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*Original article*

# Integrating Screen Time Monitoring and Visual Health Interventions Using a Web-Based Application for Children's Digital Well-Being

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**Abstract**
Today, children are increasingly exposed to digital devices for educational, entertainment, and social purposes. Although these technologies provide significant benefits, prolonged and uninterrupted screen time has been linked to adverse visual outcomes, including digital eye strain, reduced blink rate, ocular fatigue, and potential long-term effects on visual development. This study presents a web-based system designed to actively promote children's digital eye health by integrating continuous screen time monitoring with algorithm-driven visual break reminders and guided eye exercises. Unlike traditional applications that only record screen usage or provide parental controls, the proposed system provides interactive interventions directly in the user experience. The study involved sixty children aged six to twelve who were monitored over four weeks, with metrics including screen time, adherence to recommended visual breaks, and adherence to guided eye exercises. The results showed significant improvements in adherence to the visual break schedule and exercise completion rate. The proposed system demonstrates how web-based technologies can be leveraged to translate preventive visual health guidelines into practical, engaging interventions that promote healthy digital behaviors among children.
**Keywords**. A Web-Based Visual Health System, Screen Time Monitoring, Eye Care Support.

## Introduction

The integration of virtual technologies into youngsters' day-to-day activities has come to be nearly ubiquitous, transforming the methods in which kids analyze, socialize, and entertain themselves. Devices that include drugs, smartphones, and computer systems have become integral for instructional functions, online gaming, and digital verbal exchange. While these technologies provide significant opportunities for cognitive and social improvement, excessive display exposure has been increasingly recognized as a public fitness challenge due to its damaging effects on visual fitness. Evidence suggests that prolonged close-to-painting activities associated with continuous display use can bring about digital eye pressure, characterized by means of ocular fatigue, blurred vision, complications, and decreased blink rate, which could in the long run affect long-term visual improvement in children [1,2].

Children are mainly at risk of those outcomes because their visual systems are nonetheless growing and because they do not often self-regulate their screen time or recognize early symptoms of visual fatigue. Unlike adults, kids frequently lack attention to wholesome screen practices, making them dependent on environmental interventions to sell visible breaks. Preventive techniques, consequently, need to be seamlessly integrated into the digital environment that kids interact with daily, providing real-time steering and structured physical games that lessen visual pressure.

Although several digital health programs exist, most remain passive in nature, focusing on the whole on recording screen utilization or offering parents activity dashboards. Such applications, whilst informative, rarely comprise energetic interventions that inspire youngsters to engage in behaviors that defend and enhance their eye fitness. The present study addresses this gap by designing and comparing an internet-based application that not only displays video display units display screen time but also supplies proactive visual health interventions, which include reminders based on connected hints and interactive eye events tailored for kids. This method aims to bridge the gap between theoretical understanding of visual health and sensible, day-to-day implementation, growing a child-centered answer that aligns with preventive pediatric ophthalmology requirements [3].

## *Related Work*

The relationship between prolonged screen use and ocular pain has been nicely documented. Studies suggest that close work sports, specifically the ones involving non-stop awareness on digital screens, lower blink frequency and increase accommodative stress, contribute to digital eye pressure [4]. The 20-20-20 rule, which encourages looking at objects for twenty seconds every twenty minutes, has been shown to lessen eye fatigue when continually observed, yet adherence among kids stays low without external prompting [5-13]. Several systems have been developed to deal with the negative outcomes of excessive display time. Screen time management programs, overall, offer parents dashboards, signals, and tool usage limits. These structures do not actively guide youngsters closer to healthier visible behaviors or provide established physical games to relieve visual fatigue. Separate eye workout applications often lack integration with actual display time usage facts, limiting their preventive effect [6]. From a technical angle, present-day


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internet technology enables the development of scalable applications that combine tracking, reminders, and interactive sporting activities, translating hooked up visible fitness recommendations into algorithmic judgment. The gadget offered in this examine builds upon preceding studies by combining these factors right into a unified platform, ensuring alignment with recommendations from the World Health Organization and pediatric visible health authorities [7–9].

