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Multifunctional Vision Reading and Writing Posture Corrector Based on Single-Chip Microcomputer

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Abstract: The eyes are the source of knowledge acquisition and the channel for transmitting information. In modern society, due to the lack of self-awareness of primary and secondary school students, parents and teachers cannot remind them all the time. Once bad reading and writing habits are formed, it is difficult to change them. The vicious cycle of day after day leads to many primary and secondary school students wearing glasses prematurely. It is not only inconvenient in life but also causes great psychological shadow on their minds. Therefore, people gradually focus on children's vision. This system is a kind of intelligent control system that integrates human-computer interaction technology and people-oriented thinking, and combines the wisdom of electronics, physics, and human engineering and so on. The system measures the distance between the user's eyes and desk, the brightness of light in the reading scene and the reading time. If it fails to meet the standard, the system will actively suggest that users straighten their posture and straighten their waist and back to cultivate good reading habits and improve reading quality.

1. Introduction

With the rapid development of society, more and more electronic products have emerged in people's eyes. The advent of the intelligent era has made intelligent products emerge in an endless stream and gradually penetrate into all aspects of people's work and life [1]. Since retinal pigment epithelial cells will shrink when exposed to short-wave high-energy blue light emitted by electronic product display screens, serious damage will occur to the eyes after long-term use, which will inevitably cause irreversible trauma to the eyesight. In addition, using electronic products at close range will keep eye muscles in a state of contraction for a long time, which is also the main cause of vision problems. If indoor light intensity is not suitable, it will also affect eyesight. Currently, there are more and more people with myopia, especially in China [1]. Therefore, it is urgent to protect people's vision health.

2. Research Contents

2.1. Research Contents

The article describes a smart, personalized and humane correction system designed for teenagers and life's "long-lights" waste phenomenon. The system is composed of a vision and posture protection system using an STC89C52 microcontroller as the core, an infrared detection module, an AD light collection module, an alarm module and more. It can prevent and correct people's bad reading habits and effectively protect people's physical health. The innovative features of this system are as follows:

1) It is small in size, easy to use, easy to carry, and has great practical value;

2) It uses a photoresistor to collect light information and the ability of the AD module to collect light information to grade the brightness of the light so that the appropriate brightness alarm threshold can be selected;

3) The system uses a single-chip microcomputer as the core to make the control system safer.

Figure 1 is a schematic diagram of the use scenario of orthotics.

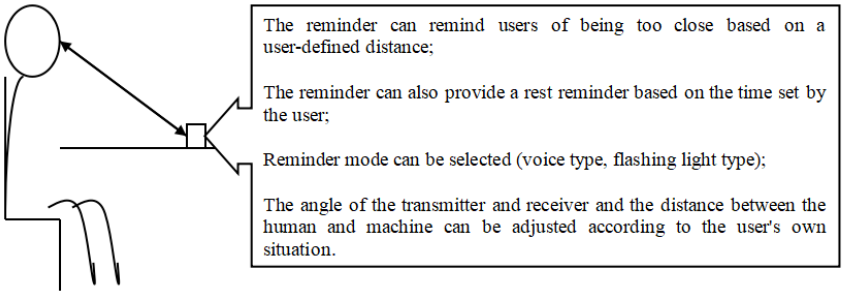

Figure 1: Schematic diagram of use scenarios of orthotics

2.2. Research Status at Home and Abroad

The article also mentions that there are existing products such as posture correctors that can be classified into mechanical balance posture correctors, bracket-type posture correctors, electronic balance posture correctors and ranging-type posture correctors. However, some of these products have limitations such as not protecting vision or causing opposite effects. Therefore, it is necessary to develop a new type of posture corrector that has powerful functions such as distance measurement reminders, angle changes, timing reminders, high sensitivity, low price, long service life, easy to carry and beautiful appearance. This new type of posture corrector should be suitable for all occasions and focus on primary and secondary school students.

2.3. Research System Technical Route

The article provides a complete intelligent control scheme that collects light signals through photoresistors and grades the intensity of light signals through AD modules. An ultrasonic ranging sensor measures the distance between the eyes and the desktop. At the same time, the internal timer of the single-chip microcomputer is used to time and automatically remind users to rest after working for a certain period of time to maximize people's visual health. The reminder circuit used in this project consists of a transistor-driven buzzer group.

The technical route of the project is shown in Figure 2.

