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Using Improved BP Neural Network and Concept Lattice to Construction Smart Sensors System

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Abstract: Smart sensor is information detection, information processing, information memory, logical thinking and judging function of sensor. It not only has the various functions of the traditional sensor, but also has the data processing, fault diagnosis, non linear processing, self correction and man-machine communication. BP (Back Propagation) neural network is a kind of error back propagation training algorithm for the multilayer feed forward network. As the central data structure in formal concept analysis, concept lattice can sign formal description the concept from the denotation and connotation to realize understanding semantic information by computer. This paper uses the implicit structure of three layers of BP neural network to build intelligent sensor network model is improved to complete the prediction of sensor information. The paper presents using improved BP neural network and concept lattice model to construction of smart sensors system. Experimental comparison shows that the method proposed in this paper is very effective to forecast information smart sensing.

Keywords: Smart sensors, Back Propagation neural network, Concept lattice.

1. Introduction

Integrated smart sensor integrated circuit technology and micro-mechanical technology and sensing element powerful electronic integrated circuits on a chip (or secondary integrated in the same housing), usually with a signal extraction, signal processing, logic, two-way communications and other functions. Sensor and classic, making the smart sensor integrated with small size, low cost, low power consumption, high speed, high reliability, and high precision and powerful advantages.

Smart sensors, intelligent features such as: digital signal output, information storage and memory, logical judgment, decision-making, self-test, self-calibration, self-compensating microprocessor based. Microprocessor-based sensors have been developed from simple digital information processing to the network communication functions, neural networks, fuzzy theory, genetic theory, and the theory of wavelet transform, multi-sensor information fusion and other new technologies of the new theory of gradual improvement of modern smart sensors.

The BP algorithm because of its simplicity, small amount of calculation, the parallel advantages, is now one of the largest and most sophisticated training algorithm using neural network training [1]. The essence of the algorithm is the minimum solution error function, because it uses the steepest descent method in nonlinear programming, modifying the weights according to the direction of the negative gradient of error function.

BP neural network is essentially implements a mapping function from input to output, the

mathematical theory of three layer neural network can approximate any nonlinear continuous function with arbitrary precision. This makes it particularly suitable for solving complex problems of mechanism, namely the BP neural network has strong nonlinear mapping ability.

Concept lattice visualization provides an intuitive method of analysis and observation of the internal relations of the knowledge unit concept lattice layout, however, is quite difficult. In a graphical representation of the conceptual grid, there are two main layout means, one is a manual layout, and another is the use of the automatic layout of the computer. The manual layout of the advantage of being able to modify the position of each node according to the people's aesthetic, resulting in a high-quality concept lattice graphics.

The sensor is a detection device, can feel the measured information, and can be detected by the sense of information, according to the law must transform into the output information required or other signal, in order to satisfy the information transmission, processing, storage, display, record and control requirements. It is the realization of automatic detection and automatic control of the primary link. Compared with the sensor intelligent sensor and the advantage of the traditional, intelligent sensor is popular, mainly because of its multiple functions. Intelligent complex sensor corresponds to the microcomputer and sensor, which is composed of main sensor, auxiliary sensor and microcomputer hardware. The paper presents using improved BP neural network and concept lattice model to construction of smart sensors system.

2. Application of BP Neural Network in development Smart Sensors

Sensor based on semiconductor technique will change this situation, the provision of cheap price, convenient use of the sensor, especially intelligent sensor itself more convenient system and set of yang. And the completion of system development in computer aided design help, realize more complex functions. Compared with the traditional design and it is different application systems without using different sensor. Through the software design to change the sensor function in sensor based on a single, in order to meet the needs of different customers. In this way, intelligent sensor with low cost, high volume can achieve system design, maintenance and function expansion of fast, low cost.

Smart sensors from the compensation and calculation functions for the sensor temperature drift and non-linear compensation has opened up a new road, so that the relaxation of the sensor processing requirements of precision, as long as they can to ensure the repeatability, the use of microprocessor test signal can be calculated by the software to obtain more accurate results. It may also be processed statistically, re-calibration of a sensor, so that it re-effectively.

BP (Back Propagation) neural network is the most in-depth study of artificial neural network, used as a model for a wide range of it, Z is the input, the output vector of the network, each neuron is represented by a node, the network is composed of input layer, hidden layer and output layer nodes, hidden layer can be a layer, can also be a multilayer (the picture is a single hidden layer), anterior layer after layer between the nodes through the weighted coefficient phase connection [2]. BP neural network learning, the input signals from the input layer to the hidden layer to the output layer (forward propagation), if the output layer to obtain the desired output, the learning algorithm: otherwise, go to the end of back propagation.

