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Application and Development of Sensors in Mechatronic Systems

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ABSTRACT This paper describes the role of the sensor and its position in mechatronic systems, but also about the common in mechatronics sensor types, characteristics, structure and use, etc., also introduced in the selection of indicators in mechatronics and sensor sensors in the future development direction and future prospects. Sensor information training as a pulse is more widely popular and development to all areas of our businesses, which is to make our transition from labor-intensive to technology-based, must use its information technology, namely sensor technology, the sensor in industrial automation, defense industry agriculture, energy, transportation, household appliances and other applications has its developing markets. Potential in our country especially in sensor technology maximum. The main applications for chemistry, environmental protection, bio-engineering and medical health and so on.

KEYWORDS
Sensor technology
Application fields
Information technology

1. Introduction

1.1. The definition and composition sensor

People in order to obtain information from the outside world, must resort to the sense organs. The people rely on their sense organs, in the study of natural phenomena and laws as well as production activities in their function is far from enough. To accommodate this situation, we need sensors. Therefore we can say, the sensor is an extension of human facial features.

The sensor is a physical device or a biological organ, can detect and feel the outside of the signal, the physical conditions (such as light, heat, humidity) or chemical composition (e.g., aerosol), and to ascertain the information to other devices or organs.

According to the national standard GB7665-87 definition of the lower sensor is: "to feel provisions are measured in accordance with certain rules and converted into a device or devices available signals, usually by the sensitive components and conversion element composition". Sensor is a detection device can feel the measured information, and can detect feel the information, according to certain rules converted into electrical or other forms of information needed to output to meet the information transmission, processing, storage, display, recording and control requirements. It is the automatic detection and automatic control of the primary link.

Sensor consists of: (1) Sensitive components: direct experience or partial response is measured. The sensitive element is sometimes referred to as a sensor. (2) Converting elements: sensor capable of feeling or response to be measured is converted into an electrical signal suitable for transmission or measuring portion.

1.2. Structural features common sensors and applications

With the development of materials science, physical sensors will play an increasingly important role. Resistance strain gauge, inductive, capacitive, piezoelectric sensors is to measure the work of most of the sensors, their working principle is simple, measuring the conversion circuit is basically fixed, the application of technology is relatively mature, following several commonly used sensors this look analysis, we must first understand their structure, characteristics and use in life.

1.2.1. Resistance strain sensor

Resistance should change sensor type has a long history.

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It is one of the most widely used sensors. Resistance strain sensing type is the use of resistance strain gauge resistance change of the strain sensor.

Strain sensor characteristics: (1) Different types of materials: metal strain gauges, semiconductor strain gauge; (2) Strain Range: Strain force, pressure, torque, displacement, acceleration; (3) Main advantages: easy to use, high precision, large-scale, small size.

1.2.2. Inductive sensors

Inductive sensors: The use of electromagnetic induction to the measured physical quantities such as displacement, pressure, flow, vibration, etc. Convert change of self-inductance and mutual inductance of a coil, and then by the amount of change in the output circuit converts the voltage or current, to achieve non- electricity to power conversion [1].

Inductive sensors have the following characteristics:

(1) Simple structure, sensor inactivity electrical contact, and therefore reliable long life.

(2) Sensitivity and high resolution, can measure the displacement of 0.01 micron. Strong output signal of the sensor, voltage sensitivity general displacement of up to hundreds of millivolts per millimeter output.

(3) Linearity and repeatability are better, within a certain range of displacement (tens of microns to several millimeters), sensor nonlinearity error of up to 0.05% to 0.1%. At the same time, such sensors can achieve long-distance transmission of information, record, display and control. It is widely adopted in industrial automation control systems. But less than that, it has a disadvantage of low frequency response, not fast dynamic measurement and control and the like.

Many inductive sensor types, a common type inductance, mutual inductance and eddy current three. Inductive displacement sensors are used to measure and can be converted into a mechanical displacement amount (such as force, strain, pressure, pressure, acceleration, vibration, strain, flow, thickness, liquid level, specific gravity, torque, etc.) measurements.

