International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design of Automatic Head Light Dimmer System for High-power LED

M. Karthikkumar[1], N. Sri Karthik[2], L. Gokul[3], N. S. Venkatesh Babu[4], S. Akilan[5]

[1] Assistant Professor, [2,3,4,5] UG Scholar

[1,2,3,4,5]Department of Electronics and Communication Engineering, Erode Sengunthar Engineering College (Autonomous), Perundurai, Erode Dt., Tamilnadu

ABSTRACT—

The present online detection sector makes extensive use of machine vision systems. The system for its light source is one of the most important parts. A new type of green light source called high-power LEDs can be used in a wide range of industries, including industrial lighting, due to their high luminous efficacy, energy efficiency, environmental protection, anti-seismic properties, and widespread application. However, there is a strong correlation between the studied object's image quality and the stability of the light source. Therefore, an automatic dimmer with a high-power LED can increase labour productivity, industrial online detection precision, and power-saving illuminations. As a result, an automatic high power LED dimmer system for the light source of the system is suggested. The brightness of the High-power LEDs used in this approach.

As a result, an automatic high power LED dimmer system for the light source of an online detecting system is suggested. In this technique, the detection system's higher computer, which has an image sensor, defines the image of the measured object, and High-power LEDs automatically adjust their light output in accordance. The following items are part of the automatic dimming system's hardware. A driver circuit of high-power LED constant current based on the PT4115 chip is utilized as the controller, and the ambient light sensor is a BH1750 chip with an I2C bus that is used in real time to automatically detect ambient light. The changes in the ambient light are managed by the PID control. The top computer will send the value of the Soble image evaluation to the lower computer if the picture definition is unable to meet the detection criterion. Before modifying the PWM wave in accordance with the actual requirements to maintain a steady level of illumination from the High-power LEDs, the lower computer makes a comparison between the current picture definition value and the present value. The experiment is then run to confirm the effects of constant illumination adaptive dimming and high-power LED constant current driving. It offers a practical and significant economic solution for improving lighting efficiency and adaptive dimming control in industrial lines.

Keywords - High-power LED; Soble image evaluation; PID; adaptive dimmer.

I. INTRODUCTION

In modern industry, the use of automatic optical inspection (AOI) has increased significantly in recent years.

For image processing and analysis, it primarily consists of a light source, lens, image sensor, and computer. By utilising machine vision, it is possible to significantly lessen the burden of artificial daily inspection product quality, significantly increase detection efficiency, and provide feedback to production in order to direct production throughout the mass repetitive industrial system. The clarity of the image is directly influenced by the light source system of the test object. High power LEDs have lately emerged as one of the key light sources for machine vision lighting because to its benefits of high efficiency, small size, energy conservation, and environmental protection. The sensing environment's illumination, however, is not constant. Due to the possibility of source light reflection, because the surface of the examined object may reflect, absorb, or transmit the light from the source during detection. As a result, the illumination of the detection environment will also change, which will lower the accuracy rate and image quality. As a result, there will be low labour efficiency and poor dimming accuracy. Based on image definition evaluation, this study suggests using a high-power LED automatic dimming system as the light source for an online detection system to improve the AOI system's efficiency and provide more illuminations that use less power.

II. THE SCHEME OF THE SYSTEM AND DESIGN OF HARDWARE SYSTEM

A. Overall system composition

The structure, schematic, and scheme of the high-power LED automated dimming system for the online detecting system are depicted in Figure.1 below. The primary working premise of this system is that the detection device's image sensor, such as a CCD, will capture images of the object being evaluated. Then, using the Soble algorithm, the higher computer will assess the definition of the object picture after gathering the images from the image sensor. If the Soble algorithm evaluation of the image does not yield the desired result, the top computer will send a dimming signal to the slave computer, the

Mega16 microprocessor. Based on the appropriate PWM signal, the Mega16 will generate a PID algorithm that can automatically alter the luminance of high-power LEDs.