The key problem of multilayer feed forward neural network is to solve the learning algorithm. Learning algorithm is the main feature of neural network, is also the main topic. Learning concepts from the biological model organism, it is effective in the complex environment and self regulation. Neural network to change its output value, but you can change the transfer function; can only change the input value, and the only way to change the input function to modify the weighting coefficients in the input. So the neural network learning is the process to modify the weight coefficient, the output reaches a desired value, the end of learning. Back propagation neural network structure is as shown in the Fig. 1.

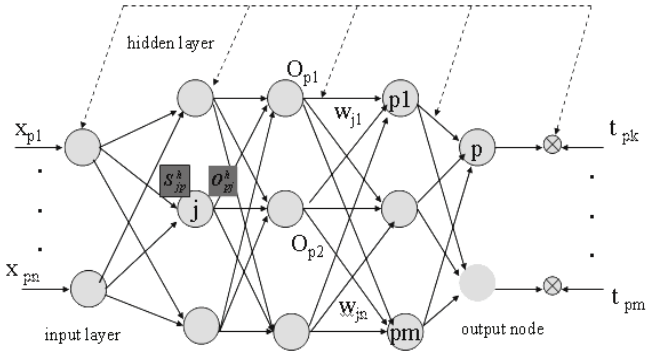

Fig. 1. BP neural network structure diagram.

In addition, the network input output node, a node of hidden layer of a layer or layers; the adjacent layer neuron completely interconnected, nodes of the same layer are independent of each other. The input signal to the input layer, the hidden layer nodes are passed, and finally to the output node: the output nodes in every layer are the input of the next layer.

Implementation of gradient descent algorithm: add mode and batch mode. On the increase mode, network input each submits a, gradient calculation time and update the weights. In the batch mode, when all inputs are submitted after the network was updated. The next two sections will discuss the increase mode and batch mode. Increase model training method (increase model training method (ADAPT) the adapt function is used to increase the training mode of network, it from the training set to accept the network object, network input and the target input, output and error return trained network object, obtained by the weight and bias.

Dubbed Smart Sensors Development and Cooperation in the field bus control system corresponding image processing software, graphic imaging and the promotion of the exhibition situation developed rapidly [3]. Automation instrument constitutes a multi-dimensional image sensor, the smart sensor meter manufacturers original set of production equipment basically reached its most advanced form. Constant plus a piece with a digital bus interface microprocessor, mixed to achieve the flapper assembled and equipped to be able to communicate, control, intelligent sensor system on a chip, self-correcting, self-compensating, self-diagnosis, etc. intelligent software, there are many difficult problems. This is one of the most economical, the system integration aspects (such as sensitive unit, the letter fastest way to build smart sensors, as is shown by equation 1.

$$\begin{cases} \dfrac{dp_0(t)}{dt} = -\lambda p_0(t) + \mu p_1(t), \\ \dfrac{dp_1(t)}{dt} = -\mu p_1(t) + \lambda p_0(t). \end{cases} \tag{1}$$

The rapid development of intelligent sensor network is closely related to the Internet of things, is closely linked with the technical progress of intelligent sensor. Here a concept referred to is the RFID technology. At networking, sensor is the role of information perception system consists of information collection layer and network layer, is the entire network chain total demand of the largest and most basic aspect; at the same time, is also the Internet of things technology support, perceived temperature sensor object information, RFID gives the electronic code.

This paper will be based on the design method of intelligent sensor intelligent sensor characteristics are given, and compared with the general sensor system structure and design method, analyze its advantages. On this basis, it points out that the intelligent sensor network will be the inevitable direction of future sensor development, internal structure models are intelligent sensor network and measurement control system based on field bus network, Internet network model.

Measurement and control system based on distributed intelligent sensor is composed of a certain network will each control node, sensor nodes and a central control unit together constitute. The sensor node is used to realize the parameter measurement and transmit the data to other nodes in the network; control node is according to the need to obtain the required data from the network and the data to formulate the corresponding control method and execution control output according to the. In the system, each sensor node and control node number can be more or less, depending on the requirements of. Network selection can be sensor bus, field bus, can also be the enterprise internal Ethernet, can also be directly is Internet.

Smart Sensor IP core design and SOC build smart sensors related to data acquisition, signal processing (programmable amplification, linearization, signal filtering, signal compensation, artificial neural networks, genetic theory, multi-sensor fusion, fuzzy theory, etc.), data communications, people machine interface and task scheduling [4]. IP core design and SOC build, in order to simplify and reduce the complexity, we use FPGA IP core and based on the ARM7TDMI-SCPU IP core two SOC design approach, which FPGA IP core complete data acquisition and signal processing module, based on the ARM7 IP core to complete the data communication, human-machine interface and task scheduling work.