1.2.3. Capacitive sensors

The mechanical quantity is needed to be measured, such as displacement, pressure changes into an electrical capacitance sensor. Its sensitive part is a capacitor having variable parameters. It's most common form is composed by two parallel electrodes, between the air electrodes as the capacitor dielectric. Capacitive sensors can be divided into pole pitch change type, area change type, change the media type categories. Pole pitch change type is generally used to measure the linear displacement or slight pitch change due to the extremely force, pressure, vibration caused. Area change type is generally used to measure angular displacement or larger linear displacement. Media change type commonly used in level measurement and a variety of medium temperature, density determination and humidity.

Advantages capacitor sensor is simple, cheap, high sensitivity, strong overload capacity, good dynamic response characteristics and high temperature, radiation, vibration and other adverse conditions, strong adaptability and so on. The disadvantage is that the output of non-linear, the influence of parasitic capacitance and distributed capacitance of greater sensitivity and accuracy, as well as the coupling circuit is relatively complicated. Since the late 1970s, with the development of integrated circuit technology, there has been packaged together with the miniature measuring instruments capacitive sensor. This new type of sensor which is the effect of the distributed capacitance is greatly reduced, so that the shortcomings inherent were overcome. Capacitive sensor is a highly versatile, great potential for development of sensors.

1.2.4. Piezoelectric sensors

A power generation and electromechanical sensors are converted from its sensitive element made of a piezoelectric material. Piezoelectric material surface charge after the force. The charge by the charge amplifier and measuring circuit amplification and impedance conversion after becoming suffered electrical output proportional to the external force. Non-electric quantities a piezoelectric sensor for measuring force and energy is converted into power, such as pressure, acceleration, etc. (see piezoelectric pressure sensors, accelerometers).

The advantage is that the frequency bandwidth, high sensitivity, high signal to noise ratio, simple structure, reliable and light weight. The disadvantage is that the DC response of certain piezoelectric materials require proof measures, and the output of the difference, we need a high input impedance circuit or a charge amplifier to overcome this deficiency. Supporting instruments and low noise, low capacitance, high insulation resistance cables appear to make more convenient using a piezoelectric sensor [2]. It is widely used in the technical field of mechanical engineering, biomedical, electrical acoustics.

Sensors very broad application in life, not only over several sensor has applications in life, there are many, many, such as: Hall sensors, thermocouple sensors, etc.

2. Select sensor for mechatronic systems

Select the sensor type sensor main consideration, sensitivity, frequency response characteristics, factors linear range, reliability and stability, precision, work and other aspects.

2.1. Sensor type

To achieve the test for a parameter is available sensor types may be a lot. Different types of sensors have great differences in many aspects the principle of measurement, signal output, accuracy, dynamic characteristics. For example, vibration test machine tool spindle, you can choose capacitive displacement sensors, inductive displacement trans-

ducer and electricity cannot meet the requirements.

2.2. Sensitivity

In general, the higher the better sensitivity of the sensor, because small changes in the measured parameters smallest high sensitivity sensor can feel when measured parameters change, the sensor will have a greater change in output. It should be noted: The higher the sensitivity, external interference, noise more easily mixed. (1) In general, the higher the sensitivity measurement (linear) smaller range. Unidirectional sensitivity. (2) If the measured parameter is a two-dimensional or three-dimensional vector, each measuring the direction of the higher the better, cross-sensitivity as low as possible.

2.3. The frequency response characteristic

In the frequency band of the measured parameters, the selected sensor should be able to achieve similar distortion test; and amplitude-frequency characteristics corresponding sensitivity should be as high as possible, and phase frequency characteristics corresponding to the response time as short as possible. A frequency response characteristic of the sensor was better than the structure type sensor; a frequency response characteristic of the non-contact sensor is better than a contact sensor.