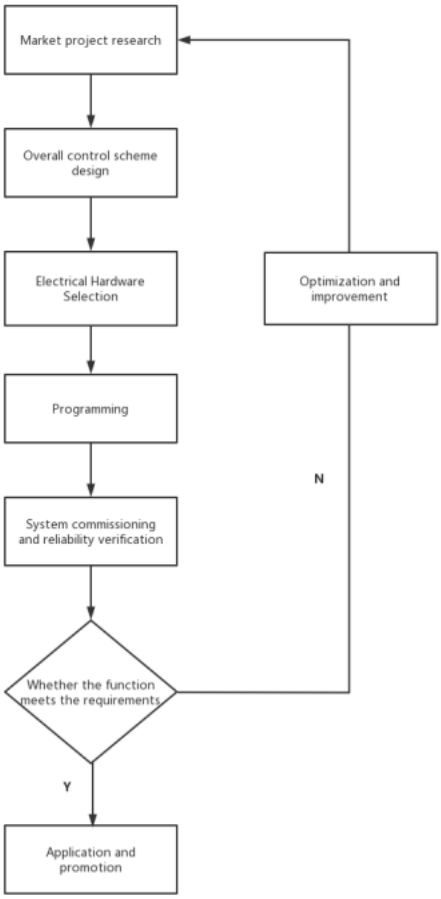

Figure 2: The technical route of this project

3. System Design

3.1. System Overall Design

The system uses an infrared detection circuit and a light detection circuit to transmit the distance between the user's eyes and the desk and the light intensity to the STC89C52 single-chip microcomputer minimum system. The single-chip microcomputer minimum system will feedback the collected parameter values to the LCD liquid crystal display screen through the display circuit. The screen will also display the time of the day, temperature and humidity values, and study duration. When there is an abnormality in light intensity or distance, the alarm circuit will sound an alarm to remind the user to adjust their posture. The ultrasonic module is used to detect the distance between the eyes and the desk, When designing the circuit, when the detected distance is less than the set value, after triggering the signal detection, an audible and visual alarm will appear in the circuit, and the LCD module will display the distance, thereby reminding and warning students to adjust their angles, sit upright, take appropriate rest, and protect their eyesight [2], and the AD module is used to detect the light intensity of the learning environment. When there is an abnormality in light or ultrasonic detection, the alarm module will sound an alarm to remind users to change their posture. This system changes the limitations of traditional correctors that forcibly correct posture by force because it has strong practicality.

Figure 3 is a hardware block diagram of the system.

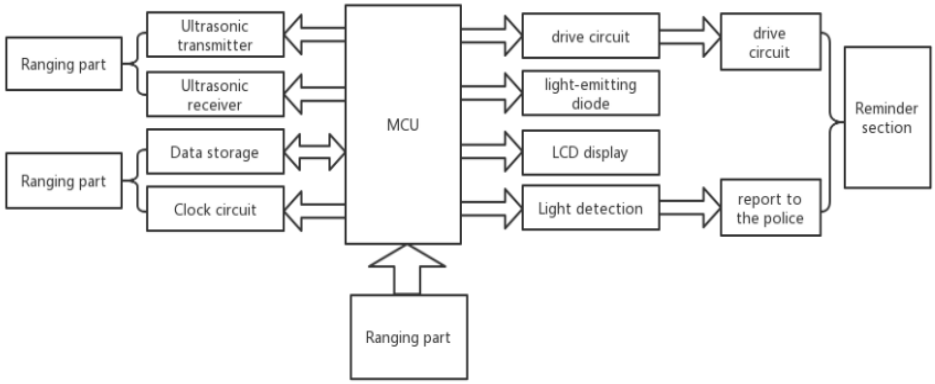

Figure 3: System Block Diagram

3.2. System Hardware Selection

3.2.1. Main Controller Module

Plan 1:

Use programmable logic device CPLD as controller. CPLD can realize various complex logic functions, large scale, high density, small size, high stability, rich IO resources, and easy function expansion. However, this system does not require complex logic functions, and the requirement for data processing speed is not very high. After comprehensive comparison and consideration, we gave up this plan.

Plan 2:

STC89C52 single-chip microcomputer is used as the core of the entire system. STC89C52 single-chip microcomputer has mature technology, complete functions, various packaging forms, and can meet the software and hardware needs of different products [3]. It has low power consumption, super anti-interference characteristics, online programming function, and forty pins. Because of its simple usage and relatively low price, it can provide a flexible and effective solution for this system. Therefore, this plan was chosen.

3.2.2. Distance Detection Module

Plan 1:

Infrared pyroelectric sensor is used. Since infrared pyroelectric sensors are sensitive to ultraviolet rays, when our posture is already sitting well and then we turn on the visual protector, once our posture changes, there will be a high-to-low electrical signal transmission in the infrared pyroelectric sensor. Although infrared pyroelectric sensors have good sensitivity, they are not ideal for use in visual protectors because they will sound an alarm when people are just moving visual protectors lightly. There are also many phenomena of false reports. Therefore, infrared pyroelectric sensors are not suitable as posture tests for multi-functional visual protectors.

Plan 2:

HC-SR04+ includes ultrasonic transmitter, receiver and control circuit. When the main control chip gives TRIG a high-level signal not less than 10μs, the module automatically emits 8 40 kHz square waves. At the same time ECHO automatically goes high until it receives back ultrasonic waves stop then: test distance=(echo high level time*speed of sound) / 2 [4]. HC-SR04 sensor has stable performance and accurate measurement distance with high accuracy. Therefore, this scheme was

adopted.