Implementation of BP neural network is applied in the safety evaluation system of (1) to determine the topology of the network, including the middle hidden layer number, input layer, output layer and hidden layer nodes. (2) the index system is determined by evaluation system includes a feature by using neural network and state parameters for the safety evaluation, we must first determine the internal structure and external evaluation system environment, determined to correctly reflect the main features are evaluation of safety state of object parameters (the number of input nodes, each node actual meaning and expression and so on), and these parameters system (output nodes, each node actual meaning and the way of expression).

$$\frac{dY}{dX} = \frac{a_1 X + b_1 Y}{a_2 X + b_2 Y} = g\left(\frac{Y}{X}\right) \tag{2}$$

Artificial neural network has the unique nonlinear adaptive information processing capability, to overcome the traditional methods of artificial intelligence for the intuition, such as pattern, speech recognition, non structured information processing, so it is successfully applied in the field of neural expert system, pattern recognition, intelligent control,

combinatorial optimization, prediction. Combining artificial neural network with other traditional methods, will promote the development of artificial intelligence and information processing technology development.

Transmission of biological neurons through the synaptic signal is a complex electrochemical process; in the artificial neural network is the simplified simulation into a group of digital signals by learning the rules of the continuous change in the renewal process, this group of numbers stored in the connection weights between neurons. The input layer of the network simulation is the nervous system of sensory neurons; it receives the input signal samples.

Neurons in the network are arranged hierarchically, each neuron only connected with a layer of neurons. Neurons are arranged hierarchically, were composed of input layer, middle layer (also known as the hidden layer can be composed of a plurality of layers and the output layer). Each layer of neurons only accepts from neurons before a layer of input, behind a layer on the front of the layer does not signal feedback [5]. The input mode after sequential communication at all levels; finally get the output in the output layer. Sensor network and BP network are feed forward networks.

BP (Back Propagation) neural network is a neural network learning algorithm. It consists of input layer, the middle layer; the output layer of BP neural network, the intermediate layer can be extended to multilayer. Between adjacent layers of neurons are fully connected, and between each layer of each neuron connectionless network, according to the teaching mode of learning, when learning a provided to the network, each neuron network input response to generate connection weights (Weight). Then according to the output and the actual output error is reduced to the direction from the output layer, the middle layer layer-by-layer correction of each connection weight, back to the input layer. This process is repeated alternately, minimal global error until the network tends to the given value, to complete the learning process, as is shown by equation 3.

$$\frac{dy}{dx}=P(x)y+Q(x)y^n \tag{3}$$

Intelligent sensor design ideas and working principle: the sensing element of physical quantities will be tested into a corresponding electrical signal, if a digital signal directly through the photoelectric coupler to the micro processing parts processing, if the 4-20mA analog signal through the first signal conditioning part, filtering, amplification, and then sent to the micro processing part. The microprocessor is the core of intelligent sensor, which is responsible for sensor measurement data analysis, A/D conversion, storage etc. And then through the communication part of the conversion of electrical signals into 485 signals after treatment, and it is using the RS-485 two buses, exchange of information with the master station.

Man-machine interface mainly design of keyboard and LCD/LED/CRT display interface. The use of ARM7 powerful function of GPIO is not difficult to achieve [6]. Task scheduling of IP include data acquisition, signal processing, data scheduling and communication scheduling and man-machine interface operation etc. We use the open source embedded operating system μ C/OS- □ 2.52 edition as the basis, it can be transplanted into the LPC2106 ARM microprocessor. The research and development is various application software based on μ C/OS-embedded operating system, and it is to complete the work of all kinds of task scheduling and configuration need intelligent sensor.

$$u=\int_0^x xdx+\int_1^y(\frac{x^2}{2}+\frac{1}{y})dy=\frac{x^2}{2}y+\ln y \tag{4}$$

Smart sensor hardware circuit is part of the microprocessor: power supply section; communication section; signal conditioning components. Intelligent sensor can measure parameters of hybrid sensors, so as to further broaden its detection and application field, and the microprocessor intervention makes intelligent sensor capable of real-time processing is more convenient to a variety of signal. In addition, the flexible configuration can not only make the same type of sensor to achieve the best performance, also can make them suitable for different working environment.

The BP neural network has the ability of associative memory and input information to external stimuli [7]. This is because it uses distributed parallel information processing, extraction of information must be associative way, can be related to mobilize all the neurons. BP neural network adaptive training through the previously stored information and learning mechanism, can recover the complete information of the original information and noise interference from incomplete. This ability allows the restoration, language processing, pattern recognition in image has important applications, as is shown by Fig. 2.

The rapid development of the Matlab software provides a convenient means to realize the simulation of neural network theory. The Matlab neural network toolbox broadened the application space of neural network. Neural network toolbox will many of the original manual calculation task to computer, on one hand, improve work efficiency, on the other hand, but also improves the accuracy and precision of calculation, reduce engineering burden.

