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Introduction of SCM technology into sensor design based on the current situation of sensors

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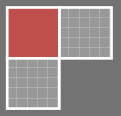
ABSTRACT

The characteristics of single chip microcomputer (SCM) technology are mainly manifested on its ability to covert the output signals collected by sensors efficiently, and correct the corresponding linear error at the same time so as to improve the measurement precision of sensors continuously. In this study, first, effective introduction to the working characteristics of the sensor is carried out, which demonstrates the function and value of sensors in the industrial production process clearly. Second, more intuitive diagrams and discussionsof the working principle of the sensors are utilized to make the basic working routes of sensors clear and effective. Third, specific research on the function of SCM in the sensor and its working principle is conductedthrough effective discussions of the specific application process, which further improves the application value of SCM technology in sensors. After that, a specific introduction mainly focused on the practical circuitis made, and effective investigation is conducted by combining the generation of correction data and the formation of an EPROM address. Eventually, based on specific application of SCM in the design of sensors, in-depth research is conducted, and the improvement of stability and anti-jam capability is studied specifically. The above is the basic technical route of the research process, which gives full expression to the main content of this study and contributes to the carefulness of the investigations and discussions in this study, and furthermore lay solid foundation of the embodiment of SCM technology's industrial value.

KEYWORDS

SCM technology; Sensor design; Working principles; Application value.



INTRODUCTION

According to the working principle of SCM, it has the function of error correction for sensors needed in various industries, and thus gives more effective guarantee of precision of measured objects. In this study, specific research is carried out by integrating several aspects including the introduction to basic knowledge and working principle of the sensor, SCM technology and application, implement circuit as well as the application of SCM technology in sensor design. In this process, the value of SCM and sensors for specific application of industrial production is effectively excavated. Effective exploration is made based on the existing deficits in the process of current research and design of sensors, which demonstrates the efficient compensation of SCM technology in contrast to the existing deficits of sensors intuitively.

INTRODUCTION TO BASIC KNOWLEDGE OF SENSORS

From a simple and intuitive view, the so-called sensor is a type of devices that have the ability of effective detection for objects. It has its foundation on the device precision, converts the corresponding basic parameters from the detected objects effectively, and forms a close relation among parameters to a certain degree. However, the constitution of a sensor itself is similar to that of human organs, as optical sensors are like human organs of vision, which have a sensitive function of the variation of light of the objects. Gas sensors, like human breathing organs, have a sensitive function to the smell variation of objects and surroundings, which results in effective responses. In contrast,acoustic sensors produce sensitive effects mainly through the sound variation of the objects and surroundings, which further results in corresponding responses. And temperature sensors have their reaction to the temperature changes on the surface of detected objects, and convey the information of changes effectively and thus are able to make effective responses[1]. Nevertheless, bases on different needs, the sensor itself should have corresponding features when taking the requirements of the detected objects into consideration. For instance, sensors for temperature controlled switch should be able to react accordingly for slight changes in temperature, which is supposed to be the main specific feature. The needed sensor in a certain industrial case and the application process is shown in Figure 1.

