RESEARCH ARTICLE

Research on the intelligent control of new energy and wind-solar complementary charging and power consumption system

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Abstract: After entering the 21st century, with the continuous development of science and technology, people's demand for energy continues to grow. However, the fossil energy reserves accumulated by the earth for hundreds of millions of years are decreasing, which makes it difficult to meet the material and spiritual and cultural needs of human beings. And the global environmental problems are becoming more and more serious. Therefore, people must use brand-new, safe and sustainable clean energy to gradually replace the old burning fossil energy. Wind energy and light energy are clean and renewable energy, with almost unlimited reserves, which will not cause too much pollution to the environment. However, they are easily affected by the external environment, and their power output is unstable. It is necessary to combine them to achieve complementary functions. At the same time, combining them will control many objects and have multiple inputs and outputs, which is difficult to control by traditional control methods. The rapid development of modern intelligent control technology and electronic technology provides technical support for intelligent control.

Based on the intelligent control research of new energy wind-solar hybrid charging and power consumption system, this study solves the problems of active power, voltage and frequency control in the current application process of new energy wind-solar hybrid, and formulates a set of practical control methods for new energy wind-solar hybrid charging and power consumption system through intelligent control research, thus improving the utilization efficiency of new energy wind-solar power generation. It can also make up for the domestic research gap and has certain technological innovation.

Keywords: Charging, Electricity consumption management, Intelligent control

1 Introduction

1.1 Research Background and Significance

With the development of science and technology, people's use of energy efficiency is constantly improved, and the earth's energy reserves are decreasing day by day, so new energy types need to be explored. [1] There are many kinds of new energy in the world, including geothermal energy, tidal energy, biological energy, wind energy and solar energy. Wind energy and light energy are excellent clean energy, and the existing technology has been able to initially extract and use these two energy sources, so it is considered to be the most promising renewable energy in the new century.[2-4]

But if you rely solely on wind or light to generate electricity, they are less stable due to weather and environmental factors, requiring more investment in research and development of technology, and their utilization may be low. [5] Therefore, complementing them can leverage the advantages of the two energy sources, and they can be used

more efficiently.

Wind and light energy comes from nature, the resources are almost endless, the energy use is clean and pollution-free. However, the power generation system established by wind and solar energy is easy to be restricted by the geographical and natural environment. Under different time and space conditions, the power generation of the system is uncertain and unstable. At the same time, wind power generation changes frequently, photovoltaic power generation is vulnerable to weather conditions, it is difficult to use. [6] To use the balance of power generation load and power load, conversion, storage and control. Play their complementarity in function and use them together. To use the two energy sources together, the control against them is very complex. [7] Traditional control methods, it is difficult to control multiple input and output variables, and modern electronic technology has made great progress, intelligent control can control the charging and electricity consumption part.

Intelligent control is a kind of intelligent control for the control object and the environment. Intelligent control is different from artificial operation. It can complete the process of constant current and constant voltage of the battery through the control of battery charging, and protect the overcurrent and overvoltage of the battery. The fluctuation of voltage and frequency within a certain range is adjusted to greatly improve the stability of the charging system. For the electricity consumption part, the intelligent control can realize the automatic control of the electricity consumption system through the intelligent controller, build a perfect and efficient electricity consumption management system, improve the safety, convenience and comfort of the electricity consumption system, and meet the requirements of energy saving and environmental protection.

1.2 Status quo and development trends at home and abroad

After the third scientific and technological revolution, control technology has developed greatly. Scholars are not satisfied with the classical control theory cannot realize multiple input and multiple output to the controlled object, but only single input and single output. Thus, with modern control theory, modern control theory can realize multiple input and multiple output to the controlled object. In the middle of the last century, the most famous scholars, known as the founder of cybernetics, in the cybernetics animals and machines, namely animals and machine as if, cause heated debate in academic circles, there are many people criticized his comments, think it violates the moral bottom line, to a certain extent affect the process of control. However, in 1954, Dr. Qian Xuesen in China discovered the importance of automatic control, and the control technology began to have a new development. In the 1960s, under the background of the development and progress of robotics and aviation technology, the controlled object in the field of control had the characteristics of nonlinearity, uncertainty and complexity, and people had higher accuracy to it and also it was able to achieve the stability of control. [8-10] The complexity and uncertainty of the controlled object are reflected in the complexity and uncertainty of the object itself, which may have the interference from the noise, as well as the dynamic characteristics of the work of the system itself, as well as the dispersed sensing elements and execution elements, extremely dispersed decision-making mechanism, complex information and a large amount of data. There are a lot of complex data and information inside, whether the classical control theory or the modern control theory, as the traditional control methods, they are difficult to process the information data, to achieve more accurate control.

