Prototype System of Low-cost LED Lighting Vision Inspection based on Image Processing

SungHo Ahn¹, YoonJeong Song¹
¹SMEs Support Section, Daegu-Gyeongbuk Research Center, Electronics and Telecommunications Research Institute (ETRI), Daegu, South Korea

Abstract - This paper describes the embedded system of the vision inspection of LED lighting modules using image processing. This device can be easily set up with low cost usb cameras and pc which is installed the developed vision inspection application. It should be briefly adopted by the LED companies and its testing-product lines.

Keywords: Inspection, Vision, Embedded System, LED Lighting

1 Introduction

Today, trends of the domestic and overseas Light-Emitting Diode (LED) lighting market is on the rise due to the restriction of manufacture and use of incandescent lamps and fluorescent lamps under environment-friendly issues. Particularly, in the case of domestic, competition of LED lighting industry is fierce to catch the related procurement market such as replacement of LED lighting of government offices and public institutions. Therefore, in order to enhance competitiveness of LED lighting products, price competitiveness and quality competitiveness should be provided. However, introduction of existing expensive vision inspection equipment is ultimately burdensome for price competitiveness, and there is a limit to the conventional visual inspection method for inspecting a large quantity of products. Therefore, by using PC-based low-cost vision inspection system introduced in this paper, vision inspection system can be constructed cheaply and easily, real-time inspection is possible, and time efficiency of product production is also obtained. In this paper, we introduce prototype of hardware device and its software that can easily inspect LED lighting parts manufactured by low cost multi camera based on image processing.

The general operation scenario for vision inspection of image processing based LED lighting components is as follows.

Figure 1. Scenario of vision inspection system for LED lighting components

In figure 1, a sample of the LED module to be inspected, for example an LED lighting component, is loaded into the vision inspection device, and images are acquired by two or more cameras. The items related to the vision inspection of the desired images which are Region of Interest (ROI) selection, image saving, editing and controlling, are set through the User Interface (UI) of the vision inspection apparatus. The obtained image data of the LED module is judged through the image analysis algorithm to determine whether it is defective or not, and the result of the inspection is stored and displayed through the UI. At this time, it is possible to set a reference value, that is, an inspection threshold value for the defective or normal state LED information, and a predetermined value can be loaded into the vision inspection device to perform the vision inspection for the LED module.

This paper consists of the following. Chapter 2 describes the vision inspection system, which includes system configuration, software platform design, prototype development, and system tests. Finally, chapter 3 shows conclusions and futureworks.

2 Vision inspection system

2.1 System configuration

This vision inspection system for LED lighting components is described below.
In figure 2, two low-cost Universal Serial Bus (USB) cameras are connected to this vision inspection hardware device, which includes the designed software platform for an image data processing algorithm and Graphic User Interface (GUI) on Personal Computer (PC).

Figure 2. System diagram of vision inspection system for LED lighting components

2.2 Software platform design

The software platform of this prototype vision inspection system is designed for plate-type LED lighting parts by using LabVIEW as known as figure 3. First of all, due to two USB cameras are interlocked, in this prototype vision inspection system we can scan a large size of plate-type LED lighting parts at the same time. In addition, we can check whether the LED lighting parts are defective or not in real time from an acquired image data.

Figure 3. SW platform design of vision inspection system for LED lighting components

The functional descriptions of each module designed software platform in figure 3 are as follows.

1. Real-time image acquisition and brightness control of camera 2
2. Inspection area setting function of camera 2
3. Inspection area setting function of camera 1
4. Real-time image acquisition and brightness control of camera 1

5. ROI area setting and inspection function of camera 2
6. ROI area setting and inspection function of camera 1

2.3 Prototype development

As shown in figure 4, the following is about the hardware device and main screen UI of this prototype vision inspection system.

Figure 4. (a) System main UI and (b) HW device of vision inspection system for LED lighting components

The brief descriptions of this system main UI in figure 4(a) are as follows.
- To (re)start or end this system
- To manage the logging history of this system
- To set the port and the brightness of multi cameras
- To set or load the inspection threshold values
- To set the ROI area and the color coordinate system (i.e. RGB, HSV, HSL and HSI)
- To display the acquired images

In figure 4(b), the hardware device prototype is shown. In other words, two common USB cameras which are connected to the PC equipped with the designed vision inspection SW platform are fixed to the top of the vision inspection hardware device prototype. Also to apply power to a plate-type LED lighting component, the lower part of the vision inspection hardware device prototype is composed of a conveyor device for conveying LED lighting components.
2.4 System test

The actual test environment for this vision inspection system is as shown in figure 5.

Figure 5. Actual test environment of vision inspection device for LED lighting components

As a result of this test, as shown in figure 6, the actual inspection result screen for the LED lighting component sample is as follows according to the defect of the inspection reference value and the actual inspection result screen.

Figure 6. Actual test results of vision inspection device for LED lighting components

3 Conclusion and futurework

In general, the cameras of the vision inspection equipment are mostly expensive machine non-dedicated cameras, which is a costly burden in the construction of the vision inspection system. In this paper, the designed vision inspection program is installed in a PC-based window environment and as for vision camera common USB cameras are connected, and then low-cost vision inspection system for the LED lighting components is made up over the indoor environment. It is possible to reduce the cost of construction of vision inspection system for LED lighting parts by small and medium enterprise companies. In addition, two or more cameras can be connected according to the inspection object of LED lighting parts having various sizes and shapes, and due to the vision inspection ROI can be easily set, this system can be expanded according to the vision inspection target. For future work when a vision inspecting apparatus is put into a manufacturing process and a system for managing two or more vision inspecting apparatuses integrally is developed, it is necessary to make the above-described functions remote control and data communication possible. Of course, the prototype of this vision inspection system still should be more embedded and customized, depending on the user or company requirements. Ultimately, we expect that this system is introduced and installed in the production line of LED lighting manufacturing by the LED lighting manufacturer in the near future.

4 References