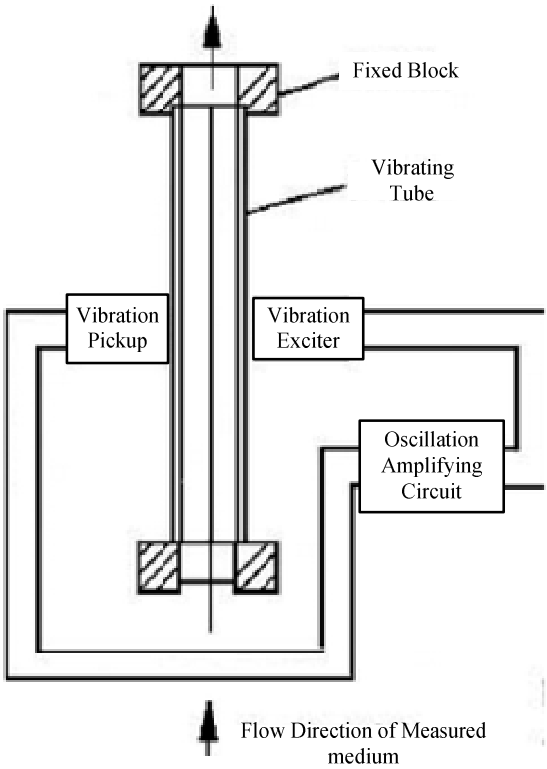


Figure 1 : An industrial application of sensors

THE WORKING PRINCIPLES

As can be seen in the basic schematic (shown in Figure 2) of the working principle, the application of SCM technology allows for effective A/D conversion of the sensor, and transforms the output to the address of linear correction value. In addition, based on the function and value of the linear result, the destination data is defined and effectively stored in storage cells to ensure that each output (Vr)of sensors is corresponding to D/A conversion. In this process, the A/D conversion result is defined as the specific EPROM address so that each (V) generates a specific EPROM address and

meanwhile the correction value in corresponding storage cell is produced. In this process, the correction value is converted efficiently and is related to V mutually, and consequently the addition part can be linearly output.

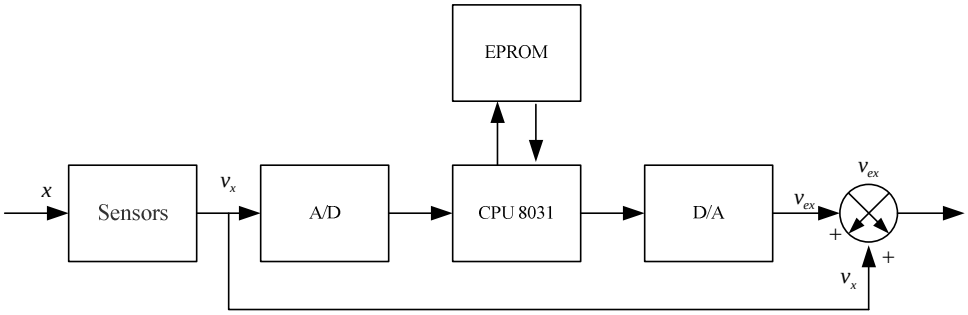


Figure 2 : The principle frame graph

SCMTECHNOLOGY ANDITS APPLICATION

From an intuitive view, the working principle of SCM technology is on the basis of effective control of circuit chip, So as to make the whole control process achieve the automation standard and form a more scientific and effective computer system. However, in the composition of SCM technology several main modules should be effectively constructed, including firstly central processing unit, then the storage of original data and converted data, and finally the I/O ports[2]. Nevertheless, in the research and development process of SCM technology, the basic hardware requirements include not just basic featuresof the semiconductor like light, heat and so on, but the increasing improvement of integration, and hence the overall dimension of SCM can be sufficiently reduced.

In the current industrial production process, many developed countries and developing countries employ SCM technology in a wide range, and SCM technology has been widely studied and applied in research fields ranging from computer science to space technology. Because of the basic development trend, the application fields and the technology development of SCM in China's large-scale industrial production process has gone rapid transformation, which has improved informatization of science and technology increasingly. However, in the research and development of SCM technology and its application, the effective introductioninto sensors is an approach of SCM technology in recent years, which has resulted in significant effecton SCM technology and its application. In the introduction of sensors,semiconductor silicon is mainly integrated andeffectively utilized, and thus a close relation is formed between them.

IMPLEMENTATIONCIRCUIT

Nevertheless, effective linearization methods varied and are diversein terms of practical circuit, and various A/D chips can be selected and applied to establish linearization circuit accordingly, In this process, the memory chip is selected according to the bits of the chip itself and requirements of the program capacity, but on the basis of the overall requirements in industrial production, the D/A chip is generally selected for linearization circuit. However, the circuit is configured differently in different cases, and V_x is matched with related circuit of zero shifts, in which $V_{ex}$is equipped with corresponding conversion circuit so that the circuit can be restored to the state of zero.