Then in 1965, Professor Fu in the United States first proposed to apply the heuristic reasoning rules of artificial intelligence to the learning control system. Six years later, Fu Jingsun put forward a concept, which was the earliest source of intelligent control. In 1971, the United States held the first academic seminar on intelligent control. [11] In 1985, the American Institute of Electrical and Electronics Engineers held the first intelligent control academic conference in the United States, and at the conference,

the concept of intelligent control was recognized by the academic community. In 1987, intelligent control became a new discipline. The first international academic conference, successfully concluded and achieved great results--intelligent control has made great progress. In the future, countries around the world often held international academic conferences and seminars on intelligent control, which represented the development of intelligent control theory. In the past 10 years, European and American countries have made great progress in the construction of microgrid, and the characteristics of self-management and self-control of microgrid have been better played. [12-15] In general, there are few foreign studies on new energy wind-solar complementary power generation, electricity consumption and comprehensive utilization.

During this period of time, China also held four sessions of the Fourth Global Intelligent Control and Automation Conference, China's Chinese Society of Artificial Intelligence has also been established, along with the Society of Computer Vision and Intelligent Control, the Chinese Intelligent Robot Professional Committee and the Intelligent Automation Professional Committee of the Chinese Society of Automation. These cases all show that intelligent control has become an independent discipline in China, China has also begun to study intelligent control, at the same time in fuzzy control, automatic control and other fields have achieved pride.

1.3 Study content

The first step is to study how to combine wind and light energy, which is for the complementary use of new energy sources. There are various forms of new energy complementarity, wind and scenery, water and light complementary, wind and fire storage, water and wind storage and other forms.

Both wind and photovoltaic power generation have grown rapidly in recent years, accounting for an increasing proportion of future power generation systems. It can also be said that wind energy and light energy have a wide range of prospects in the new energy generation.

Secondly, how to achieve the control of wind-wind complementary. After power generation, the electricity is transmitted to the battery, and the battery is connected with the electricity load. One end is charging the battery, and the other end is consuming electricity. Control of charging part can ensure the stability of the battery internal power cycle, reduce the damage to the battery, the electricity part of the control, can collect the user's electricity data, analyze the data, can get more accurate data, determine the peak and trough, the peak to try to ensure the system is sufficient, the system to run, in the trough, power generation efficiency can be reduced, do not need to give battery into too much electricity, avoid the waste of energy. At the same time, it can also get the electricity consumption data of users, and get the best scheme of electricity consumption, which can be fed back to users, so as to reduce unnecessary electricity consumption of users and improve the utilization rate of electricity. The next is to consider the choice of battery, according to its material, quantity, and then consider the economic cost, choose the right battery.

Finally, for the control of the charging process and electricity consumption process of the system, how much power the wind power generator unit needs to generate, and how much power the photovoltaic generator set needs to generate, these need to be controlled. According to the region, in the eastern coastal area, near the sea, wind energy resources are abundant, sufficient light, the utilization of wind and light energy is basically equivalent, then the current technology needs to consider the utilization of wind and light energy. To determine the proportion of wind and light power generated separately. In inland areas, wind may be small, wind resources are not so abundant, solar energy is relatively abundant, for economic reasons, solar panels can be installed. If in the mountains, the wind will be blocked by the mountains, and the wind turbine equipment is large, it is difficult to transport to the mountains, the use of light energy should also be increased.

2 Current status and control difficulties
2.1 Wind-solar complementary application

There are many difficulties in the application of wind-solar complementarity, but in the past application, it was mainly difficult to realize the application of wind energy.

