Design and Implementation of Wind Resources Web Platform

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Abstract. In the context of China's rapid industrialization and rapid growth of energy demand, wind power development has become an inevitable choice for China's sustainable development. Therefore, it is of great practical significance to study the development status of wind power in China. This paper demonstrates a web platform designed by Dreamweaver CS5 software and HTML5. It clearly and intuitively shows the situation of the development and utilization of wind power in China by four main parts: wind power status, wind power distribution, wind power prediction and wind power application, the development and implementation of this platform can provide convenience for wind power information query and research in China.

1. Introduction
The aggravation of environmental pollution and the shortage of traditional energy are two major problems facing the energy industry. China has vast territory and abundant wind energy resources. According to incomplete statistics, China's available wind energy storage capacity is 3.023 billion kW, with great potential for wind energy application [1]. Therefore, China has taken the development and utilization of renewable energy as the key content of the national medium and long term program of science and technology, and at the same time, how to improve the power grid's capacity to absorb wind power as the main research direction[2-5].

2. Overall system design

2.1. Design language -- HTML5
HTML5 is a language used to describe web pages. The language is a markup language. It is mainly used to describe how content in hypertext is displayed. The biggest advantage of HTML5 is that it has a simple grammar structure and is easy to write web pages. So we chose Dreamweaver CC produced by Adobe, which has a very friendly user interface and is an excellent web development tool.

2.2. Design flow chart
The overall design flow chart of wind resources network platform is shown in Fig.1.
3. Design and implementation of wind resources web platform

3.1. Home page

The platform is mainly divided into four modules: wind power status, wind power distribution, wind power prediction and wind power application. The system block diagram is shown in Fig.2.

![Platform design system block diagram](image1)

A web page with a map of China as the main picture was written in HTML5. The division of the webpage is also written in HTML, which successfully realizes the current situation of wind power, the distribution of wind power, the prediction of wind power and the application of wind power. Through these four tags, it is convenient to jump to the corresponding module and query the home page of relevant information about wind power development in China you want to know, as shown in Fig.3.

![China wind power home page](image2)

The main code is as follows:

```html
<ul>
  <li style="border-left:1px #cccccc dashed;">"<a href="China Wind Power.html">Home</a></li>
  <li><a href="Wind Power Status.html">Wind Power Status</a></li>
  <li><a href="Distribution Map of Wind Farm in China.html">Wind Field Distribution</a></li>
  <li><a href="Wind Power Prediction.html">Wind Power Prediction</a></li>
  <li><a href="Wind Power Application.html">Wind Power Application</a></li>
</ul>
```

Web platform also implements the provinces wind power module, the module did not design a separate module label "provincial power", but will it into the web platform home page of the map of China, provinces of the map of China with obvious click on any one of the provinces of China map, and can be easily open on the provinces of wind power development is introduced. Fig.4 is the website of introducing the development of wind power in xinjiang. Through searching this website, we can get
to know the storage and distribution of wind energy resources in Xinjiang, the status quo of wind power distribution and utilization, the impact of wind power development on the environment. It is of great help to the state to solve the development problem of wind power in Xinjiang.

3.2. Wind power status
The system block diagram of wind power status module design is shown in Fig.5. This module shows China's energy situation, wind power development situation, wind power industry situation and wind power application situation.

As shown in Fig.6, web page shows China's energy situation, it can be seen in China's energy resources are relatively rich, but with low per capita energy resources capacity, along with our country economy continues to develop and continue to promote industrialization, urbanization, while the energy production and consumption is growing, but now there is a large energy gap and the trend of present gradually become bigger.
Wind power has its own characteristics, such as intermittence, fluctuation and randomness. Large-scale grid-connection of wind power system will bring great impact on the stability and reliability of power system, which seriously restricts the grid-connection and absorption of wind power. Developed countries, such as Europe and the United States, cooperate with each other in pumped storage and wind power generation. However, water resources are scarce in China's wind-rich inland areas of northwest China, and the construction and promotion of pumped storage power stations are too limited, so China needs to study energy storage technology suitable for China [6].

3.3. Wind field distribution
Through this website, the distribution of wind power plants in China can be clearly understood. As can be seen from Fig.7, China's wind energy resources are mainly distributed in xinjiang, Inner Mongolia, jilin, hebei and other inland areas in the northwest and north China.

