MICRO CONTROLLER BASED FIBER OPTIC LIGHT SENSOR FOR SMART SPACE

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Abstract

The need of sensors has grown rapidly in recent years for industrial control, automation & consumer applications. Apart from its conventional use in communication, Optical fibers find wide applications in of photoelectric sensors. Smart Spaces require large amounts of sensor data to be transported to networked processing resources. In view of the wider scope and increasing importance of the fiber optic sensor technology, and microcontrollers the paper reports the development of intensity modulated sensors using plastic fiber light to be used in smart spaces. In case of simple fiber optic sensor the measurand such as displacement, force, pressure, temperature modulates the intensity of light propagating through the optical fiber and the modulating zone. The modulated light changes the detector output, which can be further processed and calibrated to give the value of the measurand. In the present study the ambient light is sensed using optical fiber and the light intensity of the led bulb is controlled using PWM,so that the average light in the room remains same throughout the day.

Keywords: Fiber optic Sensor, light Sensor, Smart space, Microcontroller.

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Introduction

Fiber optic sensors are replacing the conventional sensors because of their advantages like small size, low weight, immunity to EMI, safe even in explosive environment [1]. The basic fiber optic sensor consist of a optical source used to launch the optical power in to the fiber, the optical fiber link used to carry the optical signals to and from the measurand zone and the signal detection unit. As it is well known by now, the basic system of Fiber Optic Displacement Sensor **(**FODS) consists of transmitting and receiving fibers or fiber bundles, a light source, a photo detector along with signal conditioning and display system [2][3]. The light radiated from the light source is coupled to the transmitting fiber, travels to the other end and then radiates towards the reflecting target. The light radiates in a cone defined by the numerical aperture of the fiber on the target surface. The light reflected from the target, is coupled as a function of target distance x into the receiving fiber and is incident on the photo detector. The light is modulated by the parameter to be sensed. The intensity-modulated sensors have become more popular as they are simple in construction low cost and reliable.

Experimental

An automatic light intensity control system is developed in the present work. The system consist of an ardiuno kit along with based fiber optic sensor. Due to the inherent advantages of plastic fibers multimode plastic optical fibers with following specifications were used for the experimentation. Core radius (a) = 0.488 mm, Fiber diameter (f_d) = 2.2 mm,Cladding thickness (cl)= (f_d/2)-a = 0.612mm and Numerical Aperture (NA) = 0.267.

Optical fiber sensor requires two fundamental blocks light source and light detector .In the present work light source used is ambient light that we want to sense and control. For converting optical signal in to the light an optical to electrical converter circuit as shown in figure 1 is used. It consists of a phototransistor, buffer, level shifter and an amplifier designed with OPAMP IC. The hermetically sealed silicon phototransistor (L14 G3) with narrow reception angle in TO-18 package was used as the detector.

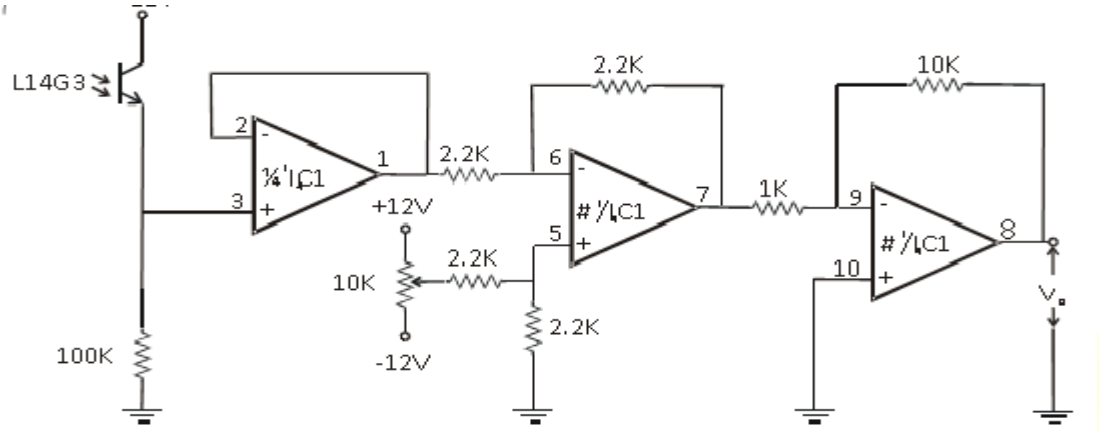

Fig 1: Optical to Electrical Converter (OEC) circuit

Figure 2 shows the block diagram of the developed system.

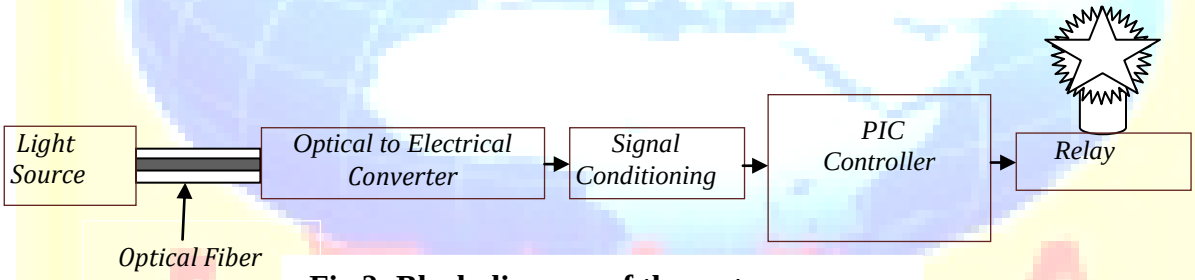

Fig.2: Block diagram of the system

Algorithm

1. System initializes with the set point values.
2. Sense the ambient light through optical fiber sensor.
3. Compare the sensor reading with the set point value and create error.
4. Adjust the duty cycle of PWM according to the error in step 3.
5. Adjusted duty cycle controls the intensity of LED bulb.
6. Go to step 2.

Results and Discussions

The fiber optic sensors are build for sensing the ambient light of the controlled environment. The open end of the optical fiber is used as light sensor. The ambient light collected by the free end of the fiber is sensed by phototransistor. The signal conditioning circuit develops the output proportional to the ambient light. The controller generates PWM signal proportional to ambient light and is used to control the intensity of light. Such system can be expanded to theme based area similar to reported by Jayashri A.Bangali et.al.[4,5]

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