Neural network toolbox is one of many tools developed in the MATLAB environment. It is based on the theory of artificial neural network; using MATLAB programming language constructs the framework of many typical neural networks and the associated function [8]. The toolbox functions mainly

into two parts. A part of the function for a certain type of neural network, such as the creation of function, BP neural network perception training function etc. While the other part function is general, and it can be used for almost all types of neural network, such as neural network simulation function, initialization function and the training function.

$$\mu(x,y) = e^{\int \phi(y)dy} = e^{\int -\frac{2}{y}dy} = y^{-2} \qquad (5)$$

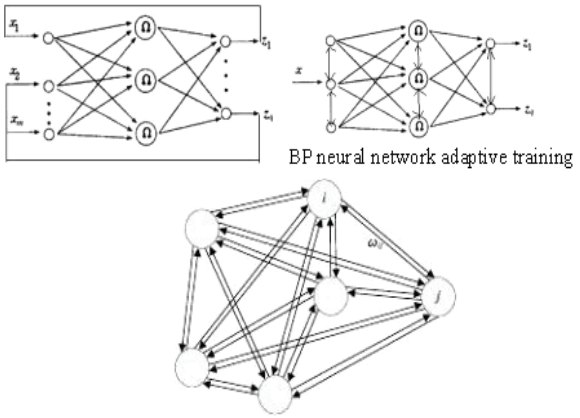

Fig. 2. The improved BP neural network algorithm running structure.

This paper first summarizes the neural network the purpose and significance of the study, introduces the research background and the current status of neural network, analyses the existing problems in the study of neural network, then describes the working principle of the BP neural network algorithm and BP neural network is presented, the limitations of BP network. Based on the BP neural network based, based on the study of BP neural network in function approximation and estimation of sample size of two examples of application. And the analysis conclusion, namely the signal frequency is high, the hidden layer node number, number of hidden units more stronger ability, approximation.

The realization of intelligent sensor system is based on sensor technology, computer technology, signal processing, network control technology, first of all, system. From the perspective of general computer, computer system to process the data is digital signal, and is directly through the external input device, the signal itself will be subject to external equipment limited. But the face for sensor system is analog signal associated with the external environment, some physical quantity related signal with the outside world. This means that signal the presence and the emergence of signals is subject to environmental constraints.

At present, the intelligent sensor system itself, although all are digital, but the communication agreement still needs the help of 40 ~ 60mA standard analog signal to achieve. Is now actively studying the introduction of general field bus digital signal transmission standards related to the structure of some international standardization research machine; however, still mostly uses the remote bus addressing sensor in this transitional phase (HART) protocol. This is a suitable for intelligent sensor communication protocol, is fully compatible with the systems currently used in 4 ~ 20 mA analog signal, analog signal and digital signal can be done at the same time communication, so that different manufacturer's products is universal.

$$y_k = f(s_k) = \frac{1}{1+e^{-(r_k - y_k)}}, \qquad (6)$$

The BP algorithm is to estimate the error directly leading layer output layer by using error output layer, then the error estimation error of a layer. So, we obtain the error estimates for all the other layers. Thus the output error end show transported along with the input signal in the opposite direction step by step to the network to the input of the transfer process. Therefore, people and this algorithm is called back propagation algorithm.

BP model of the I/O problem for a set of samples into a nonlinear optimization problem, it is the most common optimization of gradient descent method. If the neural network as the input to the output of the mapping, this mapping is a highly nonlinear mapping. The design of a neural network expert system focuses on the model of the structure and learning algorithm of choice [9]. Generally speaking, the structure is determined according to the research field and the problems to be solved. Through the analysis of a large amount of historical data and the data of the anterior neural network theory development level, the establishment of a suitable model, and the corresponding learning algorithm based on the model, the network learning process, constantly adjust the network parameters, and output the results meet the requirements.

Multifunctional sensor system consists of a number of sensitive elements of different composition, can be used to measure various parameters with. For example, can be a temperature sensor and a humidity detector configuration together (that is, the thermal sensitive element and a humidity sensor are respectively arranged bearing in the same sensor body) into a sensor, a new way, the new sensor can simultaneously measure temperature and humidity.

3. Concept Lattice model to Building Smart Sensors System

The intelligent degree is proportional to the level of development of the software; I believe that in the near future, computer platform will be widely used by virtual sensors based on software development. Software development tools including design,

management and communication management aspects. At present this kind of tool has begun to appear, Lab view, ActiveX and other software tools can be completed. The function of the software is proportional to the level of development of the software, is used to realize the sensor model, calibration parameters is established, the best calibration model selection.

Data acquisition and data processing of intelligent sensor: it must be pre-processed output signal before intelligent sensors. Because of many kinds of detected signal, a signal output from the analog, digital, the switch quantity, the vast majority of the output of the sensor output signal of the sensor cannot be used directly as input to A/D conversion, must pass various pretreatment circuit of the sensor output signal into a unified voltage signal or periodic signals [10]. Data acquisition: the sensor signal and processing as required by A/D converter bit analog signal, analog to digital the elegant depends on analog converter (A/D) by sampling, quantizing and coding the input signal is transformed into digital signal.

