Application Research of Portable On-line Inspection System for Car Lights

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Abstract. In this article, a portable automotive lighting online detection system is designed, which can test various signals of car lamps online. It also can perform function and performance tests on multiple car lamps at the same time. The system has a compact structure in order to be easy to carry. It can be tested in the car light laboratory or be used for on-line testing of the production line. The system can automatically complete data collection and processing online. It can discriminate test results and print test reports easily. It has strong versatility and high measurement accuracy. This portable online detection system is convenient for detection and has good application value.

1. Introduction
With the rapid development of the automobile industry at home and abroad, the requirements for automotive lighting inspection are getting higher and higher. As the most important headlamp of a car is a combination of multiple signal lamps, most of the headlamps are tested according to the requirements of laws and regulations, using image processing to detect the light shape of the lamp. There are currently many detection methods in this area [1-3]. Hu Wenlong tests the optical performance of daytime running lights [4]. Jin Xuanhong introduces advanced computer vision inspection technology into the quality inspection of LED car lights and integrates the inspection of the lighting performance and light source power of the car light assembly [5]. Li Yuqun designed a portable case, using STM32 chip to collect and process the car light signal, and realize the car light function detection [6]. In fact, car headlights are a combination of multiple signal lights, including far and near beams, corner lights, turn signals, position lights, daytime running lights, etc. It is necessary to test multiple signal lights at the same time, and electrical performance testing is an important testing indicator [7,8]. The detection of the current car lights is generally to control the lighting of the car lights, and then manually check whether the car lights can work normally during long-term operation. This method is limited by detection means and cannot monitor the running status of the car lights in real time. Under certain working environment, the abnormal condition of the car lights may be missed, and the development quality of the car lights cannot be effectively controlled. Another detection method uses large-scale car light detection equipment, which is bulky and is not convenient to handling. It is hard to be transported for external detection and is prone to error.

This article overcomes the shortcomings of existing detection methods and provides an online detection system with high efficiency and reliable detection quality, which can not only meet the requirements of multi-channel lamp detection, but also facilitate transportation, which greatly improves the convenience and reliability of detection and guarantees improving product quality.
2. System Design
The headlight of the car is installed on the head of the car and is the main lighting component in the driving of the car. Headlights generally include high beams, low beams, turn signals, position lights, daytime running lights, and motors in the follow-up system. It is required to test the electrical performance parameters of various lamps, involving voltage value, current value and PWM signal.

In order to make the structure of the test system compact, NI company's compact multi-slot chassis is selected, and multiple current and voltage acquisition modules are configured. The PWM signal acquisition is controlled by a timer with software, and the signal is connected to two I/O channels on the hardware connection, and the high pulse and the low pulse are collected respectively, so as to realize the duty cycle measurement. If we need more test channels, we can expand the acquisition module. The PC system adopts an industrial tablet computer, which is embedded in the test equipment. The whole system is simple and small in appearance and can be used in portable mobile applications. The block diagram of the system structure is shown in figure 1.

![Figure 1. System block diagram.](image-url)

After the system is powered on and initialized, check the status of each measurement port, set the current and current meter PWM measurement channel and signal acquisition frequency, set the data acquisition threshold, and select any channel display and record on the front panel Mode, the man-machine interface can display the working status of the entire system. The detection parameters can be flexibly adjusted through the human-computer interaction interface to adapt to the requirements of different detection conditions. The data is recorded in the background memory in real time. If you view the historical data in a certain period of time, the data playback function is used to call the background database and observe the data waveform in the oscilloscope of the virtual instrument. If the collected signal exceeds the signal threshold, the system will give an alarm to remind the inspector to deal with it.

3. System Software Design
The software of the multi-channel car light detection system adopts the LabVIEW software of NI company, which is a graphical programming language [9] that uses icons instead of text lines to create applications. It is used in the field of automatic measurement of data acquisition and instrument control. Has a wide range of applications. The software function is divided into parameter configuration module, data acquisition and display module, data playback and data processing module and printing function. The parameter configuration module sets the frequency and threshold, the data acquisition and display module collect the signals of each channel independently, and the data
playback module displays historical data in graphical form. The program flow chart is shown in figure 2.

![Software flow chart.](image)

**Figure 2.** Software flow chart.

The operation interface includes three function modules. Real-time data module can collecting data on-line. Waveform display module can display history data. Operational settings module has 4 functions such as: acquisition channel setting, display channel setting, frequency setting and data review.as shown in figure 3.

![Function module.](image)

**Figure 3.** Function module.
Before testing, it needs to define the sampling rate of each test channel. Depending on the signal type, the sampling frequency setting of each channel can be customized from 2Hz to 10KHz. The higher the sampling rate, the more realistic the signal will be restored, but it will also collect signal noise and take up more data storage space. Therefore, the sampling rate setting can be defined according to the actual situation. The test channel includes 6 types, corresponding to different (frequency or amplitude) voltage inputs. Including 1 voltage test channel and 2 current test channels.

1) Test items: electrical performance parameters of various car lights, including voltage, current, and PWM signals;
2) Detection accuracy is 0.1%;
3) Number of parallel detection channels is 20;
4) Test frequency: 10Hz~1000Hz, the test frequency can be adjusted according to the characteristics of the test signal;
5) Communication method is USB;
6) Start-up time is less than 2s;
7) Software algorithm includes real-time signal acquisition, real-time graphic display, historical record, numerical average processing, image superimposition and data display, multi-layer menu.

The interface is shown in the figure 4.

![Software interface](image)

**Figure 4.** Software interface.

Use the detection system to test the headlights, we can select the display voltage signal in the data playback function, as shown in figure 5, which shows the operating status of a certain period of time.

![Data playback diagram](image)

**Figure 5.** Data playback diagram.

### 4. Conclusion

In this article, a portable on-line inspection system for car lights is developed. It can detect the signals of multiple combined car lights online and measure the performance of multiple car lights at the same
time. It is compact, portable, and has good operability, which is very suitable to car lamp performance test in a laboratory environment. At the same time, the detection system has flexible test configuration, strong scalability, real-time recording of measurement data and playback function, which is suitable for test monitoring and report issuance, effectively improving the level of vehicle lamp performance detection, and has practical promotion value.

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