Previous research has additionally explored different methods for encouraging eye fitness in children. Augmented reality-based systems and gamified interventions were shown to boost adherence to eye sports, but these solutions are often pricey and require specialized hardware, which limits accessibility [6]. The proposed device addresses those demanding situations through supplying a wholly software program-based, web-accessible solution that is attractive, interactive, and easy to set up across more than one setting without requiring extra systems. The findings of the present study are consistent with those reported in previous research. Kassab et al. (2024) indicated that students' perceptions of the educational environment have a significant positive effect on their emotional, cognitive, and behavioral engagement in learning, which in turn leads to improved academic performance.[10] Similarly, Sundus Alawi Ruwaij (2024) found a strong correlation between the quality of the school environment and students' academic achievement, emphasizing that a supportive educational environment and positive relationships among school administration, teachers, and the community contribute to higher levels of academic performance. [11]

In the same context, Taibi (2023) highlighted a positive relationship between classroom interaction and students' academic achievement, demonstrating that increased teacher–student interaction leads to higher academic performance, whereas weak interaction may result in students' disengagement and reduced motivation. Collectively, these findings support the results of the present study and underscore the crucial role of an interactive and supportive learning environment in enhancing student engagement and academic outcomes. Furthermore, the comparison with previous studies suggests that improving both the physical and interactive aspects of the educational environment positively influence students' learning experiences, motivation, and academic achievement.[12]

## Methods

The study employed a structured experimental layout to assess the effectiveness of a web-based machine for tracking display time and selling visual fitness amongst youngsters. The studies recruited sixty participants, elderly six to 12 years, with everyday or corrected-to-everyday imaginative and prescient. Children with pre-existing ocular pathologies, neurological issues affecting vision, or developmental conditions that could interfere with digital device use had been excluded to ensure the homogeneity of the sample. Ethical approval was received from the institutional review board, and informed consent was obtained from the mother and father or guardians before participation.

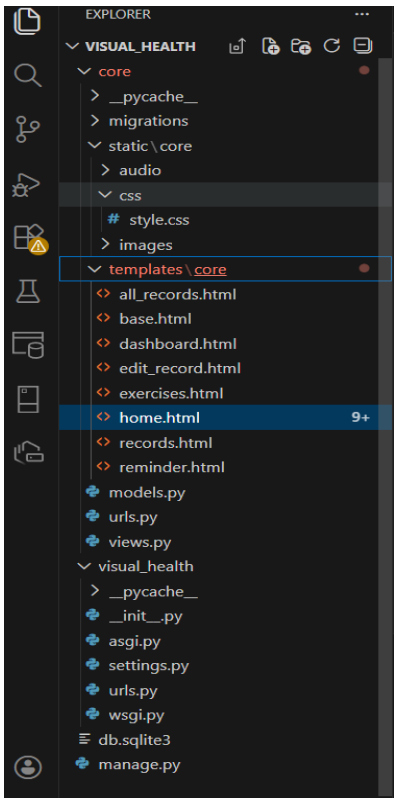



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***Figure 1. Overall gadget architecture of the Django-based visible fitness utility***.