Formal context (formal context) is usually defined as a group of three: K:= (G, M, R), where G and M are set, and R is two Yuan, the relationship between G and M. R G M, where G and M elements are known as the objects and attributes (i.e., gRm (g, m) R) read: object G has an attribute M. If the cardinal is K and it is called an order form. In the premise of not confused, formal context is referred to as the background (context).

$$\begin{aligned} A' &:= \{m \in M \,|\, \forall g \in A \cdot gRm\} \\ B' &:= \{g \in G \,|\, \forall m \in B \cdot gRm\} \end{aligned} \tag{7}$$

In order to describe the model and process model based on concept lattice based knowledge internally consistent, must solve some problems, including the scale control, simplified, background knowledge, knowledge management (metadata) isomorphic judgment, generation of new knowledge and knowledge expression, etc. But in the final analysis, the learning process is the process of generating new knowledge, then, to establish knowledge similarity model of the target is effective to obtain the concept lattice.

In order to batch build concept lattice, mainly to complete two tasks: one is to generate grid nodes all (that is, formal concept set); two is to establish a direct precursor of the lattice nodes / direct successor relationship [11]. So according to these two tasks to complete the order is different, we can use two different ways to complete: one is the first generation of the concept set, and then find out the direct precursor of / between these concepts and the direct successor relationship; another is created each time a small amount of the concept, and the concept of link to node in the collection. The first way is called the task segmentation model.

The basic principle of the design of the intelligent liquid level sensor is to measure the water pressure with a pressure sensor, the output pressure transmitter for analog voltage signal 0-9 V (or analog current signal 4-20 mA), to collect the sensor output voltage and voltage analog signals into digital level signal 0 using ADC0804, then the data will be collected into the SCM minimum system for processing and then converted by RS232 level 1. Sent to the PC machine, machine using VB MS.COM controls write a display interface, PC in the VB program will be converted into digital quantity by the centimeter height and displayed, as is shown by equation 8.

$$\overline{I_k} = \frac{\sum\limits_{x \in \Omega_i} [I_k(X')]}{L \cdot L}, \overline{I_{k-1}} = \frac{\sum\limits_{x \in \Omega_i} [I_{k-1}(X)]}{L \cdot L} \tag{8}$$

Smart Sensor and intelligent actuator and intelligent transmitter-micro sensor (or micro actuator micro transmitter) and it all or part of the processor, it is processing integrated circuit devices on a chip (such as the single chip micro acceleration meter solutions). So the intelligent sensor bionic ability, such as fuzzy logic, proactively identifies environment, and it is automatic adjustment and compensation ability to adapt to the environment, self diagnosis, and self maintenance [12]. Obviously, because of the scale of production and reduce the cost of production requirements, design thought of intelligent sensor, the selection of materials and the production process must as far as possible standard silicon planar process of consistent and integrated circuit chip. In normal process, or processes, and it is process after the completion of some special needs of process, but it should not be too much.

With the development of distributed database technology and computer network technology, distributed data storage and parallel processing has become a reality, how to rationally organize distributed data storage and parallel processing is the urgent task, whether in theory or in technology, there are many problems need to be studied. Because the concept lattice has good mathematical properties and is suitable for batch processing characteristics, therefore, distributed concept lattice is the ideal tool for solving the above problems.

Concept lattice is two L lattice node C1= (O1, D1) and C2= (O2, D2), if D1=D2, we say that C1 is equal to C2; if D1 D2, we say that C1 is greater than C2, or C2 is less than C1, C1= lattice node concept lattice on the L (O1, D1), C2= (O2, D2) and C3= (O3, D3), if O3=O1 O2 D3=D1 D2, ¬, we say that C1+C2 is equal to C3.

Concept lattice is the least upper bound of L (O, f (O)) began. Then generate all of its child nodes and connected to its parent node. Then each node is recursively repeated the process [13]. The key of the algorithm is to generate a child node. The algorithm is, let (X, Y) is the current node, D is the set of attributes. Find all P D-Y, these P can remain

completely on the nature of the X, which is the largest expansion. For any P, P Y is the connotation of the child nodes of the current node. The algorithm is very simple, intuitive, and easy parallelization. The disadvantage is that repeated generates many redundant nodes (Fig. 3).

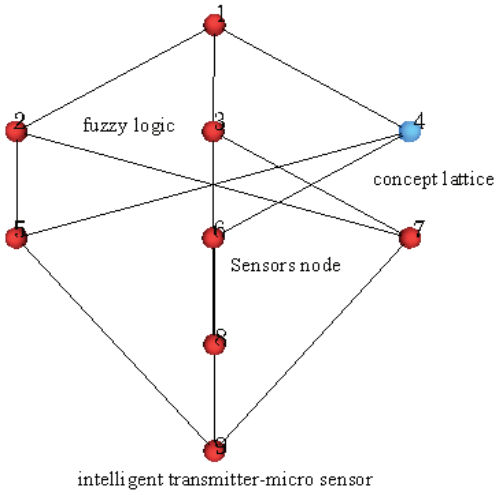

Fig. 3. Building Smart Sensors based on Concept Lattice.

