Research of Intelligent Video Surveillance System based on Artificial Neural Network

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Abstract. In order to improve the video monitoring capabilities, this paper designs an intelligent video surveillance system. Firstly, it analyzes the current problems of video surveillance, and then proposes intelligent requirement in three aspects. In the training process, the model is obtained by searching, gray conversion, and training. Finally, the correctness of this system is verified by the actual application in real station.

1. Introduction

Traditional video monitoring methods are backward and inadequate\textsuperscript{[1-2]}. In order to improve the level of intelligent video surveillance, it is necessary to embed recognition functions from video monitoring\textsuperscript{[3-5]}.

In [6], the author builds a face recognition platform through artificial neural network to enhance the security of on-site operation management and control; in [7], the author uses the quarter source image method for the first matching, and then uses the error minimum method for the second matching to improve the matching speed; in [8], the author uses Gaussian mixture model to identify moving objects in power warehouses in video surveillance to increase the reliability of warehouse management; in [9], the author uses big data to mine on-site violation warnings to realize automatic warnings of substation irregularities; in [10], the author uses deep learning neural network to realize the identification of transformer defects, and find and deal with the defects in time.

2. Traditional video surveillance problems and Intelligent video surveillance requirements

2.1. Traditional video surveillance problems

As an important device connecting the main grid and the low-voltage grid, the substation is related to the power quality of users and the safety of the grid. However, the traditional video surveillance has a problem of relying heavily on human, which restricts the innovation enthusiasm of the monitoring personnel.

when the patrol substation is far away from operation center, it is not possible to rush to the fault location immediately. Only by using traditional video monitoring, the problem is found to be insufficient in timeliness and the power supply will be delayed, and the quality of power supply will be affected.
2.2. Intelligent video surveillance requirements

Equipment status identification mainly includes switch (knife) status opening and closing, meter counting status, pressure plate throwing and retreating status, and indicator light status. Defect identification, mainly identifying broken insulators, bird's nests, main transformer oil leakage and discoloration of silica gel, etc. Operation safety identification mainly includes tooling, hard hat wearing, smoking behavior, fire, and intrusion into non-operating areas of equipment. The safety helmet is an important guarantee for the protection of on-site workers.

3. Intelligent video surveillance design

3.1. System structure

The intelligent video surveillance system is added in the original operation and maintenance monitoring platform. The system structure diagram is shown in Fig. 1. The added intelligent module is composed of a BP neural network, which can learn and then recognizes the image.

![system structure](image)

### 3.2. BP neural network

A BP neural model is shown in Fig. 2. $X_1, X_2, \ldots, X_n$ are the input variables; $w_j$ is the $j$ synaptic weight of neurons in the hidden layer; $o_j$ is the linear combination of weighted inputs to calculate the output of the neuron using Equation 1; $q_j$ and $q_k$ represents the activation threshold; $g(\cdot)$ is the activation function; the output of the neuron can be calculated by Equation 2.

$$o_j = \sum_{i=1}^{l} g(w_j \cdot x_i + q_j) \quad j = 1, \ldots, N \quad (1)$$

$$y_k = \sum_{i=1}^{l} f(\eta_k \cdot o_j + q_k) \quad k = 1, \ldots, N \quad (2)$$
In the training process, first input the video to capture the image, as shown in Fig.4 (a), and then search for the area to be recognized whether to wear a helmet, and the result is shown in Figure 4 (b), the result of the image shown in Fig.4(c) with gray conversion by Equation 3, and then the model is trained in BP neural network.

$$f(a,b) = \sum_{i=0}^{e} s(g_c - g_e) \times 2^e$$  \hspace{1cm} (3)

In Equation 3, \( s(z) \) is threshold function, \( z \geq 0, s(z) = 1; z < 0, s(z) = 0 \); \( e \) represents the total number gray is \( 256(2^8) \), \( g_c \) is the gray value of the center point, \( g_e \) is 8 points around the center point.

3.3. Actual application effect
Capture and take screenshots of the actual operating substation pictures, and the actual test results are shown in Fig.4(a)(b). For the correct wearing of a helmet, the marked box is green, the word “amqzc” means with helmet, and the word “wcaqm” means without the helmet indicates the probability with
the helmet. The red mark will always follow the person without the helmet when the man without the helmet is recognized, and simultaneously send an alarm to the on-site personnel and the back-office attendant.

Fig. 4 test results

Fig.4 (a) shows that the man without helmet, and the probability of not wearing the helmet is 99%, which effectively identifies the helmet not being worn. Fig.4(b) shows that the probability of the men with the helmet are 98% and 96.4%, respectively, and the probability of the man of distance without the helmet is 81%, the recognition probability is relatively low for long distance, the correctness of the identification ability of wearing helmet is verified by this system.

4. conclusion
This paper analyzes the shortcomings of traditional substation video surveillance, and designs and proposes an intelligent video surveillance according to the requirements of intelligence, embeds the intelligent module in the original system, and improves video surveillance status recognition, defect recognition and site safety through BP neural networks. The ability to recognize the existence of three aspects, and meet the continuous development of the power grid to the increasing importance of equipment.

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