situations. For example, Tesla has now introduced a new feature for their cars to drive automatically. It uses infrared light and radar to survey the road. However, this new technology still requires the driver to be in their seat because something sudden may happen that must have an operator.

The application of electrical automation usually contains many complex and precise machines. Otherwise, there is a risk that the whole system will not work.

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4. The chip

4.1. Introduction of smart chip classification

GPU stands for graphics processing unit and is also known as general purpose chip. GPU is a single instruction, multi-data processing that uses a large number of computing units and an extra-long pipeline. It deals mainly with the acceleration of operations in the image domain. GPUs were the first processors to develop parallel accelerated operations, which are faster than CPUs and more flexible than other chips, and gas pedal chips are more flexible and easier to program. However, the GPU cannot work on its own without calling the CPU, because it depends on instructions. It is an expert at processing large amounts of data, but not a standalone expert. Therefore, despite its incredible computing power, the GPU has some limitations.

FPGAs are semiconductor devices connected using programmable interconnects, which are arrays of configurable logic blocks (CLBs) based on CLBs. FPGAs can be easily reprogrammed after production according to the desired application or requirements. This fully demonstrates their mobility and creates more options for users. Moreover, they can even perform data-parallel and task-parallel computations at the same time, which results in more significant efficiency gains when dealing with specific applications. Faced with specific computational processes, traditional CPUs require more time to process them, while FPGAs can be programmed to reorganize circuits and generate dedicated circuits directly, consuming only a small amount of time to complete the operation. Due to the benefits of high performance and flexibility, many areas of development are gradually approaching FPGAs.

Application-specific integrated circuits (ASICs) are microchips designed for specific applications, such as communication protocols or portable computers. Although it is not scalable, it offers advantages in terms of power consumption, reliability, and size, especially in mobile devices with high performance and low power consumption. Despite these advantages, its most important characteristic is its relevance. In specific situations, ASIC would be the best choice because it is more mobile and gives a differentiated computational approach for only one situation. For example, the famous AlphaGo uses about 170 graphics processing units (GPUs) and 1200 central processing units (CPUs), which requires a computer room, a high-powered air conditioner, and several professionals to maintain the system. If all were ASICs, the memory space it would occupy would be the size of an ordinary storage box and would greatly reduce power consumption]. However, ASICs still face problems such as high costs and long construction cycles. It requires long-term technology deposition.

Brain-like chip architecture is a new chip programming architecture that simulates the neural network model of the human brain to perceive, behave, and think in a way that mimics human brain functions. It has a complex architecture that is designed to create an electronic brain. To simulate the brain, one uses storage units as synapses, computational units as neurons, and transmission units as axons. This is likely to be the future of artificial intelligence because of its special property: sensation.

4.2. The similarities and differences between traditional computing architecture and brain-like computing architecture

At present, people have a vast computing world, and all computers, cell phones, and servers, are based on von Neumann's architecture. The separation of computation and storage, where CPU is responsible for computation, memory is responsible for storage, and hard disk plus input-output system, is known as the most common computer system nowadays. However, the problem came out when training AI programs with large amount of data after entering the era of artificial intelligence. It was found that von Neumann's architecture consumes a lot of time and energy due to the constant exchange of data between CPU and memory, and this flaw is becoming more and more obvious. Therefore, scientists thought of the human brain to face this challenge, because the brain has an unparalleled function: thinking.

Both brain-like computing architectures and traditional computing architectures aim at the same direction of development, which is low energy consumption and high computing power. As people move into the Al era, the computational power required to run programs is increasing. For traditional computing architectures, people have increased the number of sensors to increase the power. However, the energy consumption of this approach is usually huge. Humans can only improve the quality and efficiency of chips. This limitation hinders the development of traditional computing architectures. On the other hand, simulating the human brain is a perfect way to reduce energy consumption and increase computational power. However, the difficulties are obvious. Brain-like computing architectures must replicate the reality of the human brain, which is a huge challenge for cold machines. It has a long way to go before

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the technology becomes more and more powerful.

Despite this goal, brain-like computing architectures have a completely different neuromorphic architecture compared to the traditional von Neumann architecture. To mimic the brain, the storage units of the neural chip are constructed as synapses, the computational units as neurons, and the transmission units as axons. In a human brain which is similar to this structure, the distribution of charged ions inside and outside the cell membrane will change after a brain neuron receives stimulation. As a result, this process creates a potential difference, which will be transmitted in both directions along the axon and dendrites of the nerve cell, forming a pulse current. When this electrical signal is transmitted to the synapse, neurotransmitters are released from the neurons that precede the synapse, thus making neurotransmitters available from the post-synaptic neurons. They produce pleasure, which then works with the human reactor to transmit the effect down and respond. The design of this architecture changes the basic structure of the chip and even changes the device level.

Another difference appears in the consumption of these two architectures. For traditional computing architectures, design flaws are shown in the face of huge data volumes. Since storage and computation are spatially separated, each time a computer runs an operation, it needs to call back and forth between two areas, CPU, and memory. The frequent data exchange leads to inefficient processing of massive amounts of information. In addition, when the chip is in working condition, most of the electrical energy will be converted into heat, leading to increased power consumption. However, brain-like computing architectures are designed to compute and store as the human brain does, and due to their architecture, their consumption is relatively low, the Truenorth example uses Samsung’s 28nm power process technology to create an on-chip network of 5.4 billion transistors with 4,096 synaptic cores, i.e. a runtime consumption of only 70mW.

