Research on Application of Deep Learning Based on Mobile Learning in Smart Grid

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Abstract. The rapid economic and social development cannot be separated from the important contribution and guarantee of the power industry. In the development of power industry, substation technology plays a very important role. The development of in-depth learning based on mobile learning provides an effective means for data value extraction. Therefore, it is of great significance to guide power enterprises to make correct decisions by making full use of these data based on the actual power grid and analyzing them in depth to discover and utilize the hidden information. Firstly, the basic framework of in-depth learning is elaborated, and the theoretical basis and technical system of mobile learning are summarized. According to the actual demand of power system, this paper summarizes the key application fields and values of mobile learning-based deep learning in power system data processing based on image data and spatio-temporal data, and puts forward relevant technical development suggestions.

1. Introduction
With the rapid popularization of mobile phone and mobile computing technology, a new form of learning-mobile learning has emerged in education. Mobile learning is the application of mobile communication technology and mobile computing technology in education, which provides conditions for learning and lifelong learning in the information age [1]. Smart grid is different from the traditional grid technology. Smart grid strives to change the shortage of traditional grid controlled by manpower, so as to make grid management informatization, intelligence, high efficiency and low risk. Information such as hidden relationships and rules is extracted from massive data, and the future development trend is predicted according to the existing historical data [2]. With the improvement and upgrading of power equipment, transmission line faults caused by wind bias, icing and other factors are gradually reduced. Most of the transmission line faults caused by lightning strike and bird damage are transient grounding faults. The vast majority of sensors record spatio-temporal large data. Spatiotemporal big data often have both temporal and spatial correlation, which are inseparable. However, due to the complexity of grid data characteristics, more interference and high accuracy requirements. In order to realize the automation of this control, it is necessary to analyze the electronic technology used in the power grid, analyze the availability of electronic technology, and apply it to the automation and intelligent control of the power grid efficiently [3]. Therefore, this paper analyzes the causes of shallow learning in mobile
learning and puts forward corresponding strategies to solve these problems, so that learners can realize the research on the application of deep learning in smart grid in mobile learning.

2. Concept of Mobile Learning
Mobile learning is learning supported by hand-held mobile technology or learning that occurs across various situations or locations. Mobile learning is a new learning form that uses wireless mobile communication network technology to acquire educational information, educational resources and educational services with wireless mobile communication equipment [4]. Mobile learning resources are information and support services based on portable mobile devices that can help learners to learn effectively, such as mobile answering system with interactive communication tools, software-assisted teaching of teaching courses browsed by mobile phones, etc. Therefore, mobile learning includes classroom learning supported by mobile or personal devices and augmented reality learning, or learning that combines fixed and mobile technologies across many different locations [5]. The development of mobile learning resources is one of the research directions of mobile learning. Current mobile development technologies can be used to develop mobile learning resources. However, due to the large differences between many products of mobile device developers and the development of mobile learning resources related to mobile devices, mobile learning is the foundation of mobile learning. In short, mobile learning can be understood as anytime and anywhere learning using computer technology and mobile communication technology. Mobile learning has the characteristics of learning convenience, contextual relevance and interactive rapidity.

3. Basic Framework of Deep Learning Based on Mobile Learning and Brief Introduction of Power Grid Application

3.1. Convolutional Neural Network.
Smart grid is not only a simple and single power distribution system, but has developed into an extremely complex and huge system network. In order to effectively monitor the system network, it is necessary to effectively observe the overall operation of the system network in order to obtain relevant data in equipment operation. Convolution neural network was first proposed by Hubel and Wiesel by studying the local induction characteristics of cat visual cortex, and then applied to handwritten digital image dataset recognition task by Yann Lecun [6]. Among them, the feature extraction part and the candidate region generation part form CNN's candidate region generation network, and the feature extraction part and the target classification part form CNN detectors.

The technical map of the combination of deep learning and power grid data is shown in Figure 1. The author divides the power grid data into image data and spatiotemporal data to elaborate. For the representative application of each kind of data, the corresponding algorithm that can effectively use its characteristics in deep learning is given.

![Figure 1](image-url)
Compared with ordinary neural networks, CNN has two main advantages: firstly, CNN's weight is shared by convolution check image convolution, i.e. the parameter quantity of the network will be independent of the dimension size of the input data and equal in the input conversion; In other words, CNN consists of two modules: candidate region generation network and CNN detector, which share convolution layer for feature extraction. The second advantage lies in the introduction of pooling operation. Through this operation, only the maximum value or average value is reserved for the network features in a certain area, thus greatly reducing the network parameter amount on the premise of ensuring that the original information of the image is not affected [7].

