Application of Adaboost Algorithm on Automatic Detection of Electrical Equipment Operation Status

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Abstract. The algorithm can integrate weak classifiers that are slightly better than random guesses, and output strong classifiers with higher classification accuracy. In order to further improve the classification accuracy of the algorithm, an infinite dimensional algorithm based on support vector machine is established. The key to realize the infinite dimensional algorithm is to establish a new support vector machine kernel function, so that this kernel function integrates infinite multiple algorithm weak classifier. The infinite dimensional algorithm is used for analog circuit fault diagnosis. The fault diagnosis results show that the classification accuracy of the infinite dimensional algorithm is better than the finite dimensional algorithm, which improves the classification accuracy of the algorithm. Based on the analysis of the operation status and fault diagnosis of modern electrical equipment, this paper discusses the necessity and possibility of monitoring the operation status of electrical equipment, and takes the method of electrical operation monitoring and the method of fault diagnosis as the research object. The methods and fault diagnosis methods of current electrical equipment operation monitoring are expounded. On this basis, the future development trend of equipment operation monitoring is explained, and the importance of online monitoring development is analyzed.

1. Introduction
The Adaboost algorithm is a variant of the Boosting algorithm proposed by Freund and Schapire. The Boosting algorithm aims to improve the classification accuracy of any given learning algorithm. Adaboost is an iterative algorithm whose core idea is to train different classifiers (weak classifiers) for the same training set, and then combine these weak classifiers to form a stronger final classifier (strong classifier). This algorithm allows developers to continually add new classifiers until a predetermined sufficiently small error rate is reached. Specific implementation of the Adaboost algorithm: Each training sample is given a weight that indicates the probability that it is trained by a component classifier. The initial weights of the training samples are equal. If a sample is classified accurately by the current classifier and its weight is reduced, then when constructing the training set of the next component classifier, the probability of its selection is reduced. Conversely, when the classification is wrong, the weight will be increased accordingly, and the probability that it will be selected into the training set of the next component classifier will increase. Therefore, for the t-th iteration operation, the corresponding training weight is set according to the t-1th training result to select a new training set. For the t-th classification, the correct classification of the classifier reduces the weight of the sample, and the classification is wrong. The sample is increased in weight, and then the training classifier Ct is performed, and then the classifier Ct+1 is trained according to the result of the t-th classification, and iteratively proceeds until the termination condition is terminated.
2. Diagnostic system for electrical equipment

The detection method of the operating temperature of electrical equipment is mainly dependent on the human feeling, the accuracy of the measurement is not high, thus affecting the correctness of the judgment, especially for high-voltage electrical equipment, the operating personnel must maintain a certain safety distance during the inspection, plus Lack of suitable testing equipment, can not find faults in time. Therefore, we have developed an electrical equipment operating condition monitoring and intelligent diagnostic system, using infrared temperature measurement technology to non-contact measurement of the site temperature, to ensure the safety of high-voltage, high-temperature, high-speed parts measurement.

The infrared temperature measuring unit converts the on-site temperature signal into a voltage signal. After being collected and processed by the central processing unit, the temperature is sent to the display on the one hand, and sent to the dynamic database on the one hand, and the inference diagnosis is performed by the fault diagnosis expert system, and the conclusion is sent to the display. Or print on the printer to guide on-site maintenance or repair. The emission energy of the target object is collected and processed by the optical system, and the infrared radiation energy is sent to the infrared detector. The detector converts the infrared radiation energy into a corresponding voltage signal, and then sends it to the signal processor, which is amplified, denoised, compensated, and After linearization, a signal proportional to temperature is output to the central processing unit. Laser aiming utilizes the laser's high concentration in the direction, allowing the infrared detector to accurately aim at small targets or distant targets for measurement. When measuring, the red fine laser beam is accurately positioned at the center point of the target to be measured. The laser sighting consists of a laser, a collimation system, and a precision regulator. The laser is a semiconductor laser with a wavelength of $670 \times 10^{-9}$ m and has the advantages of small size, light weight, long life, high visibility and low power consumption. The collimation system greatly reduces the divergence angle of the laser beam, making the directionality of the laser more concentrated and accurate. The collimation system uses the most advanced self-focusing fiber lens to collimate. After the laser beam is collimated, the divergence angle is reduced to 5 mrad. The function of the precision regulator is to align the collimated laser with the optical lens to ensure that there is no parallax to the target being measured.