2.4. The linear range

Any sensor has a certain linear operating range. Within the linear range of the output is proportional to the input, the more wide linear range, it indicates that the sensor's operating range greater. The sensor operating in the linear region is the basic condition to ensure test accuracy. General linear range and sensitivity contradictory.

2.5. Reliability and stability

Reliability refers to the ability to achieve the instrument, apparatus and other products under the conditions prescribed, the prescribed time specified function. The factor depends on reliability of the sensor design, manufacture and use of working environmental conditions, especially by the great influence of the latter. Stability refers to the test device after working long hours or working conditions change ability to maintain its performance unchanged. Stability is mainly temporal stability and temperature stability. Stability conditions and ensures reliable operation of the sensor.

2.6. Accuracy

Accuracy of the sensor indicates the degree of consistency of its output and input measured values. Sensor test system is the most advanced sectors, the output can be measured accurately reflect the true value of the input will directly affect the performance of the entire system. The selection of the sensor, and comprehensive consideration of the requirements of precision and economy. Generally meet the accuracy requirements under the premise, as far as possible selection of inexpensive sensors.

2.7. Operation mode

(1) Contact measurement and non-contact measurement; (2) Destructive testing and non-destructive testing; (3) Online and off-line test.

2.8. Other

Sensors also take into account the selection of simple structure, small size, light weight, inexpensive, easy to maintain and other factors.

According to the above requirements we are concerned about the Hall sensor, before telling. First, we must understand its sensor concept, effects, and expressions and applications.

3. The development direction and development prospects of the sensor

3.1. The development of modern sensor technology

Currently, the main developments in sensor technology, one basic research, discovery of new phenomena and new materials development and new sensor technology; the second is to achieve integrated and intelligent sensors [3].

(1) The discovery of new phenomena, develop new materials, new phenomena, new principles, new material is the development of sensor technology, an important foundation for research of new sensors, each new principle, the discovery of new materials will be accompanied by the birth of a new sensor types.

(2) Integrated, multi-functional to develop sensor sensitive functioning device integration, the recent positive application of semiconductor integrated circuit technology and its development thinking for sensor manufacturers. Such as the use microfabrication technology to produce micro-sensor; using thick-film and thin-film technology to produce sensors.

(3) Challenges to areas unexplored biosensor so far, are vigorously studied. Developed sensor mostly physical sensors, future research should actively develop chemical sensors and biosensors. Especially the development of intelligent robot technology, people need to develop a variety of analog sensors sense organs, such as the existing robot haptic, tactile sensor, taste sensor.

3.2. Future prospects

Future development will let people see a variety of sensor technology change, make people feel sensors compose chapter in their lives getting better and better, more and more exciting.

Sensor technology will move toward the development of a variety of areas: chemical sensor has a very important role in the industrial and agricultural production, home security, environmental monitoring, energy, health and other fields, the demand will be increasingly urgent.

Focus is on the future development of chemical sensors miniaturization, intelligent, multi-functional. Depth study of organic, inorganic biological works based chemical sensors sensitive material features designed to improve the ability to use a variety of flexible sticks micromachining technology, sensitive membrane modification technology, microelectronics, optical technology, bio-engineering technology integration, the sensor performance optimization.

Application of bionics, sensors, and computational science linking treatment as biomimetic sensors made significant progress. The biosensor is an interdisciplinary science, and it focuses on the detection of health, environment, clothing industry and the food industry needs.

Environmental protection more generally people's attention. At present, China's largest user sensor metallurgical industry which required 100 kinds of special high value-added sensor almost entirely dependent on imports (such as high temperature ladle weighing sensors).

In terms of energy saving, environmental protection, improve vehicle safety and comfort analysis pieces, there will be a large market demand.

In order to be able to be able to later advances in these areas, in order to later be able to get to the sensor in life plays a decisive role, must be allowed to combine technology and the reality to which it is to meet the standards, needs to be direction, sensor technology will eventually be able to in It achieved an important position in the community.

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