3.2. Cyclic neural network.
There are a large number of time series data in power grid data, that is, different data have strong correlation in time dimension. Mining the correlation performance between time series significantly improves the accuracy of tasks such as prediction and fault diagnosis. The image data is input into convolution neural network for feature extraction. Before feature extraction, the image will be preprocessed, such as size normalization, horizontal inversion, mean reduction, etc. This is the initial stage of data mining, determining the purpose of data mining, clarifying the problems to be solved, and combining these purposes with the definition and results of data mining [8]. Mobile learning takes group cooperation and individual inquiry learning as typical organizational forms. Super interactive communication function is an important feature of mobile devices, with the help of its powerful power. Under the guidance of business analysis objectives, collect the original data related to business objects and evaluate the available data. Because of its unique way of information transmission, cyclic neural network can make full use of the time correlation between data.

4. Application of Deep Learning Based on Mobile Learning in Power Grid Image Data
The theoretical breakthrough of in-depth learning in academia has also led to great changes in its application in industry, and the field of computer vision can be one of the fields most impacted by in-depth learning technology. Deep learning is learning based on understanding. It is a learning state in which learners actively acquire knowledge, think about and process knowledge, and critically memorize it [9]. Image data is an inseparable part of power grid big data. Traditional image processing methods often make some rules artificially based on tasks, and achieve tasks such as segmentation and processing through mathematical operations on image features. The vast majority of power grids have very little effective utilization time within one year, which results in a great waste of resources. The solution to this problem is to reduce the peak-valley difference of load curve as much as possible. Evaluating learners' learning in mobile learning can reflect on their learning methods and results and cultivate their learning autonomy and self-confidence. After the real-time load history sequence data of each group is constructed, the maximum load value of each month in the group is calculated. Translation invariance is introduced while the calculation amount is reduced [10]. Two common pooling methods in deep learning are maximum pooling and average pooling. The emergence of deep learning has introduced new ideas and tools for grid image data tasks, which play an important role in the application of grid image data.

4.1. Helicopter/UAV patrol inspection.
Helicopter/UAV patrol inspection of transmission lines has become an important method in China due to its advantages of high efficiency and little regional influence. Electronic system integration can combine all components in the power grid according to established rules to ensure the normal operation of all components. Electronic system integration can be said to be the actual landing control of smart grid system. Smart grid relies on integrated electronic system for power production and transmission. Taking insulator images as an example, aerial images have complex background characteristics, such as forests, rivers, farmland, etc. The signal-to-noise ratio of the image is very low, the insulator string only accounts for a small part of the image, and faults such as insulator self-explosion are difficult to distinguish by naked eyes in the image.
The process of image processing based on deep learning is as follows: get the training set by preprocessing and labeling a large number of data samples, get the model by training the training set with deep learning algorithm, and then apply the model to the test pictures to get the results. The specific flow chart is shown in Figure 2.

![Figure 2 Flow chart of image processing based on deep learning algorithm](image)

The construction and application of smart grid need synchronous phasor measurement technology, which has been introduced into the current power system. GPS provides high-precision pulses, which provide synchronous time scales accurate to microsecond level for synchronous phasor measurement, and can ensure that the voltage and current signals of each station in smart grid are in a horizontal state. The randomness of time and space in mobile learning results in learners being unable to carry out in-depth learning. However, developers can design appropriate learning resources to enable learners to learn efficiently at random time and space. In this way, the historical data of real-time load, daily maximum load and monthly maximum load of each user group are obtained respectively, thus obtaining a complete load forecasting model.

### 4.2. Code for safe operation of electric power.

For power system operation, safety is always the unshakable first index, and the progress of research results in the field of computer vision also provides a new direction for power information security. Under the acceptable time cost, the method can know as much as possible about the electricity demand of different industries and different types of users, and has important guiding value for power generation scheduling, orderly electricity utilization and lean marketing. In mobile learning, learners need to browse large pages of materials, pictures and other learning resources. However, due to the small screen of mobile devices and the inconvenience of reading, learners need to maintain a high level of attention for a long time. With the progress of science and technology, microwave semiconductors and other components are continuously produced. With its unique characteristics, microwave semiconductors have developed rapidly and upgraded continuously. The working frequency has been continuously increased and the corresponding noise figure has been continuously reduced. Using clustering algorithm to subdivide user load into different characteristic classifications; Then, different time series prediction algorithms are respectively used for load prediction, and finally, the load prediction results under various prediction algorithms are weighted and summed to form the final prediction result. When dealing with power grid image data processing tasks, depth learning can be preferred, and tasks can be carried out by selecting appropriate features and labels as training samples.
5. Application of Deep Learning Based on Mobile Learning in Time and Space Data of Power Grid

5.1. Application of power grid fault diagnosis and anomaly detection.
Fault diagnosis of power grid is the premise of fault location and accident analysis, which is of great significance to improve the stability of power grid. The basic idea of fault diagnosis is to map the fault symptoms to the fault space through a certain relationship. Smart grid needs faster and more accurate information sources. If substation technology can realize intelligent and high-speed communication, it is equivalent to providing "plug and play" technical guarantee for smart grid. However, not all image data are suitable for training the target detection model based on depth learning method. Power system faults include system-level faults and component-level faults. System-level fault diagnosis refers to the identification of fault area, fault nature, type, etc. according to various fault information such as fault component types, misoperation of devices and other phenomena when a power grid fails. After the real-time load sequence data of each group is established, the maximum load value of each day in the group is calculated. The learning time and place of mobile learning are very flexible and can take place at any time and anywhere. However, it is because of its randomness that mobile learning cannot carry out in-depth learning in many times. At the same time, when the line condition is not good, the safety and effectiveness of transmission should be considered to ensure the transmission quality under the condition of reducing the transmission voltage.

