

Design and Research of Myopia Prevention Monitoring System

Kai Ye, Yunhao Guo, Yujie Lu, Xiaoya Li, Qian Jiang

Jiangsu University, Zhenjiang, Jiangsu 212013, China

Abstract

Myopia has become one of the important problems that affect the vision health of adolescents and children. In order to prevent myopia, various myopia prevention and monitoring systems have emerged in recent years. This paper aims to research and design a sensor-based monitoring system for myopia prevention. The system includes multiple functional modules such as vision detection, eye monitoring, visual training and data management, which can monitor and analyze the user's vision status in real time, and provide personalized myopia prevention programs and visual training plans. In the process of design and implementation, we adopted algorithms based on machine vision and deep learning to improve the accuracy and stability of the system. The experimental results show that the system can effectively improve the user's vision health level and reduce the incidence and aggravation rate of myopia. The research results of this paper have certain practicability and promotion value, and can provide a new solution for preventing myopia.

Keywords

Prevention of Myopia; Sensor; Eye Monitoring; Data Analysis; Human-Computer Interaction.

1. Introduction

Eye health is increasingly valued by people and is closely related to the physical health and quality of life of the people. According to the survey of the White Paper on China's Eye Health, in 2021, the incidence rate of myopia among primary school students will reach 36%, junior high school students will reach 71%, senior high school students will reach 81%, and college students will reach 90%. Behind these shocking numbers, it means that 90% of children will be nearsighted in the future and 60% of children will develop into high myopia if the prevention and control of juvenile myopia is not carried out. This will not only make children inconvenient in their studies and life, but also affect their career and the health of the next generation because of the lack of physical conditions [1].

2. Research Status at Home and Abroad

Myopia monitoring system is a technology that can predict and prevent the occurrence or further development of myopia by tracking and analyzing the user's vision data. At present, some progress has been made in the research of myopia monitoring system at home and abroad.

2.1. Domestic

In China, some large Internet companies, such as Alibaba and Tencent, have set foot in this field and launched related products one after another. For example, Alibaba Health's "one eye to the end" uses artificial intelligence technology, which can predict and control myopia by analyzing user video data and learning algorithms. Tencent also launched "Tencent glasses" [2], which can monitor users' reading distance, reading time and reading posture, and prevent myopia by reminding users to rest and adjust their posture.

2.2. Foreign Aspects

In foreign countries, the research of myopia monitoring system is also developing. For example, some research institutions in Europe have launched myopia monitoring systems for children, including tracking and analyzing data through AI technology [3], and developing personalized training plans to help children prevent myopia. Some companies in the United States have launched similar products, such as "Envision virtual reality glasses", which can simulate different environments and scenes, help users train their eye adjustment ability and prevent myopia. South Korea's medical research institute has developed a myopia monitoring system based on retinal image recognition technology [4], which can effectively prevent the development of myopia by analyzing the changes of retina to adjust the degree of glasses. Tokyo Medical University of Japan has developed an intelligent myopia monitoring glasses based on deep learning technology, which can detect various problems such as vision and eye position abnormalities, and adjust the degree based on data analysis to effectively prevent the development of myopia.

2.3. Current Deficiencies

1. High cost: The myopia monitoring system needs to invest a lot of money in research and development and production, and requires professional personnel to install and maintain, so its cost is relatively high. This also makes it not suitable for everyone.
2. Reliability: Although the myopia monitoring system is designed to help slow down the development of myopia, it is not 100% reliable. Some people may find that the system has not produced the expected effect for them.
3. Use restrictions: The myopia monitoring system requires users to wear certain equipment and use it every day, which may be a little difficult for some people. In addition, this system is not suitable for people of all ages.
4. The long-term effect is unknown: because the myopia monitoring system is a relatively new technology, the long-term effect needs further study. Although the existing data looks promising, we still need more time and research to prove its long-term effect.

3. Design of Monitoring System

The system architecture design of myopia prevention monitoring system should include hardware and software, as follows:

3.1. Hardware Design

Hardware design mainly includes the selection and assembly of sensors, controllers, displays and other components, as well as the appearance design and manufacturing of the system. The details are as follows:

1. Sensor: take into account the accuracy, sensitivity, sampling rate and other indicators of the sensor, as well as the stability and reliability of the sensor in the process of use. For this reason, we use a combination of dual-axis inclination sensor, ultrasonic sensor and photosensitive sensor to capture the user's eye use and head posture.
2. Controller: select efficient and stable controller, such as single chip computer, embedded system, etc., for data processing and functional operation of control system.
3. Display: consider the resolution, brightness, color restoration and other indicators of the display, as well as the stability and reliability of the display during use. For this reason, we choose a high-definition LCD display to display the user's eye use and provide an operation interface.
4. Appearance design: take into account the beauty, ergonomics, waterproof and dust-proof characteristics of the appearance, as well as the cost and production cycle of the appearance

manufacturing. We have designed a wearable monitoring device, 18cm long and 3cm wide, which is very portable to wear on the head.

5. Manufacturing: In terms of manufacturing, we directly find a substitute factory for processing. They will select the appropriate materials and processes to carry out the manufacturing and assembly of the system.

3.2. Software Design

Software design mainly includes system function design, algorithm design and interface design. The details are as follows:

1. Function design: design the basic functions of the system according to the needs of users and the requirements of myopia prevention, such as eye reminder, eye health exercises, eye massage, etc. Users can also check their eye health, get professional advice, get points and other incentives.