3. Software design and Its Detection Study

The software design consists of two parts, the temperature recording and diagnostic expert system. The temperature recording software provides a device temperature monitoring table that is responsible for communicating with the temperature measurement signal processor, retrieving the temperature value, and sending it to the comprehensive database. Based on the real-time data provided by the comprehensive database, the diagnostic expert system forms the facts, calls the knowledge base, drives the inference engine to perform diagnostic reasoning, draws fault diagnosis conclusions, and provides maintenance guidance. The knowledge base of the diagnostic system consists mainly of a framework knowledge base representing structural and functional relationships and a production rule base representing expert experience knowledge. The framework structure is described in the form of BNF. Expert expertise and experience in the rule base is obtained by applying the Fault Tree Analysis-FTA method. By adopting this mixed knowledge representation method, the system better expresses domain knowledge and expert experience. The system database includes two parts: a dynamic database and a static database. The dynamic database is a storage area in memory for storing initial information of inference, intermediate results or various information or knowledge provided by the user, and the knowledge base and the knowledge base. The static database together supports the operation of the expert system inference engine, which is essentially a public database shared by each functional module, and its content is dynamically changed continuously, through which various functional modules can exchange information with each other. The static database stores the standard data tables required for system diagnostics and the historical status data of the system. The standard data table stores the standard values of various detection parameters, which is the model mode for the system to perform online diagnosis. When the system is performing diagnosis, the infrared temperature measurement unit...
performs real-time detection on the device, and the collected data is saved by the temperature recording module. The system compares the diagnostic parameters with the data corresponding to the standard data table in the static database to obtain a description. The fact of the detected data is then added to the dynamic database. The standard value in the table is the critical value of the parameter. If the value of the detected data exceeds the standard value, the parameter is considered abnormal. This fact will automatically enter the dynamic database and participate in diagnostic reasoning. Historical state data can provide the basis for system diagnosis and prediction. At the same time, historical state data plays a role in detecting the quality of knowledge in the knowledge base by recording the operation of the diagnostic system, and also provides the possibility for self-learning of the system. The function of the system learning module is to automatically correct and supplement the content of the knowledge base according to the experience of the system operation, and add it as a new knowledge to the knowledge base. The process of self-learning is: firstly, the sample link provides information to the learning link, and the learning link uses the information to expand and improve the knowledge base of the display representation; the work link utilizes the knowledge of the knowledge base, and takes corresponding actions to complete the work task. At the same time, the supervisor gives feedback information through the supervision link and feedback to the learning link. Based on the feedback information, the learning link determines whether the knowledge base needs further improvement or whether the last acquired knowledge has achieved the effect of “improving performance”.

The system adopts the inference method of forward-reverse hybrid reasoning based on framework and production rules. It operates in two ways, namely online diagnosis mode and offline query mode. The online diagnosis method is to make full use of the infrared temperature measurement real-time detection parameters. After analysis and processing, the relevant facts are obtained, and the diagnostic reasoning is directly driven. The offline diagnosis method is to input the relevant fault phenomenon by using the human-machine interface. The system performs diagnosis and reasoning according to these phenomena, finds the faulty part, guides the user to check the cause of the fault, and guides the maintenance. The idea of forward and backward mixed reasoning can be roughly described as follows:

Procedure alternate
Repeat
   Call date-driven, based on the initial evidence provided by the user to launch some targets, based on these goals to make a hypothesis about the overall goal G;
   Call goal-driven to determine the true and false of G;
   Until problem is solved
End

The inference engine of the diagnostic expert system consists of two modules: framework inference and production rule inference. The framework’s reasoning uses a forward-reasoning control strategy to find one or more pre-selected sub-frame formation hypotheses that match the phenomenon and fact based on the initial fault phenomena provided by the user or the data provided by the detection system. In the process of monitoring and diagnosing electrical equipment systems, with the continuous development of technology, the system will gradually introduce new technologies and intelligent technologies. In the current system operation, Entek’s PM system and MM system can better realize the monitoring and fault diagnosis of generators and motors, which has extremely high application value. The software has a database, which can realize the output function of the image, and is convenient for analyzing and diagnosing the running state of the device. In addition, in the design of future systems, the use of intelligent equipment will inevitably be gradually strengthened. For example, the rough set theory will be gradually applied to the design of the system according to the probability, etc., and finally the dynamic monitoring and fault diagnosis of the data can be realized, so as to develop a scientific maintenance plan.

4. Conclusion
The essence of fault diagnosis is the classification and identification of faults. At present, the classic fault diagnosis methods are mainly neural network. It can solve nonlinear and over-fitting problems well
and has good generalization performance. It is applied to the fields of pattern recognition, predictive analysis and fault classification; it can overcome the problems of local optimal solutions and slow convergence of neural networks, and has strong practicability. Ensuring the operational efficiency of electrical equipment is an important means to improve the economic efficiency and development of enterprises. However, under the new form, the traditional monitoring and diagnosis methods of enterprises have been difficult to meet the needs of the current stage. Therefore, it is necessary to continuously introduce technology and design equipment condition monitoring and Fault diagnosis system. This paper mainly analyzes the function and composition of the system. It is hoped that through the analysis of this article, enterprises can actively introduce hardware and software technology to realize the monitoring and diagnosis of the operation of electrical equipment, so as to ensure the use performance and life of electrical equipment to the greatest extent.

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