MINDFULFLOW: AN AI-POWERED DIGITAL WELLNESS AND LIFESTYLE COMPANION

Project Reference No.: *49s_Be_6668*

College : Dr.Ambedkar Institute of Technology, Bengaluru
Branch : Department of Computer Science and Engineering
Guide(s) : Prof. Asha Ranki K P
Dr. Gowrishankar S
Student(s) : Mr. Benak Kishan J
Mr. C Dhanush
Ms. Basaveshwari Malipatil
Ms. Akshatha M D

Keywords:
Digital well-being, IoT, blink detection, posture monitoring, artificial intelligence.

Introduction:

Spending excessive time with digital devices, coupled with a forward-head posture (FHP) and reduced blink frequency, poses a critical public health risk, leading to severe musculoskeletal strain and chronic eye fatigue. The pervasive proliferation of mobile handheld devices has precipitated an unprecedented convergence of multi-systemic physiological and neuro-psychological stressors. With global average daily screen time exceeding six hours and 38 minutes, users frequently adopt extreme cervical flexion angles that impose a heavy gravitational load on the developing spine. Existing health-monitoring paradigms and traditional wellness applications fail to adequately mitigate these issues, as they remain limited to passive, quantitative temporal tracking and ignore the qualitative biological cost of digital engagement. To address this diagnostic gap in preventative digital health management, there is a critical requirement for a synchronized, AI-driven framework. MindfulFlow uses AI, computer vision, and IoT sensors to monitor device usage time, blink rate, and posture to understand digital behavior. Unlike manual input methods, this system instantly responds to user actions, making wellness guidance more precise and supportive across personal and professional environments.

Objectives:

1. **Non-Intrusive Eye and Posture Monitoring:** Implement camera-based blink-rate detection using ML Kit and an IoT smart cushion with Force Sensitive Resistors (FSRs) to unobtrusively track eye fatigue and sitting posture without requiring wearable devices.
2. **Digital Habit and Screen-Time Tracking:** Provide a user-friendly mobile interface for logging screen-time, mood, and productivity levels, enabling users to gain awareness of their digital habits and behavioral patterns.
3. **Integrated Safety and Wellness Alerts:** Analyze eye-blink frequency, posture imbalance, and prolonged screen usage to trigger timely recommendations and alerts that encourage healthier digital behavior and prevent strain.

4. **AI-Generated Personalized Insights:** Utilize the Google Gemini API to transform collected data into meaningful daily wellness summaries, offering personalized suggestions for eye care, posture correction, and balanced technology use.
5. **Comprehensive Analytics and Visualization:** Develop an interactive analytics dashboard that visualizes trends in blink rate, posture patterns, and screen-time habits, helping users understand long-term behavioral impacts.
6. **Guided Wellness Exercises:** Include structured routines for eye relaxation and posture improvement, ensuring users can take corrective action based on the insights generated.

Methodology:

- **Eye and Posture Data Collection:** Utilize the smartphone camera for blink-rate estimation using ML Kit and gather posture data through an IoT-based smart cushion equipped with FSR sensors to continuously monitor user eye health and sitting balance.
- **AI and Wellness Analytics Integration:** Use the Google Gemini API to analyze blink trends, posture patterns, and screen-time behavior, generating personalized wellness insights, summaries, and recommendations.
- **Mobile Application Development:** Develop a cross-platform mobile application using React Native and Expo, enabling users to log screen-time, view real-time sensor feedback, access wellness exercises, and track analytics through a clean and intuitive interface.
- **IoT Communication and Cloud Connectivity:** Transmit posture-sensing data from the ESP32-based cushion to ThinkSpeak and store user logs, blink-rate values, and wellness reports in Firebase Firestore for synchronized access within the app.
- **Testing and Validation:** Conduct iterative testing of blink detection accuracy, sensor stability, app performance, and AI-generated insights to refine thresholds, improve reliability, and ensure effective real-world digital wellbeing support.