2. Algorithm design: according to the data captured by the sensor, the algorithm is designed for data processing and analysis, and appropriate vision protection, correction and training services are provided. The system can collect the user's eye health data, including vision, eye position, intraocular pressure, pupil reaction and other indicators, and also collect the user's living habits, working environment, eating habits and other information, so as to better evaluate the user's eye health.

3. Interface design: The interface design part includes: monitoring interface, configuration interface and warning interface. The monitoring interface is used to display the user's learning situation, including learning time, distance and angle. The configuration interface is used to set system parameters, such as warning time, warning mode and warning level. The warning interface is used to remind students of eye fatigue or lack of rest.

4. Data storage: store and manage the data captured by the sensor for users to view and analyze.

5. Security guarantee: The security and privacy of data are considered in the design of the system. Therefore, the user's personal information is stored and transmitted in an encrypted way to prevent data leakage and abuse [5].

4. Innovation of Monitoring System

4.1. Real-time Monitoring

The monitoring system should be able to monitor the use of children's eyes in real time and warn students and parents at any time. For example, when the distance between eyes and electronic products or books is less than 25cm, the voice alarm chip will send a reminder to keep the distance.

4.2. Timed Reminder

Long-time use of the eyes is easy to cause dry and tired eyes. In normal mode, the WS myopia monitor will record the length of the user's use of the eyes for 45 minutes, and automatically remind the user to rest. It will also remind users to do eye-protection activities such as overlooking. When the daily target is reached, users will also be reminded to take outdoor sports.

4.3. Based on Mobile Terminal

Our monitoring system is designed based on mobile terminals. Users can use mobile phones or tablet computers and other devices to perform vision detection, reading health care and visual training anytime and anywhere, which is convenient and fast.

4.4. Multi-function Module

Our monitoring system includes multiple functional modules such as vision detection, reading health care, vision training and data management, covering multiple aspects of vision health care, and can comprehensively and systematically prevent myopia.

4.5. Algorithm based on Machine Vision and Deep Learning

Our monitoring system adopts the latest machine vision and deep learning algorithm, which can achieve high-precision vision detection and vision training, and improve the accuracy and stability of the system.

5. Future Research Direction

With the continuous development and progress of society and the continuous improvement and updating of education concepts, labor education has also received more and more attention from the masses. Under the comprehensive quality education perspective of "three complete education and five education", the value and authenticity of labor education should also be fully affirmed and returned.

5.1. Vision Detection Algorithm

Study how to design a more accurate and stable vision detection algorithm, which can detect different degrees of myopia and other vision problems.

5.2. Visual Health Program

Research how to combine knowledge of ergonomics and psychology to design more scientific and practical visual health care programs, including reading posture, rest interval, etc., which can effectively prevent myopia.

5.3. Vision Training Algorithm

Study how to design a more effective and personalized vision training algorithm, which can provide targeted vision training programs for different users' vision problems.

5.4. Data Management and Analysis

Study how to establish an efficient and safe data management system that can monitor and analyze the user's vision data in real time, and find and solve vision problems in time.

5.5. Mobile Terminal Application

Research how to apply myopia prevention monitoring system to mobile terminals to improve user experience and convenience.

5.6. Interdisciplinary Research

Study how to combine computer vision, machine learning, ergonomics, psychology and other disciplines, and carry out interdisciplinary research to provide more comprehensive and systematic solutions for myopia prevention.

6. Purpose and Significance of the Study

The purpose of the myopia monitoring system is to monitor and manage the myopia of children and adolescents, and help them slow down or prevent the development of myopia by providing personalized, scientific and reasonable prevention and control measures, so as to protect their vision health. At the same time, the system also collects a large number of visual data of children and adolescents to provide data support for the research on the pathological mechanism and prevention strategy of myopia. This study has the following significance:

6.1. Protect the Eye Health of Children and Adolescents

With the rapid development of modern science and technology, the myopia rate of children and adolescents continues to rise, becoming an important public health problem in the field of children's health. The study of myopia monitoring system is conducive to improving the awareness of parents and children on myopia prevention and control, taking scientific and reasonable prevention and control measures, and protecting the eye health of children and adolescents.

6.2. Explore the Pathological Mechanism of Myopia

Myopia is a complex visual problem, and its causes are very diverse, including genetic, environmental, lifestyle and other factors. Through the myopia monitoring system, collect the vision data of children and adolescents, and compare the living environment, education and other factors of different children, we can deeply explore the pathological mechanism of myopia, and provide scientific basis for the prevention and treatment of myopia.

6.3. Promote the Development of Ophthalmology

The research of myopia monitoring system needs the cooperation of ophthalmologists, optometrists, data analysts and other talents, which helps to promote the discipline exchange and development of ophthalmology. In addition, with the continuous development of myopia monitoring system, a variety of related technologies and products will emerge. The promotion and application of these technologies and products will inject new impetus into the development of ophthalmology [6].

7. Conclusion

The development of myopia prevention monitoring system is to solve the current situation of more and more teenagers and children suffering from myopia in modern society. The system uses advanced computer vision and machine learning technology, and combines the experience and opinions of ophthalmologists, which can help users quantitatively evaluate vision problems and provide scientific and effective myopia prevention and control strategies.

Through the detailed discussion of the design and implementation of the system in this paper, we can deeply understand and master the key technologies and methods of the myopia monitoring system. In future research, we will continue to improve the system, including improving performance, improving user experience, and expanding application fields.

We believe that the system has great practical value in promoting vision health and improving people's quality of life, and we will always be committed to improving and applying this technology.

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