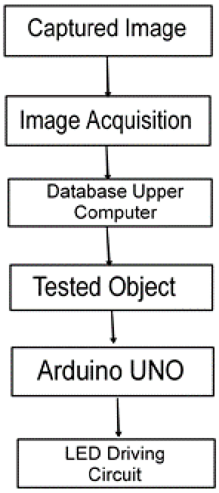


Fig.1. System Structure Block

B. Design of Hardware

The high-power LED's voltage-ampere characteristic is shown in Figure 2 below.

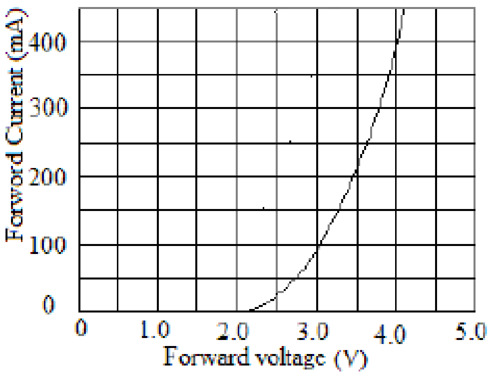


Fig.2. Volt-current characteristics of High-power LED’s

High-power LEDs, which serve as the on-line detection system's light source, are also, to some extent, power semiconductors. Its Volt-ampere characteristics are comparable to those of a typical diode. According to the aforementioned characteristic curve, the rate of current changes significantly when the voltage is slightly altered. Additionally, the light output of high-power LEDs is nearly proportional to their current. Therefore, constant current driving is used for high-power LEDs due to their Voltage-ampere characteristic and other factors. In this work, the ambient light intensity is automatically and in real time determined using the BH1750 sensor with I2C interface. The core controller is provided by the Mega16 processor. In order to adjust the illumination in response to changes in the actual illumination, the PID control method is utilized.in response to changes in the real illumination. The PWM (Pulse width modulation), resulting in an adaptive adjustment in the High-power LED's current. As a result, the light dims automatically. Figure 3 depicts the hardware system principle scheme.

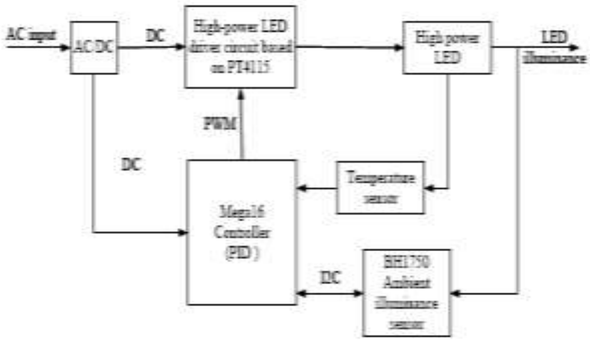


Fig.3. Block Diagram of Hardware system

C. Design of High-power LED constant current drive circuit

This system's lighting source is a 1 Watt white LED. Additionally, the PT4115 chip, an integrated circuit for continuous inductive current, may accept PWM signals from MCUs for dimming. It works well for driving LEDs. Figure 4 depicts the constant current driving circuit based on the PT4115. The Rs is a representative resistance of the working current of a high-power LED. The following equation is satisfied, and the average current through LED is as follows: Iout=0.1/Rs. When the MCU's PWM signal is accepted, the current is adjusted according to the PWM's duty.

