
Design of Illumination Automatic Adjustment System Based on LabVIEW

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Abstract

The illumination automatic adjustment system mainly uses the LabVIEW software platform. The illumination value is collected by software programming drive acquisition card, the collected data is compared with the preset value, if collected data exceeds the preset value range, then the acquisition card is used to drive the stepping motor to work, and drives the curtain to automatically adjust the illumination within a certain range.

Keywords

Illumination, LabVIEW, stepping motor.

1. Introduction

The illumination is commonly referred to as lux, which represents the luminous flux per unit area of the surface of the subject. In daily life, the strong illumination and the intuitive feeling of people are bright or dark. Illumination is a very important parameter for judging comfort in home life. Illumination automatic adjustment system can automatically adjust the illumination within a certain period of time, so that the illumination can be kept within a certain range, which can improve the comfort of the home to a certain extent.

LabVIEW is a program development environment, which was developed by National Instruments (NI), it is similar to the C and BASIC development environment, but the significant difference between LabVIEW and other computer languages is: Other computer languages use text-based language to generate code, while LabVIEW uses the graphical editing language G write the program, the generated program is in the form of a block diagram [1]. The home illumination automatic adjustment system introduced in this paper is based on the Labview2014 software platform, the USB6001 acquisition card as the bridge; the illumination value is collected by software programming drive acquisition card, the illumination value of the home environment is monitored in real time, and then is compares with the set range of illumination value, if the indoor illumination is higher than the setting upper limit, the analog quantity is output through the acquisition card, the stepping motor is driven to open the curtain. When the indoor illumination is lower than the setting lower limit, the stepping motor is driven to open the curtain, the indoor illumination is increased. The illumination is kept within a proper range. This system mainly includes three parts: data acquisition and judgment, data display and stepping motor control.

2. The Composition of Home Illumination Automatic Adjustment System

The composition of home illumination automatic adjustment system can be expressed by the following block diagram. During the operation of the system, the adjustment of the indoor illumination is a closed loop adjustment system.

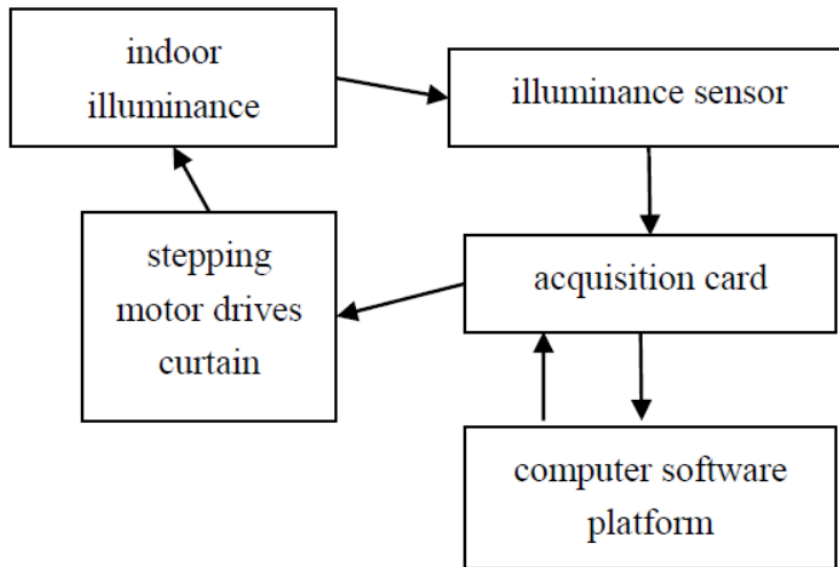


Figure.1 structure diagram of home illumination automatic adjustment system

3. Design and Implementation of System

3.1 Monitoring of illumination

The commonly used measurement principle for the detection of illumination is to use semiconductor materials to convert light energy into electrical energy, which will be converted into voltage or current output. The measurement range of illumination transmitter selected by this system is 0 to 65,535 lux, and the corresponding illumination measurement range of output range is 0 to 10 v analog voltage output. There is a linear corresponding relationship between the measured illumination and the output voltage[5]. The power supply used by the sensor is DC 24; the wiring ways is shown in Figure.2.