The generation of correction data

In the SCM data correction process for sensors, by measuring the output data of sensors effectively, the gap between the polynomial and the output data is narrowed continuously, which allows for effective calculation[3] for the expression of $V_x(x)$. By means of reasonable assumption of the n-th approximation of $V_x(x)$, the approximation can be presented in the following equation:

$$V_x(x) = \left[a_n a_{n-1} a_{n-2} \ldots a_1 a_0\right] \bullet \left[x^n x^{n-1} x^{n-2} \ldots x^1\right]^T$$

Through effective measurement of sensitivity of the sensor, the upper bound of values can be K. Furthermore,effective requirements in terms ofthe linear output feature of sensors can be met, so that the special properties of sensors enable V_{ox} always equal to K_x.

Under that condition, the polynomial after correction $V_{xx}(x)$ is as the following equation:

$$V_{xx}(x) = V_{ox} - V_x$$

While the correction data is obtained, the two formulas above combined with related mathematical calculation software can be utilized for the calculation of correction data, so that correction data can be effectively acquired[4].

THE FORMATION OF EPROM ADDRESS

During the generation of EPROM address, the correction data is put in EPROM, and then the address is converted by A/D chip according to Vx（x）,so that the data after conversion is acquired from specific calculation process of computer. In this conversion, each correction value occupiestwo bytes and appropriate correction address is formed. The specific correction address is calculated as follows:

addr = address of the header + 2 × (value of A / D conversion)

Application of SCMTechnology in Sensor Design

As the development of modern industry accelerates requirements for equipment of industrial production increase as well, among which the requirements of sensors also improve. In current industrial production, there exist deficits in the reliability of the sensor itself, and meanwhile stability and precision are not sufficiently guaranteed. In addition, the cost of sensors themselves is comparatively high, which consequently results in a certain amount of error of industrial measuring system for produced commodities. SCM technology, on the other hand, has powerful calculation function, achieves higher standard in terms of error control, gets better control of production cost and allows for smaller dimensional design of sensors. The introduction of sensors makes up the insufficiency of sensors in traditional industrial production efficiently.

Analysis of the stability improvement of sensors through SCM technology

For the sensor itself, if its stability can meet higher requirements, the precision of measurement can hopefully be improved. In the measurement process of an object, the primary step is to ensure sufficient stability, which plays a role of assessment and evaluation in terms of the operational capability of a sensor itself. However, the present conditions of sensors lie in several aspects including the fact that stability and reliability fail to meet the ideal requirements, which have negative effects to a certain extent on the measurement precision of detected objects. Hopefully, the correction process of this error can be achieved by correcting data effectively using SCMtechnology[5]. The schematic diagram of nonlinear error correction is shown as Figure 3.

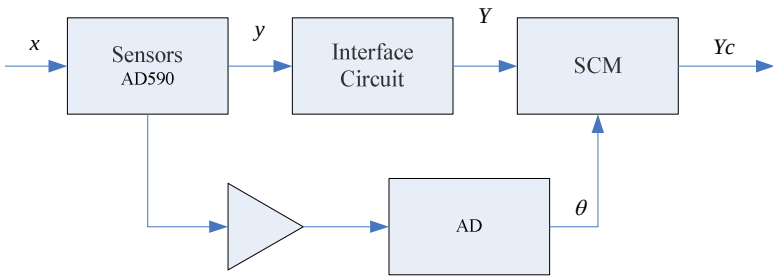


Figure 3 : The schematic diagram of nonlinear error correction

As is shown in Figure 3, the effective correction route of the SCM for sensor errorsis illustrated. In the measurement process, by converting signal x sent out by objects with sensors, signal y is received and continues to finish the output process, mainly through the circuit output interface for signal transmission. And then the signal is processed by means of processor, so that the processed x signal can be compared to digital signal y acquired by the SCM, which enables the existing error to be correction and the output signal (Yc) to achieve the expected standard.