Smart sensor signal processing as required with A/D converter point analog signal, depending on the analog converter (MD) simulation and digital input signal into digital signal, these changes are obtained by sampling, quantizing and coding. Data is processing. A/D data output signal converter to convert the pressure sensor, according to the needs of processing the digital signal, such as scaling, nonlinear compensation, temperature compensation and digital filtering software processing, otherwise it is not directly input supply Yong Cheng sequence using microprocessor, as is shown by equation9 [14].

$$\frac{dp_0(t)}{dt} = -\lambda p_0(t) + u\left(1 - p_0(t)\right) \qquad (9)$$

Smart sensor is information detection, information processing, information memory, logical thinking and judging function of sensor. It not only has the various functions of the traditional sensor, but also with the data processing, fault diagnosis, non linear processing, self correction, self adjustment function and man-machine communication etc. It is a product of microelectronics, micro electronic computer technology and testing technology with the combination of it.

Important characteristics of intelligent sensors, can be used in two ways: the selected function commands issued by the user through the keyboard; the automatic type, data acquisition and processing program has been compiled by the internal function control program coordination, receive or external signal through the IEEE--488 bus, control instruction sent by the intelligent pressure sensor, and then through the self-calibration, tracking, alarm, print output, keyboard, display, A/D conversion circuit and is connected to the 1=I, so as to ensure the orderly operation of intelligent pressure sensor. According to Fig. 2 source program flow diagram design: a calibration of a signal into a digital code a latch output ideal EPROM installed intelligent pressure sensor.

The smart sensor primarily by the information collection circuit, the control unit, keyboard input interface circuit, a display interface circuit and the external communication interface circuit composed of five parts. The high-voltage pulse for driving the ultrasonic probe and it is the probe to convert electrical energy into mechanical energy to generate ultrasonic waves. Ultrasonic pulse signal receiving circuit includes receiving a signal limiter, zoom, compared with single-shot trigger and other sectors, to form a narrow pulse signal.

4. Using Improved BP Neural Network and Concept Lattice Model to Construction of Smart Sensors System

BP network is a multi-layer feed forward neural network, the transfer function of the neurons in the S-type function, so the output of a continuous quantity between 0-1, it can achieve arbitrary nonlinear mapping from input to output. Weights to adjust the back-propagation learning algorithm often referred to as the BP network. Using the input set of output samples to training, and it is in order to enable the network to achieve a given input-output mapping relationship [15]. BP neural network trained for other input can also be given the appropriate output. BP neural network is widely used in function approximation, pattern recognition, data compression, which is a core part of the feed-forward network. BP network is the wider application of the network model, but there are some limitations, such as slow convergence rate, you need to construct a training sample set.

Intelligent temperature sensor based on AT89S52 single chip microcomputer as control core, by a digital temperature sensor DS18B20 measurement of temperature controlled. Peripheral circuit including communication and digital PC display circuit, and it is multi-channel temperature acquisition, output control potential.

Initializes the system's AD converter, and it is the voltage reference system because the input frequency ups to 1.1 MHz, so the system main frequency divider input 8. ADC has no input cache MSP430F2013, cache in cache mode selection in the closed. System for measuring the physical quantities of continuous change, and it is to set up the system for continuous conversion mode [16]. When measuring open interrupt, when measuring results,

generate an interrupt, interrupt flag bit, the measurement results are stored in the conversion result register, when the measured results from the readout register results after conversion, interrupt flag bit is automatically reset. So read the conversion result only when the query interrupts flag, as is shown by equation 10.

$$MI_{FA}(f,a)=\sum_{f,a}P_{FA}(f,a)\ln\frac{P_{FA}(f,a)}{P_F(f)P_A(a)} \quad (10)$$

Concept formation method based on concept lattice, mainly proposed to extract implication rules from concept lattice algorithm, contains problem and use the results of function dependency in relational databases to handle rules, but the implication rules is a deterministic rules, not able to describe probabilistic rules and noise resistance ability, and it is in order to improve the robustness of rule discovery.

Now let us consider L (K2) has a plurality of concept lattice, given L (K1) and L (K2) is the two extention-independent same field lattices, solution of L (K1) L (K2). This algorithm is based on L (K2) was used for constructing concept lattice incremental Godin algorithm to each grid node, insert it into the L (K1) of concept lattice, can get the final L (K1) L (K2).

BP (Back Propagation) neural network is a kind of error back propagation training algorithm for the multilayer feed forward network, is one of the most widely used at present neural network model. BP network can input and output schema mapping relationship between learning and mass storage, without prior to reveal the mathematical equations describing the mapping relation. Its learning rule is to use the steepest descent method, through the back-propagation network to continuously adjust the weights and thresholds of the network, the error square and minimum. Multilayer feed forward BP network is a neural network form the most applied. Multilayer feed forward BP network essentially implements a mapping function from input to output, and the mathematical theory has proved that it has any complex nonlinear mapping function.