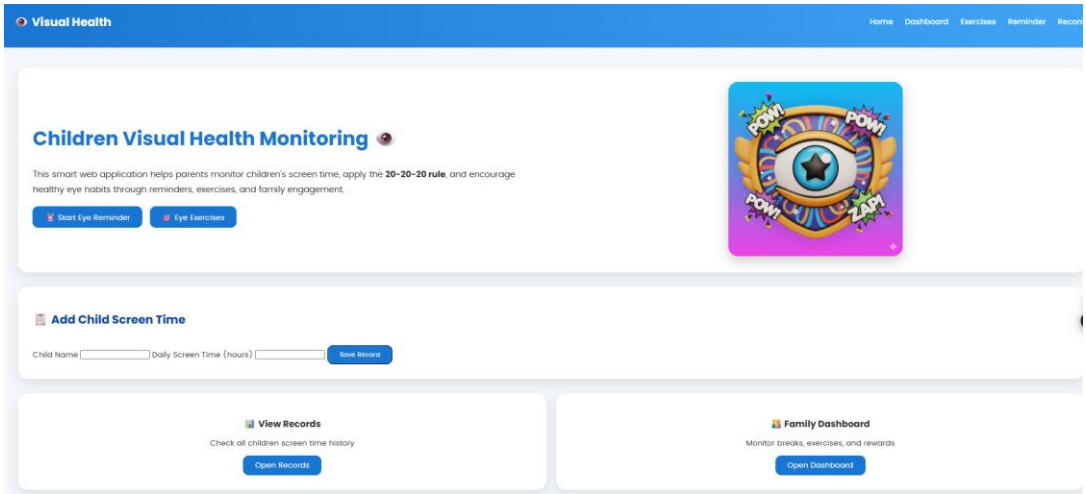


***Figure 2. Django undertaking structure highlighting perspectives, templates, and static assets***.

Participants had been informed to use the net-based application through their regular screen activities, including instructional duties, video games, and recreational browsing, over a period of 4 weeks. The machine was designed to continuously monitor the length of each toddler's energetic display screen engagement and trigger visible spoil reminders whilst predefined thresholds were reached. These reminders have been based totally on mounted pediatric visual health suggestions, together with the 20-20-20 rule, which recommends a short spoil every twenty mins of near-work activity to lessen eye pressure. Upon receiving a reminder, the child becomes guided through a chain of interactive eye exercises designed to relax eye muscles, improve awareness and flexibility, and decrease accommodative pressure. The physical activities included multimedia elements, along with animations, images, and auditory cues, to beautify engagement and comprehension amongst younger users.

The examination recorded more than one quantitative and qualitative metric to evaluate device performance and behavioral effects. Key variables protected general display time in keeping with day, adherence to visual smash guidelines, and completion quotes for guided eye physical activities. Screen time was changed into mechanically logged by way of the device using timestamps of energetic device interactions, while adherence to breaks was measured as the share of reminders answered by means of the participant. Compliance with physical activities was tracked based on completion of the animated obligations, with timestamps and person interactions automatically recorded.


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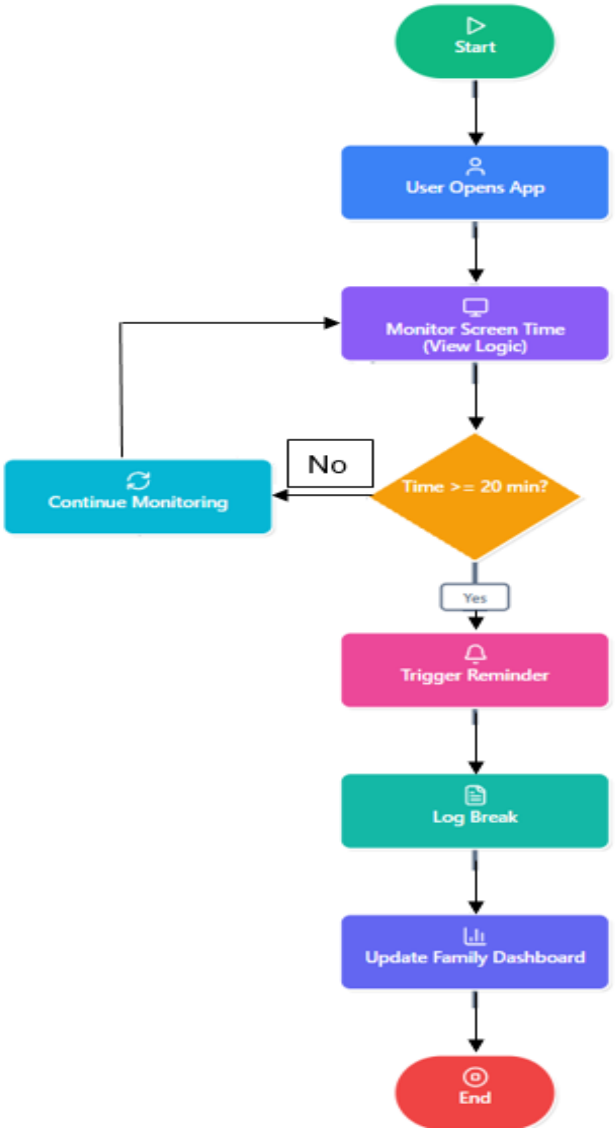