3.2.3. Light Intensity Detection Module

Plan 1:

The M124749 illuminance sensor is used. The M124749 illuminance sensor uses a new integrated circuit module technology to develop transmitters that can be used for real-time detection of environmental illuminance and output standard voltage and current signals. It has a small size, simple setting, high linearity, long propagation distance, good anti-interference ability, and adjustable maximum range. But because it is too expensive in price, its cost-effectiveness is not high and it is often unavailable for purchase.

Plan 2:

ADC0809 is an 8-bit analog-to-digital converter that can quantify ambient brightness into an 8-bit binary value [5]. It uses a photoresistor to collect light information. The AD module's ability to collect light information levels up light intensity and samples output voltage values to feed back to single-chip microcomputers for adjustment processing so that voltage values are converted into corresponding light intensities that are displayed in real-time on LCD screens [6], thus selecting appropriate light intensity alarm thresholds.

3.2.4. Alarm Prompt Module

Plan 1:

Through voice alarm, users can be reminded to rest and whether their posture is correct, which is intuitive and clear. Although there are many benefits to using a voice reminder system, the programming process of the voice chip requires a dedicated programmer, and the price is expensive and the program is cumbersome, which is not suitable for the application of multifunctional visual protection devices. Therefore, after comprehensive comparison and consideration, we still gave up this plan.

Plan 2:

Use a buzzer for alarm. The buzzer has small size, light weight, easy installation, and convenient use. The price is affordable and has strong superiority for promoting the application of visual protection devices. And it can also achieve the effect of the system very well, so we chose this system.

3.2.5. System Hardware Design Circuit Diagram

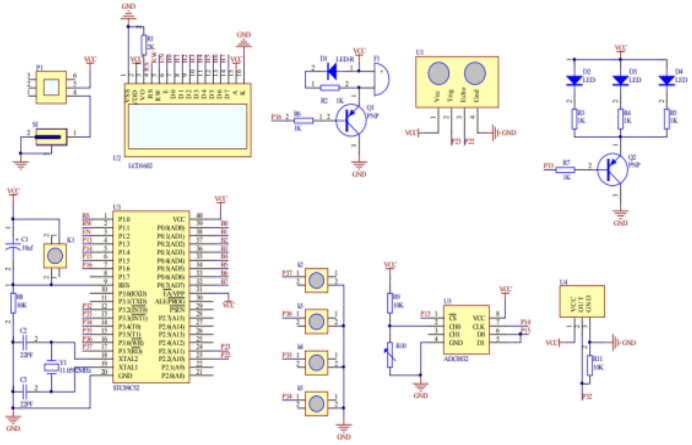

Figure 4: Hardware circuit diagram

Figure 4 shows the hardware circuit diagram of the system.

3.2.6. System Design Hardware List

The hardware of this system includes STC89C52 single-chip microcomputer chip, AD acquisition chip ADC0832, ultrasonic module HC-SR04, LCD1602 display screen, light-emitting diode, photoresistor, transistor 9012, Capacitors, resistors, switches, buttons and other components.

Table 1: Hardware Design List of Bit System.

Component model	Component Name	Component label	quantity
ADC0832	AD acquisition chip	1	1
buzzer	buzzer	B1	1
10μF	electric capacity	C1	1
20pf	electric capacity	C2, C3	2
light-emitting diode	light-emitting diode	D1	1
Light dependent resistors	Light dependent resistors	GR1	1
LCD1602	liquid crystal	LCD1	1
9012	triode	Q1	1
2K	resistance	R1, R2, R3, R5	4
10K	resistance	R4	1
SW-PB	key	S1, S2, S3, S4	4
sw-grey	power switch	SW1	1
STC89C52	singlechip	U1	1
12M	Crystal oscillator	Y1	1
DC3.5	Power interface	P2	1
HC-SR04	Ultrasonic module	P1	1

4. Conclusion

In summary, the visual acuity correction system has the following functions:

(1) When the distance between the user's eyes and the desk is too close (less than the set distance), the system will provide audio and visual prompts;

(2) When the light intensity in the reading and writing environment does not reach the set value, the system will provide audio and visual prompts;

(3) When the usage time exceeds the reserved time, the system will provide audio and visual prompts.

Time flies like an arrow, and a year has passed in a blink of an eye. The "College Student Innovation and Entrepreneurship Project" is nearing its conclusion. With the concerted efforts of each group member, our work has basically achieved the expected results, and the effectiveness of the entire work has been successfully verified through experimental results. Looking back on the experience of working over the past year, from not understanding the entire development and operation process of the work at first, to gradually solving all problems that occurred in the work with everyone's efforts, each group member has always worked together, supported and helped each other, and finally overcome one problem after another, basically achieving the expected results of the work.

Acknowledgments

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