BP neural network is a typical global approximation of neural network; the radial basis function (Radial Basis Function, RBF) neural network is a typical artificial neural network. RBF neural network is a neural network proposed by J. Moody and C. Darken in the late nineteen eighties. The basic idea of RBF neural network is used as the "base" of neurons in the hidden layer radial basis function, constitute the hidden layer, hidden layer to the input vector transform, the low dimensional model of the input data is transformed to high dimension space, the low dimensional space of the linear non-separable problem in high dimensional space linear reparability [17]. Basic RBF neural network is three layers feed forward networks with a single hidden layer. RBF hidden layer generally have higher dimension, as input to the hidden layer output between nonlinear transformations; linear transformation, providing a response to activation patterns in the input layer.

Three layer neural networks have strong learning ability. The learning algorithm is three layer BP neural networks. Input layer node number three layers of improved BP neural network for m, the number of nodes in the hidden layer is p, node of output layer is Q, definition of symbols which are as follows.

1) The corresponding number of unit input layer by the sample values; as the activation value, the weight matrix, for the value of the activation of each unit;

2) The input vector of training samples for BP neural network input layer neurons in the input, then the amount of neurons in the hidden layer:

$$b_j = f(a_j) = \frac{1}{1+e^{-(a_j-\theta_j)}}, \quad (11)$$

3) Concept lattice L (K2) grid nodes in ascending order according to the content stored in the queue VEC;

4) Concept lattice is two L lattice node C1= (O1, D1) and C2= (O2, D2), if D1=D2, C1 is equal to C2; if D1 D2, said C1 is greater than C2, less than C1 or C2;

5) According to the output samples of the expected value and the output layer of the poor, to calculate the error signal and is connected on the weights of the output layer neuron threshold related:

$$\delta_k\delta_k = (c_k - y_k)y_k(1-y_k) \quad (12)$$

6) **IF** f*({x*})⊄Intent(inf(L)) **THEN**
IF Extent(inf(L))=Φ **THEN**
Intent(inf(L)):=Intent(inf(L))∪f*({x*})

7) Repeat the calculation (2) - (5) step, until the error is small enough for or zero (at this time).

8) For j←1 to ObjNum－1 Do
For k←j＋1 to ObjNum Do

9) Modified formula weights of neurons in the input layer to the hidden layer neurons of smart sensors.

$$w_{ij}^{(i+1)} = w_{ij}^{(i)} + \alpha\sigma_j I_i \quad (13)$$

10) BP neural network with hidden layer is introduced, and the transfer function for Sigmoid nonlinear function, therefore, its characteristic is it can approximate any continuous function.

Smart sensor parameters may be varied. But from the function module, it mainly includes the data acquisition module, compensation and correction module, data processing module, data communication module, man-machine interface and task management and scheduling module and other

functional units. Thus the intelligent sensor SOC design process based on IP: universal module model firstly to establish intelligent sensor; then the reasonable division of the module function specification, make the interface protocols between modules and standard; then design a series of generic IP kernel; finally the required for IP nuclear build together intelligent sensor system integrity, as is shown by Fig. 3.

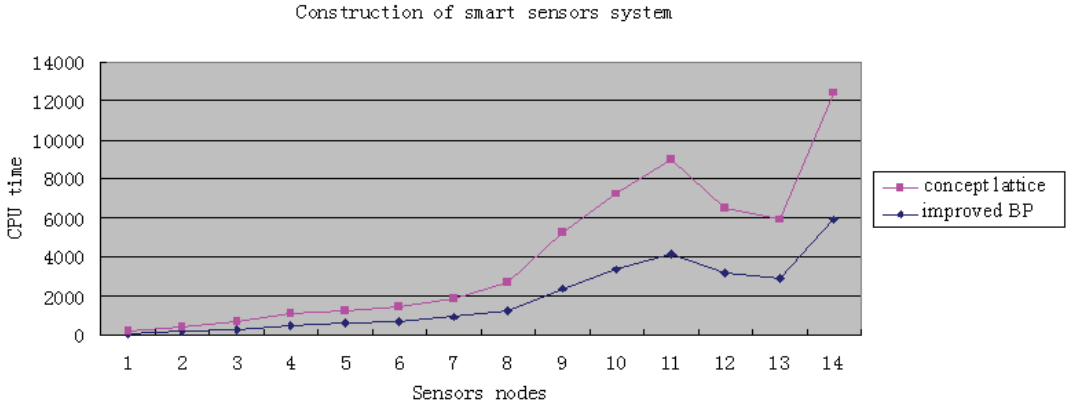

Fig. 4. Comparison results of construction smart sensors system improved BP neural network with concept lattice.