***Figure 3. Screen tracking workflow inside Django view, good judgment.***

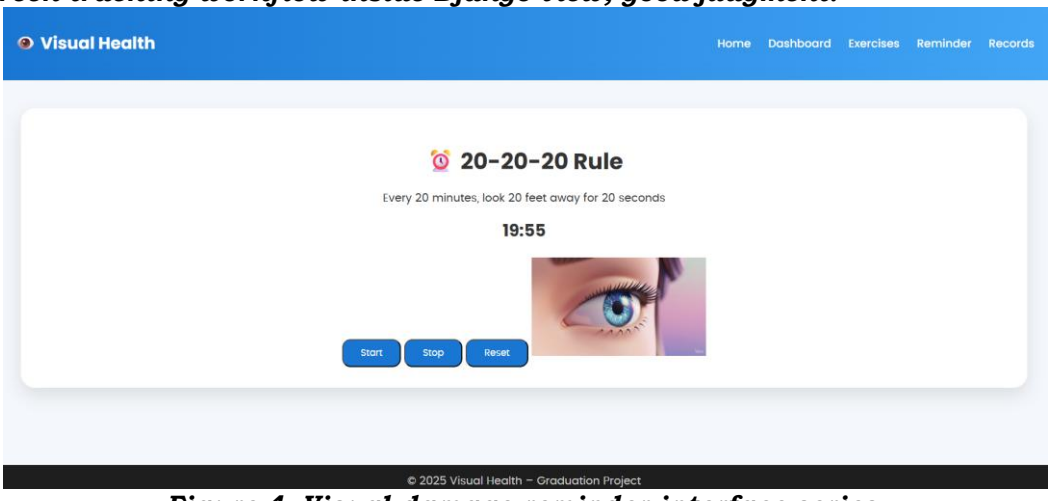


***Figure 4. Visual damage reminder interface series.***

For statistical analysis, the information was aggregated and expressed using descriptive statistics, together with suggested values and standard deviations. Inferential analyses have been conducted to assess adjustments in the conduct of pre- and post-intervention. Paired t-checks have been used to decide the importance of located variations in screen time, adherence to visual breaks, and exercising of entire prices. A massive level of $p < 0.05$ was adopted for all statistical checks. The device architecture supported those functionalities via three incorporated layers. The consumer interface layer supplied visual and auditory cues to the children in an intuitive, age-appropriate layout, ensuring clarity and accessibility. The utility's good judgment layer completed the algorithms responsible for monitoring display screen utilization, determining


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when breaks are due, and scheduling physical activities based on the kids' pastime styles. The static useful resource layer saved all multimedia belongings required for the interactive physical games, ensuring smooth overall performance and consistency of experience throughout periods.