According to the distribution characteristics of wind energy resources in China, the eastern coastal area is the most abundant wind energy resources in China. In this area, the effective wind energy density is greater than or equal to 200 W/m^2 is parallel to the coastline, the wind energy density of coastal islands is above 300 W/m^2, the percentage of effective wind occurrence time is 80~90%, the wind speed of greater than or equal to 8 m/s is about 7000~8000h, and the wind speed of greater than or equal to 6 m/s is about 4000 h. But because China's inland areas are mountainous, can block the extension of the wind. As a result, the southeast coast only has more wind power dozens of kilometers inland, and the wind power decreases inland. In even some islands in Fujian province, the wind speed reaches more than 3 m/s, and the duration of each day is more than three-quarters, which is the region with the most abundant wind energy resources in China. Inner Mongolia and Gansu region of wind energy resources is also very rich, this region, within the scope of the westerly, also often by the invasion of cold air, wind energy density of 200 ~ 300 W/m^2, effective wind time percentage is about 70%, greater than, is equal to 3 m/s wind speed more than 5000h, is greater than or equal to 6m/s wind speed above 2000h, from north to south, but not as big as the southeast coastal gradient. The region with the most abundant wind energy resources, with a wide distribution range of wind power, is the largest wind energy resource area in China. Northeast China is also rich in wind energy resources, with wind energy density more than 200 W/m^2, and the annual cumulative hours of wind speed greater than or equal to 3 m/s and 6 m/s are 5000~7000h and 3000h, respectively. Subsequently, there are certain wind energy resources in the Qinghai-Tibet Plateau, the Central Plains and the northern coastal areas. The wind energy density is between 150 and 200 W/m^2, and the annual accumulation of wind speed greater than or equal to 3 m/s is 4000~5000h, and the annual accumulated wind speed of greater than or equal to 6m/s is more than 3000h. Finally is the cloud, southern Gansu, shaanxi, Henan, Hunan, Fujian, Guangdong, Guangxi mountainous area, and the tarim basin, for the minimum wind area effective wind energy density below 50 W/m^2, available wind only about 20%, greater than, equal to 3 m/s of the annual cumulative hours under 2000h, is greater than or equal to 6 m/s wind speed below 150h, the wind energy resources in these areas, almost no value. This uneven distribution of wind energy resources very affects the utilization of wind energy, and at the same time also has high requirements for wind energy units, which requires the fan to have a large single capacity. If the single capacity is less than a certain value, the use efficiency of wind energy is very low, the power generation effect will be affected, and the value of wind power generation will decline. At the same time, the single capacity of large equipment price is relatively high. The fan is in the outdoor work, often affected by the weather, the wind and sun, and even snow and hail, easy to damage, at the same time maintenance is very inconvenient, maintenance price is also very high.

2.2 Analysis of difficulties in wind-solar complementary control

For scenery complementary control at the same time also has the many problems, first or wind and light these new energy problems, use of these energy generation will be restricted by the factors such as weather, environment, wind and light power output power instability, in the absence of wind or no light environment, their power output may be discontinuous, for their control is difficult to achieve. Secondly, there are some problems of wind-solar complementarity. The output power of fan and panel is different, and how to suppress their complementary power should be studied. There are also some problems in the realization of control. The control of the charging part should consider many problems, such as information collection, physical information such as weather environment, various electronic information when the motor runs, various data information inside the battery, and the control of the energy

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storage device.

The electricity consumption part also needs to consider the control of the AC load, that is, the control of the inverter, the collection of the power end data, which is a problem. Realize intelligent control is only use the intelligent controller, or add other modules, will control fine, if add modules, you need to add a new circuit.

3 Research on intelligent control scheme of new energy scenery complementary and electricity system

3.1 Overall system scheme

In order to realize wind-solar complementarity, the whole system should be composed of multiple parts, first, the charging part and the electricity part.

The next is the core control part, the intelligent controller to realize the control can be single chip or PLC. I carefully studied the use of microcontroller and PLC control system found that: microcontroller control small system is relatively simple. And PLC control requires a lot of modules, data acquisition module, communication module, computer analysis module, and the control of AC load is relatively complex. Therefore, using a single-chip microcontroller control is relatively simple. Charging part, electricity consumption part, control part.

3.2 Intelligent control scheme of new energy and wind-solar complementary system

The intelligent control for wind-solar complementary is mainly the monitoring of weather and environmental information and the feedback of users' electricity consumption information to determine whether the wind power generation or photovoltaic power generation.

Control method is in the charging part with light sensor and wind speed, collecting weather and environment information, the information input, MCU through the built-in potential information and internal operation logic to realize the control of the charging part, at the same time through the electronic sensor electricity information, these also sent to the MCU, SCM minimum system will also according to the logic control charging end, determine the complementary power generation or separate generation.

Because the system is connected with a DC load in addition to the AC load, the inverter can convert the direct current transmitted by the battery into alternating current. In addition, the inverter also has the function of voltage stabilization, improve the power supply efficiency and quality. Inverters are divided into two categories, one is the sine wave inverter, the other is the square wave inverter. Because the sinusoid wave inverter is the most commonly used inverter can meet most of the needs, high efficiency, low noise, moderate price, so this system chooses sinusoid wave inverter.