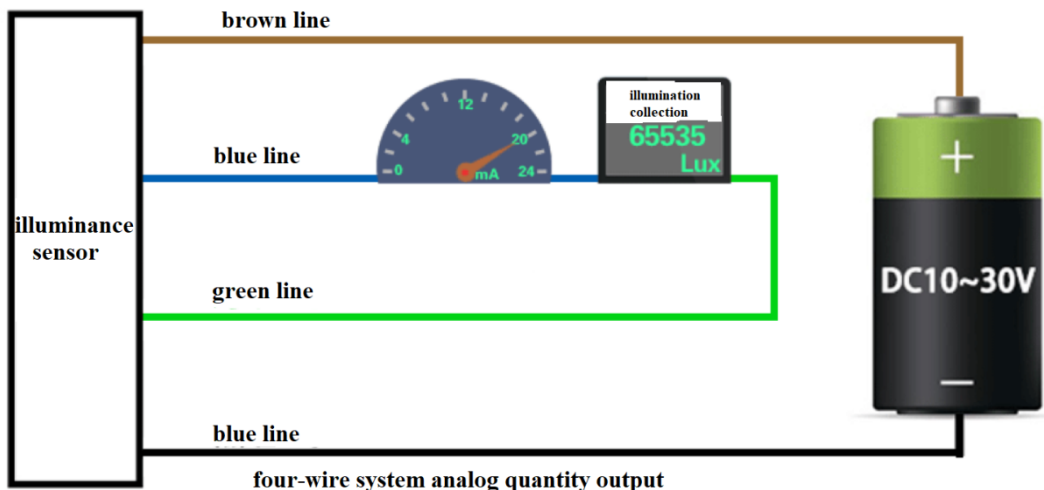


Figure.2 Four-wire system connection diagram of illumination sensor

For the output of the illumination sensor, the analog voltage collected and output by the acquisition card can be used to convert the corresponding illumination value according to the linear corresponding relation.

3.2 Data acquisition

Considering the requirement of illumination monitoring responsiveness of this system, the USB6001 data acquisition card of National Instruments was selected. The USB6001 acquisition card has 8 analog inputs, 2 analog outputs, 13 digital outputs, and one 32-bit counter, 14-bit sampling accuracy,

sampling rate can reach 20KS per second. It is connected to the computer through the USB port, size is small, which is enough to meet the needs of system design [4].

The output of the illumination transmitter used the analog input terminal for acquisition. Because the illumination transmitter has a certain hysteresis for the response of the illumination, intermittent sampling is used for the sampling form, and several points are collected each time, so that the sampling takes a little longer to obtain the final stable output of the illumination transmitter.

3.3 Selection and control of stepping motor

Since the method of adjusting the indoor illumination is the form of dragging the curtain by the motor, the torque output requirement for the stepping motor is not very high. The stepping motor with 1.8 degrees stepping angle and two-phase power supply is selected. The selected stepping motor needs to use the stepping motor driver to ensure the normal operation of the motor. The definition of driver terminal is shown in Figure. 3 [3].

The control of the stepper motor can use the two analog output ports of the USB6001 acquisition card. The analog output of the acquisition card can output signals of sine, triangular wave, square wave, etc., the characteristic parameters of the output signal can be set in the Labview software platform through programming. When it is necessary to drive the stepping motor to rotate, the USB6001 acquisition card can be used to output a square wave signal, which is sent to the PUL end of the driver, and the motor is driven by the stepping motor driver.

