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EXPLORATION OF AN ANDROID-BASED MYOPIA DETECTION AND PREVENTION SYSTEM IN CHILDREN USING THE EXTREME LEARNING MACHINE METHOD WITH A RISK FACTOR ANALYSIS AND EYE EXERCISE THERAPY APPROACH

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ABSTRACT

Myopia, or nearsightedness, is a visual impairment whose prevalence continues to increase, particularly among children. This condition is influenced by both genetic and environmental factors, such as excessive use of digital devices and insufficient outdoor activities. These challenges highlight the need for solutions that not only enable early detection but also provide effective preventive measures. This study aims to explore an Android-based system for the detection and prevention of myopia in children using the Extreme Learning Machine (ELM) method, combined with a risk factor analysis approach and eye exercise therapy. The research employs a qualitative method with a library research approach, utilizing various relevant scientific sources, including journals, books, and conference proceedings. Data were collected through systematic searches in academic databases using keywords aligned with the research variables, followed by a selection process based on relevance and source credibility. Data analysis was conducted using content analysis techniques, which involved stages of data reduction, categorization, synthesis, and inductive conclusion drawing. The findings indicate that the Extreme Learning Machine method demonstrates high accuracy and efficient processing speed in detecting myopia, while the Android platform offers accessibility and ease of use for users. The primary risk factors identified include excessive screen time and limited outdoor activity. Furthermore, eye exercise therapy has been shown to improve visual acuity and reduce eye strain. The integration of these components results in a comprehensive system that functions not only as a detection tool but also as an educational and preventive medium. This study contributes to the field of education by providing a technology-based health education tool and to the scientific community through the advancement of artificial intelligence applications in healthcare. Future research is recommended to extend this study through experimental approaches or direct system implementation to empirically evaluate its effectiveness in real-world settings.

Keywords: Myopia in Children, Extreme Learning Machine, Android, Risk Factors, Eye Exercises.

INTRODUCTION

Myopia, or nearsightedness, is one of the most common refractive eye disorders, with a prevalence that continues to rise globally, particularly among children and adolescents. The World Health Organization (WHO) projects that by 2050, approximately half of the world's population will be affected by myopia, with the majority of cases developing from an early age (WHO, 2021). This condition not only reduces visual quality but also

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increases the risk of severe complications, such as retinal detachment, macular degeneration, and glaucoma, if not properly managed (Holden et al., 2016). Therefore, myopia has emerged as a significant public health concern that requires comprehensive attention, particularly in terms of early detection and prevention in children.

The increasing prevalence of myopia among children is closely associated with multiple interrelated risk factors, including both genetic and environmental influences. Behavioral factors, such as prolonged near-work activities, excessive use of digital devices, and limited outdoor exposure, have been shown to significantly contribute to the development of myopia (Morgan et al., 2018). This trend has intensified during the COVID-19 pandemic, when online learning systems increased children's screen time, thereby elevating the risk of visual impairment (Wong et al., 2021). These conditions indicate that myopia is not merely a medical issue but is also strongly linked to modern lifestyle changes, which must be addressed through appropriate preventive strategies.

On the other hand, early detection of myopia in children still faces several challenges, particularly due to limited access to eye care services and low public awareness regarding routine eye examinations. Many cases are only identified when the condition has progressed to a more severe stage, reducing the effectiveness of subsequent interventions. In this context, the utilization of information technology presents a strategic opportunity to provide more accessible and efficient solutions. The widespread adoption of Android-based mobile devices offers significant potential for developing independent and real-time health detection systems.

With the rapid advancement of technology, the application of Artificial Intelligence (AI) in healthcare has continued to expand, including the use of the Extreme Learning Machine (ELM) method. This method is recognized for its fast training process and strong generalization capability in data classification, making it highly suitable for health detection systems, including those targeting myopia (Huang et al., 2006). Previous studies have demonstrated that the implementation of ELM in Android-based myopia detection systems can achieve relatively high levels of accuracy, indicating its potential as an effective tool for early diagnosis (Pratama et al., 2022). In addition, other studies have reported that eye exercise therapy can help reduce visual fatigue and potentially slow the progression of myopia when performed regularly (Anggraini & Putra, 2020). Furthermore, research on the determinants of eye disorders emphasizes that a combination of environmental factors and individual habits plays a significant role in the occurrence of refractive errors (Kurniawan et al., 2019).

However, these studies still exhibit certain limitations, as they generally focus on a single aspect, such as technology-based detection, risk factor analysis, or preventive intervention, in isolation. There remains a lack of research that integrates these three approaches into a comprehensive and practical system. In fact, an integrated approach is essential to develop solutions that not only enable early detection of myopia but also promote effective prevention through behavioral modification and simple interventions.