Single-chip microcomputer is the core of the control system, the relay is the device that plays a role, the intelligent control system needs to control the charging and discharge of the battery through the relay, so that it is not in the state of overcharge or overdischarge. The relay can act immediately after receiving the instructions from the microcontroller.

SCM is a kind of microcontroller and also a kind of integrated circuit chip. It is a microcomputer system that integrates the arithmetic device, memory RAM and ROM, controller function and various input and output equipment into a piece of silicon chip. The intelligent control system contains the wind energy controller and the light energy controller, which control the wind energy generator and the photovoltaic generator respectively. The core inside them is the microcontroller. The MCU has built-in pre-stored electrical signals, and realizes the on-off and conduction of the system by comparing the input points and the built-in electrical signals.

Also known as the minimum application system, single chip microcomputer minimum system in almost no external circuit interference conditions, forming a single chip microcomputer system can complete the work independently, at the same time it is also the minimum system of the system operation, it can ensure the normal operation of single chip microcomputer. The minimum system is usually composed of single chip chip, crystal vibration and reset circuit, switch input circuit and output display circuit. It may only

be composed of chip and crystal vibration circuit and reset circuit, representing the minimum configuration of the system.

3.3 Intelligent control scheme of the charging system

The wind turbine is connected with the photovoltaic generator and the battery, forming a charging system with the battery as the energy storage device. At the same time, the single chip is the control core, and the single chip realizes the control of charging through the control relay.

Wind turbine can provide a large amount of electricity, to ensure that the battery has sufficient energy, but also to ensure the stability of the internal power system. Wind power generator set: its most important component is the fan, the fan is the generator set to generate electricity device. The fan is a three-blade structure. The three-blade of the fan has a horizontal axis structure, and the FRP material with high strength and low quality is selected. This material has anti-corrosion characteristics and can effectively avoid the corrosion of acid rain and salt and alkali. The wind generator uses NdfeB permanent magnet generator, which has strong overload capacity, small size, light weight and high power generation efficiency.

Wind turbine from the appearance of only the tower tube and blade, in fact, the wind turbine is composed of wind wheels, engine room and tower. The engine room of the wind turbine contains the air control device, speed regulating device, transmission device and braking device, and power generation device generator. Simply put, the wind turbine and the generator are the most core part of the wind turbine. In addition, wind turbines also have some auxiliary components. It is the complex structure of the generator set that converts the wind energy in nature into high-quality electricity.

Photovoltaic generator set is a large solar cell module, and cooperate with the power controller to form the power generation device. The generator set is a traditional solar photovoltaic power generation device, which uses the photovoltaic effect to convert solar energy into electricity device.

Solar photovoltaic panels are an important component of the system, and also the main device to generate electricity. Solar panels can be made of silicon photocells, a monocrystalline silicon solar panel that converts solar energy into electricity.

Photovoltaic generator set is an independent power generation device, which generates electricity by relying on the battery square array composed of tempered glass, EVA, cell, backplane, aluminum alloy, junction box and silicon gel. Through the photovoltaic effect, when the two ends of the solar energy generate electromotive force, the light energy is converted into electric energy. In addition to the battery array, the photovoltaic generating set also has a charge-discharge controller, which prevents the battery from overcharging or overdischarging. And the inverter, the direct current into alternating current, to ensure the stability of solar cells and batteries, the inverter in the system is an independent operation inverter, for independent load power generation.

The energy storage device consists of multiple batteries, which are responsible for mediating and balancing the energy of the entire charging system. It converts electricity from wind and photovoltaic systems into chemical energy for use when power is insufficient. For the charging system, the importance of the battery is not complain, it can store electricity for the system. Battery is the most widely used energy storage equipment in the world, it has the advantages of stability, safety, cheap price, easy to use and so on, can ensure the repeated use, is the most easy to produce batteries at this stage.

The progress of science and technology has brought convenience to human life, and the development of science and technology also represents the right.

3.4 Intelligent control scheme of the power consumption system

Electricity consumption: AC load, DC load, inverter, microcontroller, relay.

Power generation, transmission, transformation, distribution and electricity consumption are the five

links of the operation of the power system, among which the electricity consumption is the process of electricity consumption. In reality, various forms of electronic devices continue to consume electricity, and the power load connected to the charging system fills every corner of life: urban electricity, rural electricity, industrial electricity and commercial electricity. The electricity consumption part is mainly to manage the use of power resources and monitor the irregular electricity consumption of users. These electricity consumption data is the best feedback to the charging end.