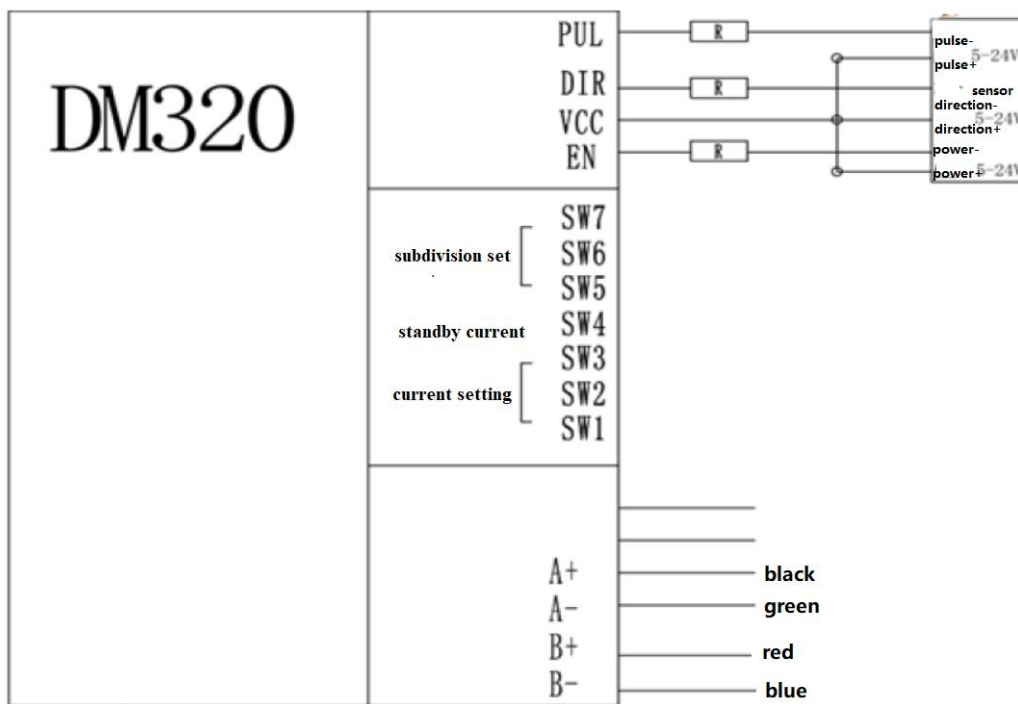


Figure.3 definition of Stepping motor driver terminal

3.4 The overall structure of the system

For the design of the illumination automatic adjustment system, the software programming thinking as follows:

Through software programming, the ai0 port of the USB6001 acquisition card is selected as the acquisition port of the output signal of illumination transmitter, and the acquisition voltage of the acquisition card can be set to 0~10 volts, the sampling point is 10, and the sampling frequency is 100 Hz, which can make the completion time of each sample faster, we can leave time waiting for the illumination transmitter to reach steady state. The collected data is displayed in the waveform display window of the front panel, moreover, according to the linear relationship between the illumination

value and the output voltage, the illumination value can be converted at this time, and the collected voltage value and illumination value are displayed in the corresponding numerical display controls.

In order to decide whether the the real-time illumination value is appropriate illumination, the voltage range is set, if the collected voltage value belongs to a preset voltage range, the indoor illumination is regarded as appropriate at this time, and no operation is required. If the collected voltage value is higher than the preset voltage range, the stepping motor needs to be driven to rotate forward. Conversely, if the collected voltage value is lower than the preset voltage range, the stepping motor need to be reversed. The forward rotation and the reverse rotation of the stepping motor are corresponding to close the curtain to reduce indoor illumination and open the curtain to increase indoor illumination, respectively.

The acquisition card drive the stepping motor, this function is realized by using the ao0 port of the acquisition card and output of the square wave signal. The appropriate output of square wave signal and needs to be judged according to the logical structure of the output voltage and the preset voltage range of the collected illumination transmitter. Here, the conditional value structure of the software is used, and three conditions are set. These three conditions correspond to the voltages range collected above, below and at preset voltage, respectively.

The direction control signal of the stepping motor, the condition for changing the direction is - $5.5V \leq \text{low level} \leq 0.3V$, $3.6V \leq \text{high level} \leq 5.5V$ [3]. In the case that the stepping motor needs to change the optional direction, the DIO port of the USB6001 acquisition card outputs voltage with high level 5V, when the original optional direction needs to be maintained, the voltage is not output, thereby controlling the option of stepping motor to achieve the purpose of adjusting illumination. Figure.4 shows the front interface of the illumination automatic adjustment system.

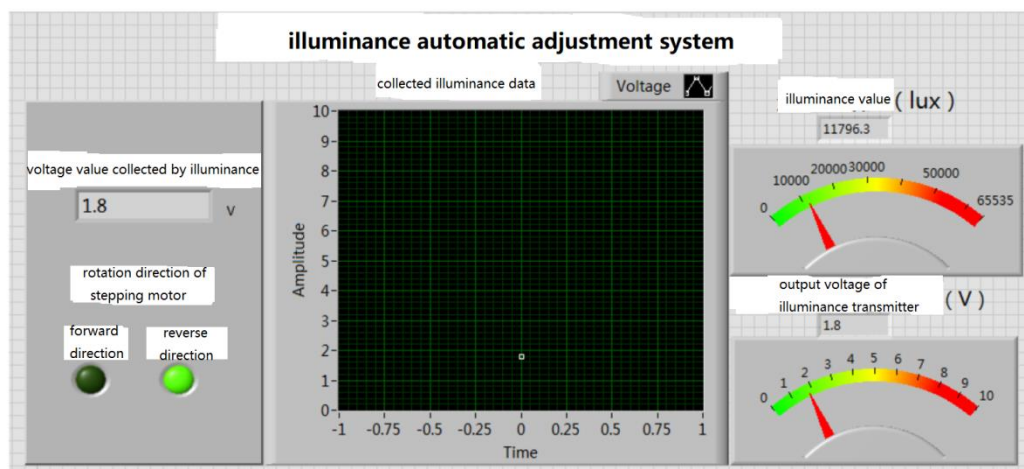


Figure.4 illumination automatic adjustment system

4. Conclusion

The design of the illumination automatic adjustment system is mainly to combine the sensor, acquisition card, software platform, stepping motor and other parts to realize the automatic adjustment of the indoor illumination within a limited range, which is a beneficial practical attempt.

References

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