Design and application of color analyzer based on touch screen

Jiao Ren *, Shaohua Zhang, Yingjie Jiang and Jun Yao
Zhejiang University Kunshan Innovation Institute, Kunshan 215300, China
*Corresponding author e-mail: rj_1987@163.com

Abstract. Aiming at the problems of unfriendly human-computer interaction and complicated keyboard operation of color analyzers on the market, a color analyzer with true color touch screen is developed. It not only has high test precision, low cost, convenient to carry, but also has clear visual interface, simple operation and good user experience.

1. Introduction
In recent years, the measurement of chromaticity parameters has gone deep into every aspect of life, and the application of color analyzer is more and more extensive [1]. Most of the color analyzers on the market are large in size, less probe expansion, and the measurement accuracy and measurement range is not high; the operation interface uses a single LCD as the display screen, and the use of buttons as input equipment, the operation steps are more complex and cumbersome, to the user's use of inconvenience; although there are already some products that have better performance and higher accuracy, but the price is very expensive and it will cost more for using them [2].

Therefore, it is very important to design a color analyzer that with the characteristics of high-test accuracy, low cost, friendly human-computer interaction, USB communication function and easy to carry. The color analyzer developed in this design not only has the above advantages, but also uses real color touch screen to design display and control software. The human-computer interaction is relatively simple.

2. Overall design
The color analyzer mainly consists of optical system and circuit system. The detailed block diagram is shown in Figure 1.

Figure 1. Block diagram of system
The main function of the optical system is to correct the incident light by the lens, and eliminate the influence of the test angle on the test accuracy, then the light through the optical fiber into the optical filter incident to the photoelectric sensor, after that, the sensor converts the optical signal into electrical signal.

2.1. Design of display and control software for touch screen
The main function modules of touch screen display and control software are four modules: zero calibration, parameter setting, measurement and communication module [3]. As shown in Figure 2.

![Software overall design block diagram](image)

Figure 2. Software overall design block diagram

2.2. zero calibration
Zero calibration refers to adjusting the zero point, when it makes sure that the detector has completely been blocked, pressing the return key and start zero calibration, as OK shows on the screen, zero calibration is completed, if ERROR shows that zero calibration is unsuccessful, please check whether the probe is completely shaded and re-zero. The flowchart is shown in Figure 3.
2.3. Parameter setting
User calibration is to set the user calibration coefficient of the device's memory channel by measuring the display color and setting the device's standard values (x, y, L_v). Once the coefficient is set, the values calibrated by this coefficient will be displayed and output in each measurement.

When the user needs to set the standard value of the target color in the channel selected by himself, it can be realized through this module. The flowchart is shown in Figure 4.

2.4. test
Before surveying, we must make measurement preparations, including zero calibration and parameter setting. When you are ready, select the measurement channel, aim the probe to the target, then perform the measurement. The flowchart is shown in Figure 5.
2.5. communication

The main function of the serial communication module is to communicate with each other according to the communication protocol that agreed between the Master computer and the slave computer. The primary communication flow is shown in Figure 6.

The touch screen sends instructions to the core controller ARM, and the slave computer sets the product address, calibrates, reads the real-time measurement value and transmits it according to the command recognition code received. The module first initializes the clock, configures the serial port to receive and send interrupts and initializes them. After the configuration is successful, the serial port can send and receive data normally.
According to the commands specified in the instruction function table, the function to be executed is realized when the instruction is received. The instruction function table is shown in Table 1.

| function                          | ID  | Data ID 1 | Data ID 2 | Data ID 3 | ACK ID |
|-----------------------------------|-----|-----------|-----------|-----------|--------|
| Read addr                         | FF  | addr/FE   | AC        | 0         | 0      | 0      | 1      |
| Initialization                    | FF  | addr/FE   | AC        | 0         | 0      | 0      | 2      |
| Read brightness values            | FF  | addr/FE   | AC        | 0         | 0      | 0      | 3      |
| Set addr                          | FF  | addr/FE   | AC        | 00~FF     | 0      | 0      | 4      |
| Connection query                  | FF  | addr/FE   | AC        | 0         | 0      | 0      | 5      |
| Read x                            | FF  | addr/FE   | AC        | 0         | 0      | 0      | 6      |
| Read y                            | FF  | addr/FE   | AC        | 0         | 0      | 0      | 7      |
| Read color temperature value      | FF  | addr/FE   | AC        | 0         | 0      | 0      | 8      |

Communication format: computer send address "FF MM"+ data "AC XX XX XX XX", illuminometer communication is normal, will return address "MM"+ data "BC XX XX XX XX XX".

3. Conclusion
After the integration of the various functional modules, and using touch-screen software to control the various modules to achieve the corresponding functions, as shown in Figure 7. It can clearly see the various functional modules of the switch button, as well as the current channel number and test data on the screen. It is not only intuitive but also simple to operate.

**Figure 7. Touch screen test interface**

References
[1] Wang Pu, Liu Jiaoyu, Chen Qianping. Research and design of color analyzer based on WinCE [J]. Electronic measurement technology, 2011, 34 (5): 49 J
[2] Zhang Juan, Li Guokui, Sheng Huaping. Development of calibration system for color analyzer [J]. Modern measurement and laboratory management, 2013 (1): 12-13.
[3] display color analyzer CA-310 instructions.