Construction of Intelligent Lighting System of Vehicle based on Optical Fiber Sensors Technology

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Keywords: Optical fiber; Vehicle; Intelligent lighting system; Signal processing; Sensor

Abstract. This paper introduces the optical fiber sensing system for broadband light source, fiber optic systems are described, analyzed the sensing principle of fiber sensor. Optical fiber sensor is that a kind of change measured state for the device of optical signal can be measured, which is composed of optical transmitter, optical receiver, signal processing system and optical fiber. The paper puts forward construction of intelligent lighting system of vehicle based on optical fiber sensors technology. Finally, simulation experiments are carried out to show the effectiveness of the proposed new method.

Introduction

The automobile application has become more and more complicated, and more and more use of electronic drive, therefore, will be more innovative technology and special technology applied in this field will be not at all surprising. In the automotive environment we can a unique solution for more and more is to see the popularization and application of the ambient light sensors throughout the internal environment of the car. This paper will discuss the principle of environmental light induction and advantages of using this device in the car in the environment.

The optical fiber is a light conducting medium is the sensitive element of fiber optic sensors; light in the optical fiber is measured by a modulation and change [1]. Advantages of this type of sensor is of compact structure, high sensitivity, but need special fiber and advanced detection technology, therefore the cost is high. Non functional type optic fiber sensors fiber only light, light to shine in the non optical fiber sensing element will be measuring modulation. This kind of optical fiber sensor requires no special optical fiber and other special technology, so it is relatively easy to implement and low cost, but the sensitivity is low, is suitable for the sensitivity of less demanding occasions.

The optical fiber sensor is a variation of the measured object by sensitive components the refractive index, absorption or reflection parameters, and lead to the light intensity changes to achieve sensitive sensors measuring [2]. With the use of optical fiber microbend loss; absorption properties of the material; changes in reflected light intensity vibration membrane or crystal; material for various particle radiation or chemical, mechanical excitation and luminescence phenomenon; as well as the material of fluorescence radiation or light road trip to pressure, vibration, temperature, displacement, gas etc. a variety of intensity modulated fiber optic sensor.

In the automotive environment, mainly as follows: the application of in-vehicle entertainment/ navigation backlight control/DVD system, in order to ambient light conditions all can display backlight brightness ideal; with the display backlight rear seat entertainment control; instrument group backlight control (speedometer / tachometer); control mirror brightness automatically after the (usually require two a sensor, a forward, a backward); automatic headlights and rain sensing control; rear view camera control. The paper puts forward construction of intelligent lighting system of vehicle based on optical fiber sensors technology.

Application of Optical Fiber Sensors System

Optical fiber only light guide effect, only "pass" not "feeling", to the outside information "feel" depend on other physical properties of functional components. This kind of optical fiber sensor without special optical fiber and other special technology, easy realization, low cost. But the sensitivity is low; the sensitivity requirement is not too high.

Optical fiber sensor is generally composed of light source, interface, optical fiber, optical modulation mechanism, a photoelectric detector and a signal processing part of the system. The light from the light source, into the optical fiber through the interface, then the detection parameter modulation into amplitude, phase, as is shown by equation(1), where color or polarization information, finally by the microprocessor for information processing. Summary of optical fiber sensors generally consists of three parts, except the fiber outside, still must have two important parts of the light source and the light detector [3].

$$MEAN = \sum_{i=0}^{M-1}\sum_{j=0}^{N-1} F(i,j)/(M \times N) \tag{1}$$

Optical fiber sensor is a sensor using monochromatic light the object to be tested the reflected light changes the frequency of the monitor to the. Fiber velocity, velocity, vibration, pressure, acceleration sensor has a Doppler effect of moving objects using reflected light and scattered light; gas sensor material by Raman scattering by the glare of the gas concentration measurement or monitoring of atmospheric pollution; and the use of the photoluminescence temperature sensor.

Optical fiber with sensitive ability and the ability to detect the outside information (or special fiber) as a sensing element, will "pass" and "feeling" integrated sensor [4]. Not only the light on optical fiber, but also the use of optical fiber in the external factors (bending, under the effect of phase change), the optical characteristics (intensity, phase, polarization and so on) changes to achieve the "pass" and "sense" function. Therefore, in the optical fiber sensor is continuous. Because the fiber continuous, increasing its length, and it can improve the sensitivity of it.