The electricity consumption part is mainly connected to all kinds of electricity equipment, there are various electricity sensors at the electricity end, they should monitor the current and voltage of the use end and the electricity consumption of the electricity equipment. These electrical signals are transmitted to the MCU, the single chip microcomputer according to its own internal operation logic, control the relay work, using the relay to control the wind energy and light energy how to generate electricity, power output power, form, etc. In the electricity part, the inverter will also play a role in changing the direct current into AC current, which can meet the use of AC load.

4 Application of charging/electricity intelligent control scheme of a new energy

However, the intelligent degree of intelligent management system is not high, often in all kinds of accidents in use process, therefore, the new intelligent electricity management control system can realize real-time warning monitoring, active monitoring temperature, current, voltage, also can automatically analyze the power situation of the circuit, can effectively prevent over current, over voltage problem. The management system's real-time monitoring of electricity consumption, the collection of electricity consumption information, and the safety warning, can provide effective and accurate power data, which are difficult for the traditional electricity consumption system to reach. And with the progress of technology, its functions are more diverse and more widely used.

In terms of monitoring electricity information, the intelligent control technology, whether for the industrial power system, household electricity system or fire power system, can play the role of prevention and management, realize the accurate monitoring of electricity equipment, and eliminate the risk of electricity consumption. In addition, it has many functions, for example, real-time monitoring of short circuit, electrical circuit aging, overload, leakage of electricity safety, monitoring the usage of high power appliances, and real-time alarm, the safety monitoring of power lines, prevent electrical fire, real-time upload electricity data, provide data reference for line optimization. If applied to the family level, it can even realize the data connection of electronic devices, and can also support the management of mobile phone and network platform, 24-hour uninterrupted control, saving the cost of line maintenance and management.

At the same time, in China's construction of smart grid, there is also the intelligent control of complementary, smart grid in the application of complementary technology in the field of new energy generation, the power grid in the construction of distribution network, the use of intelligent control technology.

The wind-solar complementary power generation system also uses the intelligent control of wind-solar complementary. The intelligent controller of these systems either uses single chip or PLC.

A power generation system is controlled by PLC, and PLC selects Siemens S7-200. It consists of four parts: wind power generation part, photovoltaic power generation part, inverter part and remote monitoring. Photovoltaic power generation part includes photovoltaic power supply device and photovoltaic power supply control. The light source and photovoltaic cell module of the photovoltaic power supply unit are driven by the motor. Get the photovoltaic modules to follow the sun. Collect solar energy from different angles, Wind power generation system includes wind power supply device and wind power supply system. The wind strength of the simulated wind field is set with the frequency converter.

The wind direction is changed by the circular motion of the motor. Wind turbine tail offset is driven by a motor. The movement of the two power supply devices and the system operating status indicator light are controlled by Siemens PLC. The inverter system converts direct current into power frequency AC power for load use. The monitoring system enables remote control through the HMI interface.

The device simulates wind and solar power generation. According to the system function, it can be divided into wind power generation device that can generate electricity and solar power generation device, DSP controller that can control the charge and discharge of battery, lead acid battery that can store electric energy, inverter that can transform alternating current and load. The photovoltaic power generation and wind power generation of the whole system are independent of each other before the electricity is generated, and they have their own intelligent adjustment of energy collection.

5 Summary

There are indeed many difficulties in the intelligent control of wind and solar complementarity. This study provides a new idea. The complementary use of wind energy and light energy can determine the state of power generation according to the electricity consumption situation and environmental weather information. Whether it is generated alone by the fans or photovoltaic panels, or by a combination of the two. This information can be collected either before charging, or after using electricity. The collected information is input to the SU, which is used as the intelligent controller to control the charging and electricity consumption of the system. The control of electricity consumption is the collection of electricity consumption information, and then realize the feedback of the whole system.

Wind complementary power generation technology can adapt to a variety of different environment and climate, in the night and rainy weather without light environment using wind power generation, sunny wind, using light power, both wind and sunny, both work at the same time, very economic and scientific, with the power supply, can power through

the line input to the battery, realize the complete charging process.

Intelligent control can realize the input and output of multiple information, reduce the difficulty of control, and also play a positive role in improving the utilization rate of energy. It can save valuable power resources for users, enterprises and even the whole society, and can change the energy efficiency of the entire power network, promote the technological innovation of the entire power industry, and guide the whole society to save energy saving and environmental protection.

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