Based on these considerations, this study proposes an exploratory approach that integrates an Android-based myopia detection system using the Extreme Learning Machine method with risk factor analysis and the implementation of eye exercise therapy as a preventive strategy. The novelty of this research lies in its multidimensional integration of artificial intelligence technology, behavioral risk analysis, and simple health interventions within a single accessible platform. Accordingly, this study is expected not only to produce an accurate detection system but also to enhance awareness and preventive behaviors among children and parents in maintaining eye health. The primary objectives of this study are to explore the application of the ELM method in Android-based myopia detection, to analyze the risk factors influencing myopia in children, and to examine the effectiveness of eye exercise therapy as an integrated preventive strategy within an innovative and practical system.

RESEARCH METHOD

This study employed a qualitative research design using a library research approach. This approach was selected because the study focuses on conceptual exploration and theoretical synthesis of an Android-based system for myopia detection and prevention in children using the Extreme Learning Machine (ELM) method, through the analysis of relevant scientific literature. A qualitative library-based approach enables a comprehensive understanding of the phenomenon by reviewing, comparing, and integrating findings from prior studies related to the research variables, without direct field data collection. Accordingly, this study emphasizes secondary data derived from credible and up-to-date scientific publications.

Data collection was conducted through a systematic search of various relevant literature sources, including reputable national and international journals, reference books, conference proceedings, and previous research reports. The search process utilized academic databases such as Google Scholar, ScienceDirect, and other scholarly journal platforms, employing keywords aligned with the research focus, including "myopia in children," "myopia risk factors," "Extreme Learning Machine," "Android-based health detection," and "eye exercise." Subsequently, the identified literature was screened based on inclusion criteria, such as relevance to the research topic, recency of publication, and the quality and credibility of the sources. The selected literature was then compiled, thoroughly reviewed, and key points were extracted to support the analysis.

Data analysis in this study applied content analysis techniques, involving a systematic examination of the collected literature. The analytical process consisted of several stages, beginning with data reduction by selecting information relevant to the research focus, followed by organizing the data into categories based on the research variables, such as technology-based myopia detection, the Extreme Learning Machine method, risk factors, and eye exercise therapy. This was followed by a synthesis process, in which findings from multiple sources were compared and integrated to identify patterns, relationships, and research gaps. The final stage involved drawing conclusions inductively, resulting in a comprehensive and conceptual understanding of the integration of myopia detection and prevention systems in children. Through these analytical stages, the study is not only descriptive but also critical and analytical, thereby generating more in-depth and focused scientific contributions.

RESULTS AND DISCUSSION

Following the data collection process, the data were systematically analyzed to obtain the research findings, as presented in Table 1. These findings represent a synthesis of three primary strands of study: research on eye exercise therapy as a preventive strategy for myopia in children during the COVID-19 pandemic, studies examining the determinants of eye disorders such as glaucoma, astigmatism, hypermetropia, and myopia, and research related to the implementation of the Extreme Learning Machine (ELM) method for Android-based myopia detection.

Table 1. Research Findings

No	Research Aspect	Variables/Indicators	Findings	Analysis	Implications
1	Technology-Based Myopia Detection	Accuracy, speed, classification	Accuracy 92.5%, <1 second	ELM is fast and efficient	Suitable for early mobile screening
2	System Platform	Accessibility	Easy to use	Android widely adopted	Enables self-assessment
3	Risk Factors	Genetics, gadget use, activity	Gadget use is dominant	Environmental factors	Importance of education

4	Physiological Aspect	Axial length of the eye	Main cause of myopia	influential Fundamental biological factor	Basis for detection
5	Disease Comparison	Prevention level	Myopia is preventable	External factors are dominant	Focus on prevention strategies
6	Preventive Therapy	Visual acuity	55% → 74%	Proven effective	Low-cost solution
7	Statistical Testing	Significance	Significant effect observed	Statistically significant	Feasible for implementation
8	Pandemic Impact	Gadget usage	Increased cases	Lifestyle changes	Need for digital solutions
9	System Integration	Detection + risk + therapy	Comprehensive system	More effective	Holistic solution
10	System Output	Results & recommendations	Comprehensive information	Educational value	Increased awareness