Fiber grating sensing system is mainly composed of a broadband light source, fiber grating sensor, and signal demodulation [5]. Broadband light source to provide light for energy, fiber grating sensor using optical sensing external light source of information was measured, reflected outside of information was measured by real-time signal demodulation system, as is shown by equation(2).

$$u'(x_1,x_2) = \sum_{s=-n}^{n}\sum_{t=-n}^{n} w(s,t)u(x_1+s,x_2+t) \tag{2}$$

Optical fiber sensor with its lightweight and durable, high sensitivity, immunity to electromagnetic interference and can realize distributed detection and other advantages, is more suitable for stress, strain detection in construction, the fiber Bragg grating sensor is sensitive element is the most ideal. For large projects, at present the main point type optical fiber sensing technology require the placement of a fiber optic sensing system in each monitoring point, besides the high cost, the problem is not part of the sensing point on the situation is easy to cause the omission.

Optical fiber sensor is a sensor to transmit the information of the detected object using the change of polarization state. Current, magnetic field sensors made by optical Faraday Effect in the field of media dissemination; using electric field, bubble's effect. The voltage sensor of piezoelectric crystal light propagation in the electric field; constitute the use of substances in the photoelastic effect pressure, vibration or acoustic sensors, as is shown by equation(3), where the use of birefringence optical fiber temperature, pressure, vibration sensor [6]. This kind of sensor can avoid the light intensity changes of ah, so high sensitivity.

$$\hat{f}_n = f(u_n) = f[\sum_{k=1}^{K} w_k \sum_{m=1}^{M} x_m \psi(\frac{x_m - b_k}{a_k})] \tag{3}$$

Optical fiber sensor is mainly composed of light source, optical fiber, sensor, photoelectric detector and signal processing system components, light emitted from the light source through the transmission fiber reaches the sensitive element (sensor), then a property of light is measured by a modulation, optical signal modulated by the photoelectric detector into electrical signals, the signal processing systems have been measured.

Design of Intelligent Lighting System of Vehicle by Optical Sensors

In the traditional lighting control system and it is often used in ordinary optical sensor with A / D converter (ADC) scheme [7]. On the one hand because of the light signal light detected by the sensor contains both visible and infrared light component composition, to be considered in the design of filter infrared detection results of optical sensor, and because of the separation of the device, thus lead to the design of more complex; on the other hand, the detection range of illumination is very limited, is not conducive to the realization of multiple illumination detection of zoning control a plurality of lighting equipment implementing same place.

The sensor output is more common, fast response time (digital output is limited to the integral time), the controller integrated ADC converter, and voltage output eliminates the need for external resistance (the current into a voltage) and the need to provide a low impedance output. The current output in the output adds passive elements to gain range of current conversion settings for voltage sensor, and according to the need to increase the low-pass or high-pass filter. Nonlinear analog output current or voltage output: allow very weak light sensitivity and dynamic range (up to 100, 000Lux), sensing light and human perceive light way more similar (linear and nonlinear), voltage or current nonlinear output selection, the output voltage is low impedance and current output is high impedance, as is shown by equation(4).

$$\binom{\delta}{k} \equiv \frac{\delta!}{k!(\delta-k)!} = \frac{\Gamma(\delta+1)}{\Gamma(k+1)\Gamma(\delta-k-1)} \tag{4}$$

Through the illumination compared to the values obtained E and standard illuminance value ES to adjust CPSW value in the program, automatic dimming control [8]. The CPSW value is set to 0, and divided into several files in O ~ CNSW, such as 10 files, each CPSW adjustment value △ P= (CNSW-1) / 10, in order to achieve a smooth adjustment. Calculate the illuminance value comparison and ES standard illumination, if less than the standard illuminance value increased ES, △ P on the basis of the current CPSW, until it reached the maximum value CPSW (CNSW-1); if ES is greater than the standard illuminance value, reduce △ P based on the current CPSW value, until the CPSW value 0, lighting equipment shutdown, as is shown by Fig. 1.