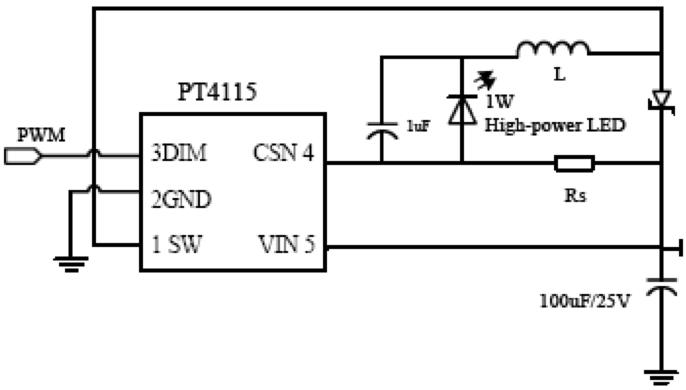


Fig.4. Constant current drive circuit of High-power LED

D. Design of automatic detection circuit of light intensity

The BH1750 chip is a high-sensitivity digital ambient light sensor integrated circuit. Photo diode, operational amplifier, ADC acquisition, and crystal oscillator make up the majority of its components. Through the photovoltaic effect, its photodiode transforms the optical signal into an electrical signal. Following operational amplifier circuit amplification, a logic circuit stores 16-bit binary integers in internal registers before transmitting them to the Mega16 controller through an I2C interface. The illumination detection is accomplished by connecting the clock signal line to the PB5 port of the Mega16 chip and the data signal line of a light sensor to the PB6 port. Figure 5 depicts the automatic light intensity sensing circuit.

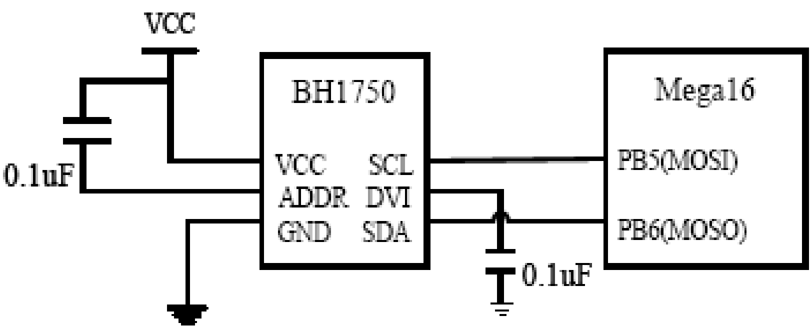


Fig.5. Automatic detection circuit of light intensity

III. DESIGN OF SOFTWARE SYSTEM

The higher computer programme and slaver computer programme are the two components of the developed system software.

The photographs of the examined object are primarily obtained, processed, and analysed by the upper computer programme. Additionally, determine if the definition of the present image complies with the requirement, then contrast. If the image definition cannot satisfy the detection criteria with the present value, the top computer will send the result of the Soble image evaluation to the bottom computer over the serial port. Figure 6 depicts the higher computer software workflow.

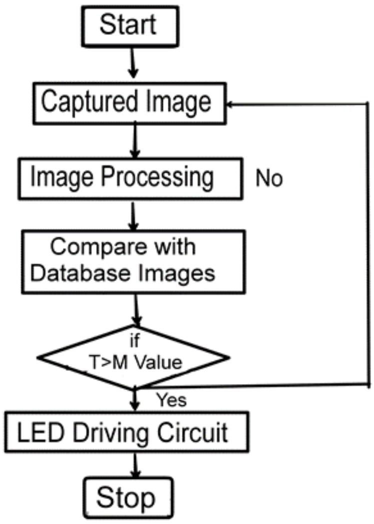


Fig.6. Upper Computer Flow Chart

After receiving the signal from the higher computer, the Mega16 single-chip microcomputer, acting as the slaver computer, utilises PID algorithms to automatically alter the PWM wave in accordance with the top computer's directives. Additionally, the High-power LED's constant current drive circuit operates using the PWM signal from Mega16 single chip microcomputer.