More importantly, the brain-like computing architecture's approach to computing differs from traditional computing architectures. Brain-like computing architectures no longer utilize stable 0 and 1 commands. Instead, complex information comes out and creates more possibilities. This process has the potential to become fitted. Although the complexity of this computational approach is still high, it will lead to a revolution in computational architecture.

4.3. The application of smart chips in computing and medical rehabilitation

The CPU in computers is one typical example of smart chips. It is a super-large-scale integrated circuit which is the core of the operation and control of the computer system. The central processor mainly includes two parts which are the controller, the operator while high-speed memory and the data implements control the connection between them. Its functions are mainly to interpret computer instructions and process data in computer software. CPU, as the base of many electronic devices, is significant for computers due to its functions.

In Artificial intelligence, the typical smart chips are ASICs. The famous example of ASIC is the TPU used in AlphaGo. According to the Google, TPU replaces more than a thousand CPUs and hundreds of GPUs in AlphaGo.It aims at the deep studying and computing of AlphaGo. Comparing to the traditional GPUs and CPUs, it has much lower energy consumption as it is designed for AlphaGo for special purpose. As a result, AlphaGo acquires successive self-studying ability and surprising computing speed. Though there is big limitation for ASIC chips, it highly improves the ability and computing level of the AI.

The representative example of Brain-like chips is Tsinghua University's "sky movement". This chip is not the traditional 0, 1 switch circuit, but to simulate the human neurons, the human neurons of the dendrites and axons with the circuit simulation. When it receives input stimuli more than the threshold, it will give output backwards. If it receives less than the threshold, no output will be given. Also, output would be given with the time, waveform, phase, and a variety of information. To be precise, the output value of the whole system is not calculated but fitted. The Brain-like chips are still on the beginning of growth and face numerous difficulties. The innovation of them may roll up the wave of new ways of computing.

On the other side, smart chips are gradually becoming irreplaceable products in the medical rehabilitation. There is a variety of applications in healthcare and medical treatment. To some extent, it changes the method of modern medical science. Also, to fit the smart chips, the special AI computing method is coordinated in treatment for improving computing power of chips. According to DeePress, this method of treatment used a lot of data to do the test. The test results show that the deep-thinking artificial intelligence M-DPU using this kind of medical chip is able to intelligently classify 90,000 cells in 100 seconds. 99.3% accuracy appears in cell class classification. The smart chips do a great job in detecting

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human body condition.

In addition, the smart chips can be inserted in body in order to promote medical rehabilitation. At present, the function of them is limited to some simple movements in the real life. It may help some patients but not a lot. However, implanted chips are expected to enhance human ability. The interaction between implantable chips and the human body relies on signal conversion and transmission. Most animals' internal and external behaviors are controlled by brain nerves. Stimulation of specific cells obtains the corresponding neural signals that are transmitted between the brain and the organs. The chips can use electricity to join the process and improve the ability of people. For instance, the stimulation of the brain by the chip may help alleviate the condition in Alzheimer's patients. Stimulation and repair of brain cells can possibly restore the memory.

Furthermore, the smart chips can be placed in the micro robots which are used in medical rehabilitation. The chips can control the robots to get to the accurate position of human body. The robots are able to deliver the medicine for the patients without pain. In fact, it can not only carry the medicine but also kill cancer cells. As a result, this technique can be used for many types of cancer. There are still a lot of possibilities in this technique to promote medical rehabilitation.

4.4. The development direction of the chip

For the era of artificial intelligence, smart chips are in an increasingly important position. No matter in which field, the utilization of smart chips will increase. For AI chip makers, in addition to their technological development strength in software and hardware, market knowledge and cost control are also indispensable capabilities. To adapt to this era, smart chips will continue to innovate and improve quality.

Most of the current chips continue the development path of traditional computing architectures, aiming to accelerate the computing power of hardware. However, along with the increase in computing power, problems with the chip in terms of consumption will emerge to plague the program. There are ways to face this challenge and potentially break the current bottleneck. For example, compute and storage integration technologies eliminate the need for data movement and can achieve significant improvements in power performance.

Chips with brain-like computing architectures are considered suitable for the era of artificial intelligence. In recent years, an increasing amount of research has focused on improving the adaptive capabilities of neural networks, cognitive computing models, and intelligent systems, as well as developing sustainable human-like learning mechanisms, which requires brain science to build cognitive architectures that accommodate such learning mechanisms. In the future, chips with brain-like computing architectures will set themselves above other innovations and will be widely exploited for their excellent functionality and low energy consumption.

5. Conclusion

With future breakthroughs in chip processing, new semiconductor materials and physical devices, and a better understanding of the human brain and intelligence itself, it is expected that a truly universal AI chip will eventually be realized. A general AI chip is a chip that can support and accelerate any AI computing scenario, i.e., through a common mathematical model, AI that, with some learning, will be able to accurately and efficiently process intelligent computing tasks in all situations to their essence to the fullest. With the development of the times and the advancement of technology, industries have continued to export core R&D capabilities, strengthen innovation capabilities, enhance core technology research, optimize innovation systems, and accelerate the development of smart chips.

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