Application of SCMT echnology in anti-interference of sensors

While the measuring process of sensors is conducted, the measurement precision of an object tends to be interfered by complex surroundings and thus a certain degree of error is produced. Hence the ability of anti-interference has to be improved topromote the measurement accuracy of sensors, so that the industrial production under complicated conditions is guaranteed. For the sensor itself, it generally plays the role of primary components in industrial production and reflects the property of sensitivity. In this process, the sensor remains stationary relative to the rotation axis ofthe manufacturing machine, but there still exists inhomogeneity of composition material on the axial plane to a certain degree, which makes the voltage of the axial plane continue to output and generates a certain degree of error in terms of the measurement precision of rotation axis. However, after introducing SCM technology, in each turn of the rotational axis, the existing curves related to output features can be adjusted specifically, so as to achieve effective and precise measurement of its manufacturing machine.

Application in the promotion of sensor development

From the view of the rapid industrial development, research on sensors have involved in more and more fields. A certain degree of difference in specifications and models of sensors would lead to variation of output parameters, which causes it difficult to form a kind of evaluation criteria[6]. SCM technology, however, is able to correct error effectively, mainly through powerful data computing functions and low cost of research and production. And thus standardized definitions among sensors can be expected to make, so that more scientific criteria is achieved and the measurement precision of sensors is promoted. On the other hand, the SCM is supposed to meet several requirements as blow based on the

fundamental trend of modern industry. The corresponding requirements include firstly strong unity of signal output, secondly effective compensation for detected objects, thirdly the linear correction related to existing error, fourthly strong signal storage capabilities, fifthly excellent performance in the signal processing function, and eventually the seamless connection with other control units.

The application of SCM technology in the sensor design

Improving the stability of sensors

The so-called sensor stability refers to the property that the operating feature of detected objects would not vary accordingly in a long span of working time, and hence make the measurement results maintain continuous effectiveness. However, the evaluation index is more significant compared to other related indexes. How to improve and remain the stability further is the key of research. After research and exploration of a long-term, the application of SCM technology has positive effects on the improvement and maintenance of stability for sensors. Moreover, the working principle of sensors is that through signal conversion and output correction, linear correction of sensors in the measurement process of the detected objects is conducted, so that existing error is made up and eventually industrial production capacity is increasingly improved.

Accelerating of standardization process of sensors

For sensors, different specifications and models are demanded by sensors in different industrial production, in which the input and output signals vary to a certain degree. However, the working characteristics also determine the large differences of working circuit, which makes it difficult to form uniform criteria in terms of the design and selection of sensors. For industrial production, the development is hindered to a certain extent, and thus how to avoid measurement error of the sensor itself becomes the primary issue for every researcher and designer. Nevertheless, as can be seen from the current research and design progress, the functional improvement of sensor design should be sufficiently valued, and functional development should meet the following requirements[7]. The requirements include firstly the effective amplification of signals collected by sensors from detected objects and conduction of the standardization of processing, secondly the sufficient compensation of detected objects, thirdly the linear correction of existing error, fourthly strong signal storage capabilities, and finally the excellent performance of processing functions. In this way, the production cost of sensors themselves can be reduced constantly, and forms unity among instruments at the same time.

CONCLUSIONS

The contents above are the research and discussions based on the subject of the introduction of SCM technology into sensor design based on the current situation of sensors, in which the working principles of SCM technology and sensor technology, and application of SCM technology in sensor design are the two emphasis of research. Such emphasis makes the research targets more clearly, in which the application value of SCM technology in industrial production is demonstrated, and hopefully theresearch in this paper would contribute to the theoretical foundation for further development in implementation of sensor design.

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