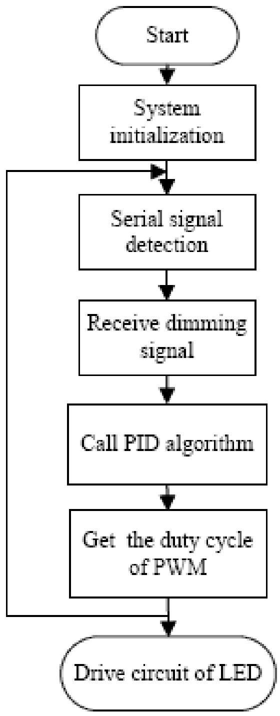


Fig.7.Slaver Computer Flow Chart

If the light is darker than the value that has been predetermined, the duty ratio of PWM is increased to meet the actual requirements. In contrast, duty ratio is decreased. Thus, automated dimming is realised. Figure 7 depicts the slaver computer programme workflow.

IV. EXPERIMENTAL RESULTS

To confirm the system's functionality, an experimental platform is built. Micro detection platform and led adaptive dimmer system make up the majority of its components. The machine vision (CCD), display, rough metal sheet, and LED automatic dimmer system are the components of the micro inspection platform.

A. Experiment to investigate the current characteristic of a high-power LED driving circuit. The current for high-power LEDs is pre-set at 200 mA, and actual current values recorded at various periods are displayed in Table 1:

Table: 1 Current values measured at different times

TABLE I. THE CURRENT VALUES MEASURED AT DIFFERENT TIMES

Test order	*Current Value (A)*	*Test order*	*Current Value (A)*
T1	0.203	T9	0.193
T2	0.198	T10	0.193
T3	0.198	T11	0.192
T4	0.197	T12	0.192
T5	0.196	T13	0.192
T6	0.195	T14	0.191
T7	0.194	T15	0.192
T8	0.194	T16	0.192

The table above shows that the deliberate current worth is basically consistent at 0.193A when 2 the current is essentially set to 200mA. Figure 8 portrays the current with time bend. The current value briefly tends to decrease as soon as the constant current circuit is turned on. It can eventually stabilize in the range of 0.193A, effectively meeting the requirements of the constant current drive circuit, thanks to the current variation range IMAX = 0.007A and the current fluctuation rate within 5 percent.

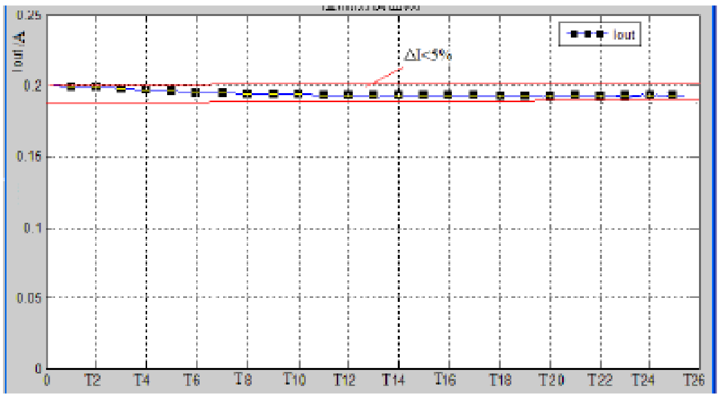


Fig.9.The curve of current change with time

Examining the error: Between the measured current and the present current, there is some error. The two primary causes of the error are a decrease in sampling precision that results in the output current being lower than the specified value and the cooling of the resistor, which causes the error.

B. Constant illumination test experiment of single tube micro inspection system

The change in light intensity will have some effect on the image quality that the CCD captures. An image sensor with brightness adjustment, like a CCD, will automatically raise gain if the light source's intensity is too low. However, both the image quality and the signal-to-noise ratio will suffer as a result of this. If the illumination is too strong, the image will experience data overload and less meaningful information. An adaptive lighting system is required to solve this problem. A single-tube micro detection platform is used in this study to test the adaptive dimming system's performance in an industrial detection system and simulate an online detection system. Test strategies and procedures: After placing the metal sheet that will serve as the test object on the micro platform, adjust the focal length of the microscope to ensure the best possible imaging quality. Keep the focus for the same amount of time.