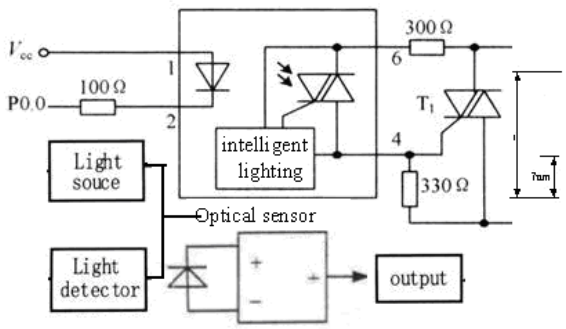

Figure 1. Optical Sensors in intelligent lighting system of vehicle

Two sensors need tunnel detection input [9]. The first sensor has a "look up" the wide field of vision, and the average travel time relatively long, long time segment can prevent the lights on and off. The second sensor has a "look ahead" narrow field of vision, and the average travel time relatively

short. This can make the tunnel sensors make rapid response to sudden changes in sunlight, and open the car headlights, and can adjust the display screen in the tunnel when the backlight brightness. Prior to the sensor eliminates entered the bridge or Zhetianbiri trees when opening and closing the lamp. In these cases, the sensor will be "seen" in front of the light.

When entering a tunnel, tunnel sensors signal will decrease, and the wide field sensor signal will still maintain high strength car headlights will be opened. When the tunnel, tunnel sensors signal will be strengthened, and the wide field sensor signal will drop; car headlights will be closed [4]. With the average travel time of different segments, controller can make a clear distinction.

Construction of Intelligent Lighting System of Vehicle based on Optical Fiber Sensors Technology

Optical sensor, especially the photodiodes and phototransistors, and it is used in automotive body electronic applications to increase the safety and convenience of the consumer need [10]. These functions may only apply to the current high-end car, but as general automotive applications, these functions will soon be applied to each car spaces.

The intelligent lighting control system illuminance detecting problems, put forward a kind of illumination acquisition scheme based on ISL29004 multiplexer, and gives the hardware structure, working principle and software flow chart. The ISL29004 integrates ADC, directly output digital quantity, has strong anti-interference ability and low power consumption; and can be programmed flexibly configured with I2C bus interface, and more flexible, which simplifies the design of lighting control equipment; after using the quasi bidirectional I2C bus buffer P82896 to drive expansion on the I2C bus, extends the transmission distance of I2C bus, realize the multi-channel illumination lighting places within the detection, which can implement zoning control for a plurality of lighting equipment, and through the P87LPC768 output of the PWM to realize the automatic dimming control, create lighting environment more comfortable in energy saving at the same time, as is shown by equation (5).

$$\frac{\partial u}{\partial x_1} = u(x_1 + 1, x_2) - u(x_1, x_2) \tag{5}$$

Through the timer interrupt to read 4 ISL29004 ADC output in the program, and converted to luminance values; ISL29004 internal ADC work in mode 2, the resolution is 16, the illuminance detecting range set requirements for general illumination O ~ 1000 Lux can meet the lighting places the general detection. The output hypothesis to read ISL29004 ADC DATA, you can through the following formula to illuminance value, as is shown by Fig. 2.

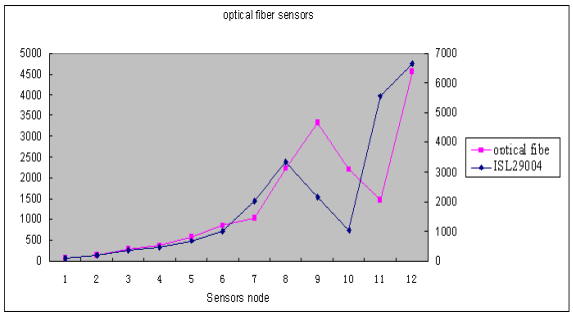

Figure 2. Comparison optical and optical fiber sensors in intelligent lighting system of vehicle

The system consists of MCU P87LPC768 as the main controller of I2C bus, ISL29004 as the control device, the device address of 4 ISL29004 were as follows: 44H ~ 47H, through the ISL29004 address pins A1, A0 set. In the system, using the quasi bidirectional I2C bus buffer P82896 to drive expansion on the I2C bus, long-distance transmission of I2C bus, expand the illumination distance

acquisition; P87LPC768 I2C bus by P82896 buffer extended through twisted-pair and distal P82896 and ISL29004 connection.

Summary

The paper puts forward construction of intelligent lighting system of vehicle based on optical fiber sensors technology. This paper introduces the optical fiber sensing system for broadband light source, fiber optic systems are described, analyzed the sensing principle of fiber sensor and how to distinguish between the measurement technology, the signal demodulation method for signal used is summarized, finally, put forward to meet the future needs of the various parts of the system optimization measures.

Acknowledgements

This paper is supported by Science and technology project of Henan Province (162102310478).

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