With the extensive use of intelligent monitoring devices, the amount of data accumulated in power systems is increasing. These data contain rich information about system operation status. How to effectively extract and mine information from massive data to realize real-time state perception and abnormal situation detection has become a research hotspot. The common method in evaluating the algorithm is to set a threshold of intersection and parallel ratio first. As long as the coincidence degree between the frame located by the target detection algorithm and the real frame is greater than the threshold of intersection and parallel ratio, it is regarded as an effective detection. The common method in evaluating the algorithm is to set a threshold of intersection and parallel ratio first. As long as the coincidence degree between the frame located by the target detection algorithm and the real frame is greater than the threshold of intersection and parallel ratio, it is regarded as an effective detection. Due to the randomness of the occurrence of mobile learning, learners are often in an isolated and individual learning state, so they lack communication and cooperation with their peers when learning, thus they cannot discuss problems with other learners. The setting of learning rate plays a vital role in the training of deep neural network. If the learning rate is too small, the training algorithm will converge slowly, while if the learning rate is too high, the training algorithm will diverge. In order to effectively monitor the smart grid, sensors have become an essential technical link. Optical fiber sensors or wireless sensors should be introduced into substation technology to monitor the temperature, humidity and position of relevant equipment in the smart grid through smart sensors.

5.2. Forecast and application of renewable energy.
In order to reduce the consumption of traditional energy, the installed capacity of renewable energy, especially wind energy, is increasing all over the world. At present, the most reliable communication technology is no more than optical fiber communication and wireless communication technology. The application of optical fiber communication technology has matured day by day. What needs to be improved now is the application of wireless communication technology. The introduction of wireless communication technology into substation technology can strengthen the function of smart grid. It is of great significance to relieve peak load regulation pressure of power grid, reduce reserve capacity allocation of power system, improve wind power injection power level and operation reliability of power system. Only when learners have a correct and in-depth understanding of mobile learning, can they use mobile devices correctly for learning, and can they carry out mobile learning efficiently and deeply. The problem of needing intermediate nodes in power transmission usually involves the problem of voltage reduction. Voltage reduction usually uses a voltage reducer to convert the transmitted high and low
voltages into low voltages through voltage transformation, but the whole power will not change. It learns the relationship between input and output through non-statistical methods without any predefined mathematical model. Artificial neural networks have strong representation ability for complex nonlinear relations, which can make up for the deficiency of traditional methods that rely solely on mathematical models to solve problems to a certain extent.

Generally speaking, in wind power prediction, the research results of point prediction are relatively abundant, while interval prediction is an important research direction in the future. In practical application, usually on the same data set, a variety of data mining algorithms are applied, and through comparison and selection of a plurality of models, the model with the best effect on the current data set is finally determined. In mobile learning, learners are in a state of separation. Only by building a mobile learning community, enabling peers to carry out collaborative learning and share each other's learning results can they have a deeper and more comprehensive understanding of knowledge. Before circuit design, it is first necessary to allocate specific power transmission lines according to the actual power consumption, optimize the wiring of power transmission lines, and ensure that the power consumption caused by repeated power transmission lines will not occur. When the data is missing or the amount of data is small, the training cannot be carried out or the training effect is not good. The accuracy of weather forecast and the completeness of information also have a great influence on the forecast results. The development of China's smart grid started late. At this stage, it is necessary to innovate the original power transformation technology, introduce new technologies, speed up the development and construction of smart grid, realize more efficient power utilization guarantee, and provide a reliable development foundation for the development of social economy and the development of the power industry.

6. Summary
Big data in smart grid is generated in every link of power system. Through effective use of data mining technology, knowledge helpful for management and decision-making can be obtained from data accumulated by power enterprises. The emergence of mobile learning provides conditions for us to learn better and more conveniently in the 21st century, a digital age and information society. In today's social environment, people should be able to use new technologies to solve practical problems. Deep learning is no longer a completely unfamiliar mathematical tool for scholars. In addition, in-depth learning has proved its excellent application effect and stability in many industries such as security and medicine. Taking the application of depth learning based on mobile learning in power load forecasting of subdivided users as the breakthrough point, this paper analyzes the use of depth learning technology to improve the economic benefits of power grid enterprises and realize management innovation under the background of electricity sales side reform. Starting from the application research of smart grid, this paper analyzes the electronic power technology involved in smart grid, expounds the development direction of smart grid based on actual power transportation, and discusses the technical points existing in the whole system of smart grid.

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