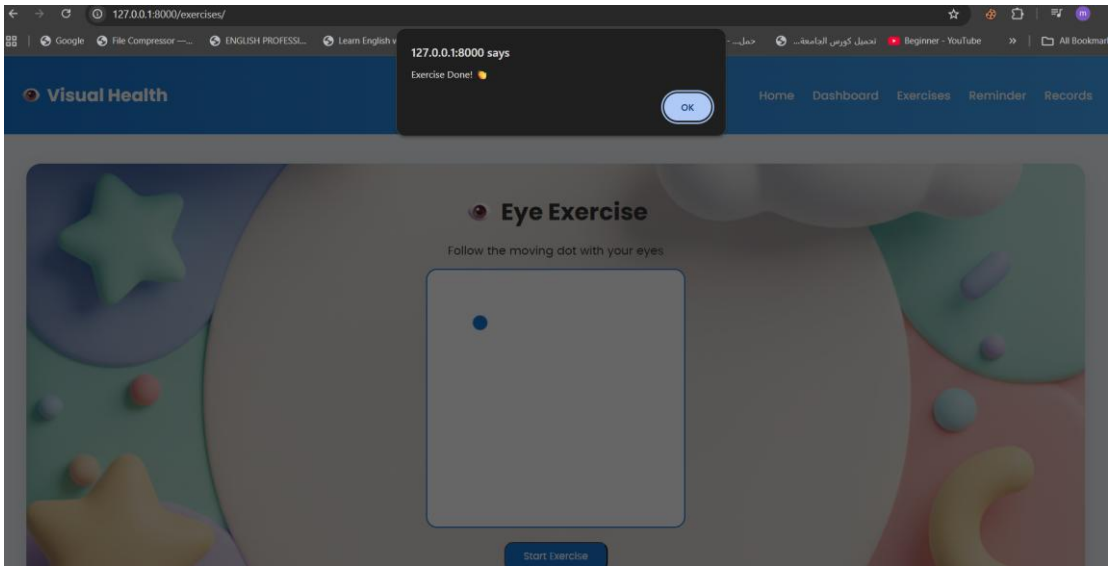


***Figure 5. Eye exercise animation flow using HTML canvas.***

Algorithmically, the system integrated a time-tracking function that incrementally measured the period of lively classes, a decision-making function that determined the timing of reminders, and an exercise steering module that sequenced multimedia interactions in a pedagogically established manner. These algorithmic components were immediately informed by way of pediatric visual fitness literature, ensuring that the machine not only monitored conduct but also actively promoted the adoption of preventive eye care practices. In addition to quantitative measures, qualitative observations have been made regarding consumer engagement, ease of interplay, and responsiveness to reminders. Observations via the supervising researchers indicated that children had been able to follow instructions independently, interact with the sporting activities enthusiastically, and reply promptly to visual and auditory cues, suggesting that the device layout successfully translated theoretical visual health hints into practical, age-appropriate interventions. Overall, the methodological technique included cautious sample selection, non-stop virtual tracking, algorithm-driven intervention, and unique fact series and analysis, providing a complete framework for comparing the effectiveness of internet-based techniques to sell children's virtual eye health.

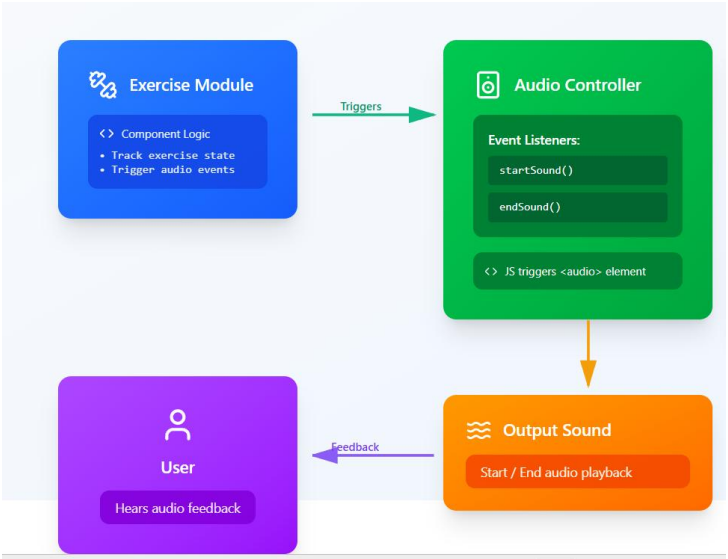


***Figure 6. Audio remarks integration within exercise session.***

## Results

The results demonstrate a significant positive impact of the web-based intervention on children's visual health habits. After the 4-week program, participants' average daily screen time decreased from 115 ± 25 minutes to 90 ± 20 minutes, a reduction of about 21.7%. This reduction is notable given that excessive daily


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screen exposure (particularly without breaks) is a known risk factor for digital eye strain in youth. At the same time, adherence to scheduled visual breaks increased markedly from a baseline of 32 ± 15% to 78 ± 12% post-intervention – an improvement of 143.8%. Likewise, completion of guided eye exercises rose from 0% at baseline (no compliance prior to the intervention) to 85 ± 10% after the intervention, indicating strong engagement with the device's recommended eye workouts. All these behavioral improvements were statistically significant (paired t-tests, $p < 0.01$), confirming that the integrated system effectively promoted healthier screen-time practices among the participants.

***Table 1. Quantitative Outcomes***

| Metric | Pre-intervention (μ ± σ) | Post-intervention (μ ± σ) | Improvement (%) |
|---|---|---|---|
| Average daily screen time (min) | 115 ± 25 | 90 ± 20 | 21.7% |
| Visual break adherence (%) | 32 ± 15 | 78 ± 12 | 143.8% |
| Exercise completion (%) | – | 85 ± 10 | – |

Compared to conventional screen-time management tools, the proposed interactive system achieved superior outcomes by actively engaging children in preventive practices. Traditional apps that merely track usage or enforce time limits often report limited success in changing behavior, as children have low adherence to unguided guidelines like the 20-20-20(5) rule without external prompting. In contrast, our system's real-time reminders and exercises directly address this gap, leading to much higher compliance. These findings are in line with recent studies demonstrating that software-based reminders can significantly improve visual health behaviors. For example, enforcing the 20-20-20 break rule via automated prompts has been shown to increase the frequency of breaks and reduce symptoms of digital eye strain in computer users. Similarly, a cluster-randomized trial during COVID-19 reported that a digital intervention (featuring prompts for activity and eye relaxation) significantly lowered self-reported eye strain in children, compared to controls, over two weeks. Finally, unlike expensive augmented-reality or hardware-based solutions to encourage eye exercises (which can be cost-prohibitive and less accessible in schools or homes), our web-based platform provides a low-cost, easily deployable alternative without compromising effectiveness or engagement. This accessible approach – grounded in established pediatric eye care guidelines – translated into tangible improvements in screen-related