The second step is to capture and store the current light intensity value in the Mega16 single chip microcomputer's memory as the current light intensity value. After adjusting the intensity of the surrounding light, activate the CCD's automatic image capturing feature and LED adaptive dimmer system.

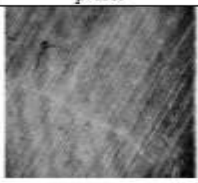
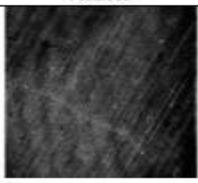
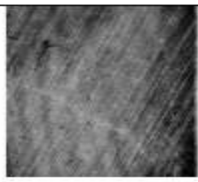
Item	*When the illumination is preset*	*When the illumination is reduced*	*After automatic dimming*
Images collected in different states			
illumination (lux)	1150	560	1138
Image evaluation Sobel definition value	118.855	62.954	115.461

Table: 2 Constant illumination test experiment

Due to the low illuminance value, Table 2 demonstrates that the Sobel picture definition is the worst at 560 lux. After adaptive dimmer, the final image quality is nearly identical to the specified value, despite a 12 lux error.

V. CONCLUSION

The results of the tests indicate that the newly developed constant current drive basically meets the requirements of constant current operation for high-power LEDs. When the environment has changed, the illumination meter is used to detect light changes. The results show that the illumination value measured by the illumination meter following system dimming is still within the acceptable range, despite some errors. As a result, the system is essentially able to perform self-adaptive dimming, preserving the predetermined light range for the ambient light. The findings of the experiments indicate that the high-power LED dimming scheme is both realistically and practically attainable. In addition, it has some reference value for the adaptive LED lighting of the industrial AOI on-line detection system. Additionally, it is compatible with other adaptive dimming systems, resulting in energy savings.

REFERENCES:

[1] Bauri, P.K., Gour, S., and Jain, A. (2020). Automated headlight dimmer for vehicles using light dependent resistor (LDR). International Journal of Recent Technology and Engineering (IJRTE), 9(2): 4304-4309.

[2] Bhargava, B., and Sharma, A. (2020). Automated headlight dimmer for vehicles using light dependent resister (LDR). International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, 8(5): 128-132.

[3] Gajera, J., and Thaker, S. (2020). Automated headlight dimmer for vehicles using light dependent resistor (LDR). International Journal of Engineering and Advanced Technology, 9(6): 645-648.

[4] Gowtham, V., & Sekar, N. (2020). Automatic Headlight Dimmer System for Automobiles using LDR Sensor. International Journal of Engineering and Advanced Technology, 9(4), 671-674.

[5] Kumar, S., and Kumar, M. (2020). Automated vehicle headlights using light dependent resistor (LDR). International Journal of Advance Research, Ideas and Innovations in Technology, 6(2): 24-29.

[6] Khan, D.A., and Akhtar, M. (2020). Automated headlight dimmer for vehicles using light dependent resistor (LDR). International Journal of Applied Engineering Research, 15(11): 14404-14407.

[7] Mankar, R., and Patil, A. (2020). Automated headlight dimmer for vehicles using light dependent resistor (LDR). International Journal of Innovative Research in Science, Engineering and Technology, 9(12): 4649-4654.

[8] Shah, A., and Patel, G. (2020). Automated headlight dimmer using light dependent resistor (LDR) for vehicles. International Journal of Engineering and Advanced Technology, 9(3): 985-989.

[9] Singh, S., and Lakhani, V. (2020). Automated headlight dimmer for vehicles using light dependent resistor (LDR). International Journal of Innovative Research in Science, Engineering and Technology, 9(5): 486-491.

[10] Zor, F., and Kaya, M. (2020). Automated headlight dimmer system for vehicles using light dependent resistor. International Journal of Recent Technology and Engineering, 8(5): 2228-2231.