Based on the findings presented above, myopia can be characterized as a complex eye health problem influenced by multiple interrelated factors, thereby requiring an integrated approach that combines early detection, comprehensive understanding of risk factors, and effective preventive strategies. The results of this study confirm that the utilization of artificial intelligence–based technology, particularly the Extreme Learning Machine (ELM) method, provides a rapid and accurate solution for early myopia detection, achieving an accuracy rate of 92.5% with a processing time of less than one second. These findings are consistent with Huang (2006), who highlighted the advantages of ELM in terms of training speed and predictive stability, and are further supported by Ahmed et al. (2021), who demonstrated that machine learning–based systems for eye disease diagnosis can achieve accuracy levels exceeding 90%. The implementation of an Android-based platform further enhances accessibility, enabling users to perform self-screening conveniently and efficiently, in line with the recommendations of the Indonesian Ministry of Health (2022) regarding the importance of developing affordable early detection tools.

On the other hand, the findings reveal that environmental factors, particularly excessive gadget use and reduced outdoor activity, are the dominant contributors to the increasing prevalence of myopia, especially during the COVID-19 pandemic. This is evidenced by a significant rise in myopia cases among children, consistent with the findings of Wang et al. (2021) regarding the impact of activity restrictions during the pandemic on eye health. Rahayu (2023) further emphasized that although genetic factors play a substantial role, environmental factors remain the primary modifiable triggers. From a physiological perspective, this condition is associated with axial elongation of the eyeball caused by prolonged near-vision activities, as explained by Cooper and Tkachenko (2018), thereby underscoring the significant influence of modern lifestyle changes on the increasing incidence of myopia.

Furthermore, this study demonstrates that eye exercise therapy is an effective preventive intervention for improving visual acuity, as indicated by the increase in the proportion of normal vision from 55% to 74%, supported by statistically significant test results. These findings align with Susanto (2022), who reported that eye exercises can reduce the risk of myopia by up to 40%, and are further supported by Maisal et al. (2020), who found that such exercises help reduce visual fatigue and improve ocular muscle flexibility. The underlying mechanism of eye exercises, which involves relaxation of eye muscles and variation in visual focus, makes this approach effective, safe, and easy

to implement, particularly among school-aged children who are highly susceptible to visual disturbances due to intensive digital device use.

The integration of technology-based detection, risk factor analysis, and preventive intervention in this study indicates that a holistic approach is more effective than partial or isolated strategies. This is consistent with the promotive and preventive health framework advocated by the World Health Organization (WHO, 2021), which emphasizes the importance of combining education, early detection, and simple interventions in disease control. Moreover, Divayana et al. (2023) demonstrated that systems integrating multiple methods can enhance decision-making accuracy, thereby supporting the development of systems that function not only as detection tools but also as platforms for education and actionable recommendations for users.

The implications of this study for the field of education are substantial, particularly in promoting the implementation of school-based eye health programs, such as routine eye exercises and the integration of digital health literacy into the learning process. This is especially important given the increasing use of digital devices as learning tools, which necessitates preventive efforts to mitigate the risk of visual impairment among students. In the context of scientific advancement, this study contributes to the development of artificial intelligence applications in healthcare, particularly in mobile-based early detection of visual disorders, and opens opportunities for future research integrating more advanced technologies such as the Internet of Things and deep learning. Overall, this study provides both theoretical contributions by enriching multidisciplinary perspectives across health, technology, and education, and practical benefits by offering a feasible solution that can be utilized by the community to enhance awareness and maintain eye health independently and sustainably.

CONCLUSION

Based on the findings of this study, it can be concluded that the integrative approach employed provides a comprehensive and practical solution to addressing myopia in children. The results demonstrate that the Extreme Learning Machine (ELM) method achieves high accuracy and efficient processing speed, making it highly effective for early myopia detection in mobile-based systems. Its implementation on the Android platform further enhances accessibility and usability, enabling individuals—particularly children and their parents—to perform self-assessment in a convenient and flexible manner.

In addition, the analysis of risk factors indicates that environmental influences, such as excessive gadget use and limited outdoor activities, are the primary contributors to the increasing prevalence of myopia among children. This finding underscores the importance of preventive strategies focused on education and behavioral modification. Furthermore, eye exercise therapy has been shown to effectively improve visual acuity and reduce ocular muscle strain, making it a simple, cost-effective, and easily applicable preventive intervention.

Overall, this study proposes a system concept that functions not only as a detection tool but also as an integrated platform for education and prevention. The novelty of this research lies in the integration of artificial intelligence technology, risk factor analysis, and preventive therapy within a single Android-based system. Therefore, this study contributes significantly to the development of effective digital health solutions and supports efforts to enhance awareness and improve children's eye health from an early age.

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