The paper presents using improved BP neural network and concept lattice model to construction of smart sensors system. Smart sensor can not only carry out processing, analysis and control of information, can compensate the measured value and its error, but also can think logically and conclusions, can use to linearism nonlinear signal on the list, with the help of software filter digital signal. In addition, also can realize the nonlinear compensation or compensation in more complex environment by using BP neural network, it is to improve the accuracy of measurement. The improved BP algorithm has the additional momentum gradient descent algorithm, adaptive learning rate gradient descent, conjugate gradient algorithm. Momentum gradient descent with momentum reduces the sensitivity of neural network for details of error curved surface; effectively inhibit the network into a local minimum. The comparison results of construction smart sensors system improved BP neural network with concept lattice are shown in Fig.4.

6. Conclusions

The smart sensor has the diagnosis and self calibration function, and it can be used to detect the working environment. When the work environment nears the limit condition, it will send out an alarm signal, and according to the diagnostic information related to the given input signal analyzer. When the intelligent sensor due to some internal failure and it can use its internal detection link is to find abnormal phenomenon or a faulty component. In this paper, by using BP neural network for forecasting strong sensing. Using the improved additional momentum and adaptive learning rate gradient descent algorithm of BP, determine the neural network model, intelligent sensor prediction. Concept lattice as core data structure in formal concept analysis, symbolic formal description with concepts from the denotation and connotation of the two parties, semantic information to realize the computer can understand.

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References

[1]. Liu Min, Using Fuzzy Neural Network Approach to Estimate Contractor's Markup, *Building and Enviroment*, 38, 2003, pp. 1303-1308.

[2]. Liang Xiao, Shan Kang, Lianfen Huang, Sensor-Assisted Security in Cognitive Radio Networks, *JCIT*, Vol. 8, No. 6, 2013, pp. 31 - 39.

[3]. Xiaofei Wang, Jinyan Chen, Dong Li, Xu Zhao, Haiming Shao, The Establishment of the Human Body's Perception Current Threshold Model Based on BP Neural Network, *IJACT*, Vol. 4, No. 20, 2012, pp. 659 - 665.

[4]. Yongbin Li, Prediction Model of Traffic Based on Wavelet Analysis and BP Neural Network, *JDCTA*, Vol. 6, No. 22, 2012, pp. 775 - 784.

[5]. Xuejun Li, Xin Li, Lingli Jiang, Guangbin Wang, M. Ka Pickavet, AE Signal Fault Recognition based on Improved Lifting Wavelet Denoising and BP Neural Network, *JCIT*, Vol. 7, No. 22, 2012, pp. 719 - 727.

[6]. Yu Zhou, Jun Li, Xiaoming Zhou, Study on EEG Password based on AR Power Spectrum and BP network, *JCIT*, Vol. 7, No. 9, 2012, pp. 6 - 14.
[7]. U. Krohn, N. J. Davies and R. Weeks, Concept lattices for knowledge management, *BT Technol*, Vol. 17, No. 4, October 1999.
[8]. Ganter B., Wille R. Formal Concept Analysis: Mathematical Foundations, *Springer Verlag*, Berlin, 1999.
[9]. Nourine L., Raynaud O., A fast algorithm for building lattices, *Information Processing Letters*, 1999, 71, pp. 199-204.
[10]. Dan Dan Cui, Cai Qian Zhang, The Novel Model of Fusion Temperature Error Compensation System by Neural Network and Smart Sensors, *JCIT*, Vol. 8, No. 5, 2013, pp. 379 - 387.
[11]. Duk-Jin Chang, Dahl-Ho Song, Selection Process of IT Applications for the Korean Next-Generation High-speed Train, *IJEI*, Vol. 2, No. 2, 2011, pp. 95 - 102.
[12]. Desheng Liu, Keqi Wang, Flow Meter online Compensation Based on Neural Network Algorithm, *IJACT*, Vol. 5, No. 1, 2013, pp. 297 - 303.
[13]. Seung-Hyun Oh, Stanislav Tyan, A Collision Avoidance Delayed MAC Protocol for Underwater Sensor Networks, *JCIT*, Vol. 8, No. 3, 2013, pp. 185 - 192.
[14]. Xisheng Li, Yongjiang You, Highway Construction Cost Estimation Based on Improved BP Neural Network Model, *JCIT*, Vol. 7, No. 21, 2012, pp. 236 - 244.
[15]. Machado, R Fuzzy. Connect lonlst Expelt Systems, In: *IEEE International Conference on Neural Networks*, 3, 1994, pp. 81-103.
[16]. Ye Hong, Yang Zhan-Ping, Li Jun, Li Shi-Ling, A Survey of Filtering Theory Based Multi-sensor Registration Algorithm, *IJACT*, Vol. 4, No. 5, 2012, pp. 318 - 328.
[17]. Junhai Ma, Xiaolei Meng, The Research on Development Path, Mode and Feasibility Based on the Complex Network and the BP Neural Network, *JCIT*, Vol. 7, No. 9, 2012, pp. 311 - 320.