![Figure 7. Distribution of wind resources in China](image)

3.4. Wind power prediction
The overall design flow chart of the wind power application section is shown in Fig.8.

![Figure 8. The system block diagram](image)

Wind power prediction web page as shown in Fig.9, through the upper left corner of the wind power prediction technology, the economic benefits of prediction system of four labels, can be convenient and quick to jump to where the label content. This paper introduces the related content of wind power prediction. And in the website two kinds of wind power prediction technologies are presented: short-term wind power prediction based on kalman filtering principle and short-term wind power prediction technology based on neural network algorithm.
3.5. Wind power application

Wind power application module design of the system block diagram as shown in Fig.10, this module contains a given wind power development situation, the power grid wind power capacity analysis and the method of improve grid given wind power capacity of three parts, through the analysis of wind power development and application situation in our country, given wind power capacity is to restrict China's wind power to power grid main problem of large scale, improve the network given wind power capacity for the application and development of China's wind power industry is of great significance.

![Figure 10. Module design system block diagram](image)

Wind power application page as shown in Fig.11, the interface is divided into wind power development situation, the power grid given wind power capacity analysis and improve the method of grid given wind power capacity three child module, wind power application situation in our country are introduced, and according to limit China's wind power of large scale wind power given problem, put forward in accordance with China's national conditions to increase the ability of given wind power grid method.

![Figure 11. Wind power applications](image)
The wind power consumption capacity of the power grid is mainly affected by the system load size, load characteristics, power structure, regulatory capacity and wind power output characteristics. Among them, many influencing factors are constantly changing, such as the power output characteristics of wind power in different seasons and periods, the regulation capacity of hydropower in rainy season and dry season, and the system load characteristics of different seasons. Therefore, the wind power consumption capacity of the system must take into account the peak capacity, transmission space and safety margin of the power grid.

3.6. Ways to improve absorptive capacity of power grid

3.6.1. The utilization of wind-electric energy storage technology to improve wind-power absorption capacity. The basic principle of the thermal energy storage and power generation technology of wind power plant is to convert the electrical energy generated by the surplus wind energy into heat energy and store it in the high temperature storage medium. When power is needed, the high temperature storage medium is used to heat the water to generate high temperature and high pressure steam and drive the steam turbine generator to generate electricity, so as to complete the energy storage function of wind power. In order to improve the efficiency of energy storage and circulation and realize the "cascade utilization" of heat energy, the combined heat and power production method is generally adopted, and the efficiency can reach 70% to 85%, which is of great significance to areas in north China where there is high demand for winter wind and high demand for heating and severe power limitation. The web interface design of this part is shown in Fig.12.

![Figure 12. Wind electric energy storage technology](image)

3.6.2. Reasonable wind abandoning to improve wind power consumption capacity on a large scale. Wind power is intermittent and random, and its output cannot be arranged and controlled like other conventional power sources. When the system load is at the minimum value, the power output of wind power may reach the maximum, while other power sources need to adjust the power output, so that the load is supplied by wind power. However, due to the limitation of the conventional thermal power micro-increment, reducing the output operation or closing down will increase its power generation cost. If the wind can be properly abandoned during the low load period of the power grid, it can not only reduce the pressure of the conventional thermal power generation to reduce the output power operation, but also improve the capacity of the power grid to accept wind power to be connected to the grid, so as to improve the security and economy of the entire power system operation. The web interface design of this part is shown in Fig.13.
4. Conclusion

The realization of the wind resources website platform centralizes the fragmented wind power information in various regions of the country. Through the web design, the development status of China's wind power is introduced simply and clearly and intuitively. It is convenient for the inquiry of wind power research data and provides theoretical support for the formulation of wind power policy. At the same time, the phenomenon of wind abandoning and the prediction method of wind power are introduced, and the methods to improve the power consumption capacity of the power grid are put forward: wind power storage technology and reasonable wind abandoning method, which provide the solutions for the severe situation of wind power consumption in China.

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References

[1] Wang Changlu, Wang Weigong, Zhang liyong, Qiao Xuetao. Analysis on the development of China's wind power industry [J]. Journal of Chongqing University, 2015, 1: 148-154.
[2] Outline of the national medium - and long-term plan for scientific and technological development (2006-2020). Website of the development planning division of the national development and reform commission of the People's Republic of China.
[3] Medium - and long-term development plans for renewable energy. Website of the development planning division of the national development and reform commission of the People's Republic of China.
[4] Chi Yongning, Liu Yanhua, Wang Weisheng. Effects of wind power access on power system [J]. Grid technology, 2007, 31(3): 76-81.
[5] Zhu Lingzhi, Chen Ning, Han Hualing. Analysis on key problems and countermeasures of wind power consumption [J], automation of power system, 2011, 35(22): 90-96.
[6] Jia Hongxin, Zhang Yu, Wang Yufei, etc. Application of energy storage technology in wind power system [J], renewable energy, 2009, 27(6): 11-15. Yang Zhongkai, patent measurement and patent system [M], Dalian University of technology press, 2008, first edition.