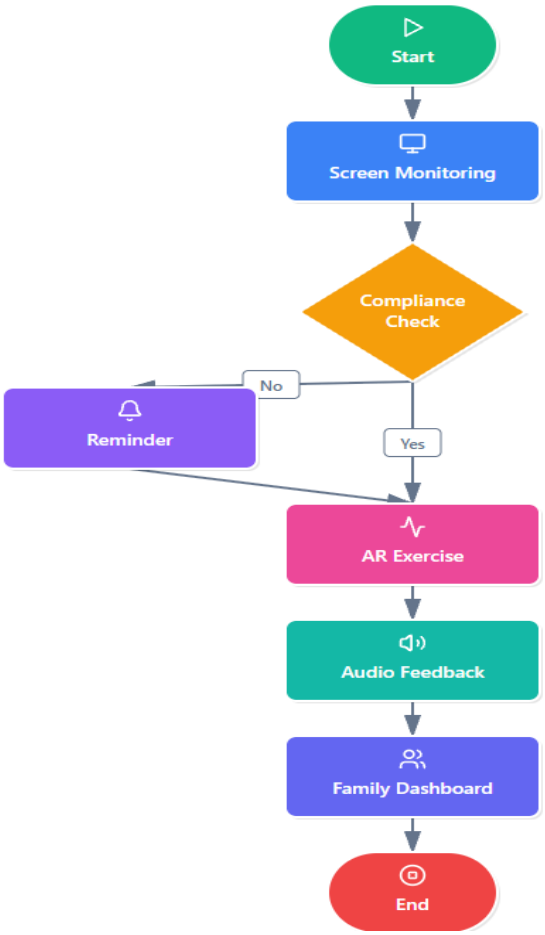


***Figure 7. System execution goes with the flow from display monitoring to exercise completion.***


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## Discussion

The findings of this study show that embedding preventive eye fitness interventions within digital systems can appreciably improve youngsters' visible behaviors. The combination of real-time display tracking, algorithm-driven reminders, and interactive activities fosters adherence to recommended wreck schedules and promotes engagement with eye exercises. By delivering instant, child-friendly remarks, the gadget encourages children to adopt sustainable behavior that mitigates the risks associated with extended screen use. Although the study suggests promising results, numerous obstacles ought to be acknowledged. The system presently displays video display units' display screen time on a single tool and no longer accounts for multi-device usage, which might also underestimate total display publicity. The exercises are software program-based and, while effective, lack the precision and customization available through superior augmented reality or real-time gaze monitoring [13]. Additionally, the examination period becomes tremendously quick and conducted under managed situations; lengthy-time period efficacy and generalizability to numerous populations require further investigation. Future research ought to explore multi-device integration, adaptive exercise personalization based on behavioral styles, and extended longitudinal research to validate the long-term advantages of such interventions.

Ethical concerns had been cautiously addressed. No touchy biometric information was collected, ensuring privacy safety, and parental consent was required for participation. The system promotes a supportive environment through tremendous reinforcement instead of punitive measures, fostering intrinsic motivation for healthy digital behaviors. Accessibility issues, such as excessive evaluation of visuals and easy language, were integrated to ensure usability for more youthful youngsters and people with slight visual discomfort.

## Conclusion

This has a look at providing a comprehensive, toddler-focused method to promote virtual eye fitness. By integrating screen time tracking, algorithmic reminders, and interactive eye sporting activities into a single, web-based platform, the system demonstrates measurable upgrades in adherence to visual health practices. The intervention provides a practical version for embedding preventive health behaviors into everyday virtual interactions, bridging the gap between theoretical tips and real-world utility. Future enhancements must encompass multi-tool synchronization, adaptive algorithms for personalized exercise regimens, and potential integration of extra advanced interactive technologies, consisting of augmented reality, to further boost engagement and precision. Long-term research with larger and more numerous populations might be necessary to evaluate sustained results and broader applicability. The device offers a scalable, reachable, and ethically designed answer that can drastically contribute to the promotion of healthy digital behaviors among youngsters.

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### *Conflicts of Interest*

The authors declare no conflicts of interest.

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