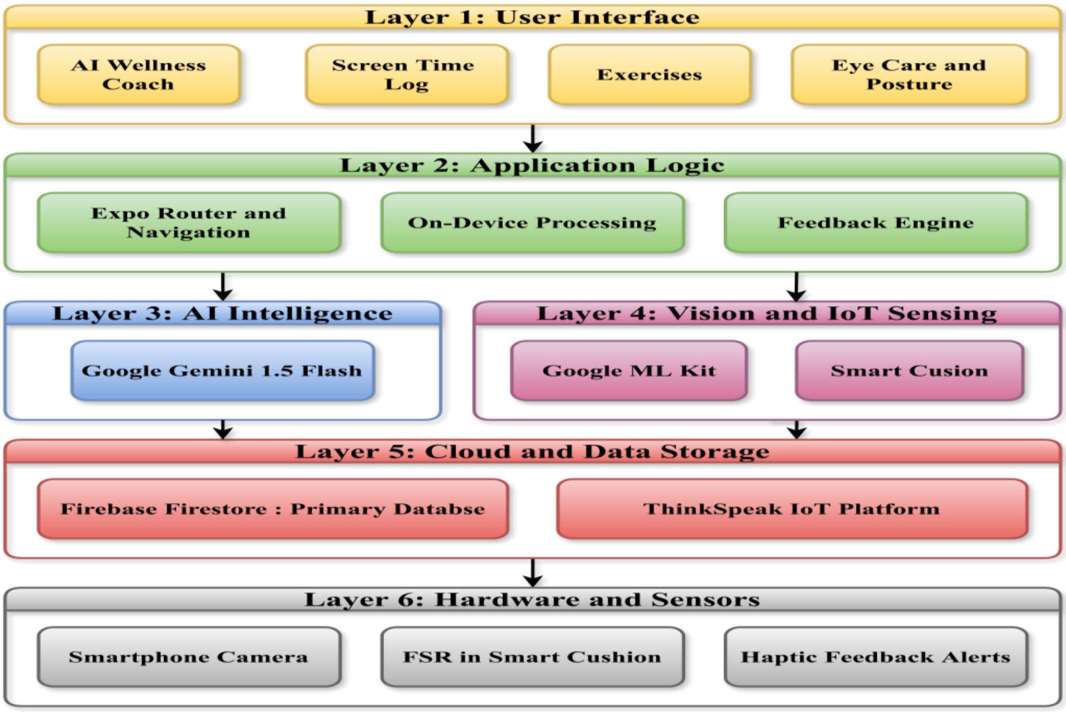

Figure 1: System Architecture

Result and Conclusion:

A live functional pilot evaluation was conducted in natural desk-working environments to assess the real-world viability of the MindfulFlow framework. The system accurately detected blinks and analyzed posture with high dependability, achieving high observational success rates across all modules. Specifically, Google ML Kit served as the core vision engine for the framework, successfully driving both Blink Detection (achieving a 95.0% success rate) and Posture/Slouch Classification via Euler X angle tracking (achieving an 89.0% success rate) on a dataset of 100 instances. Alongside these metrics, the system effectively monitored screen time, revealing observable associations between extended screen usage, reduced blink frequency, suboptimal posture, and user-reported fatigue. These findings confirm that the integration of Google ML Kit's lightweight edge processing with low-cost IoT sensors yields highly effective behavioral monitoring. MindfulFlow effectively tracks user behavior in real time and delivers reliable guidance for digital well-being.

References:

1. [1] Zhu, W.; Liu, J.; Lou, H.; Mu, F.; Li, B. Influence of Smartphone Addiction on Sleep Quality of College Students: The Regulatory Effect of Physical Exercise Behavior. PLoS ONE 19(7): e0307162. https://doi.org/10.1371/journal.pone.0307162
2. [2] Abdel Wahed, S., et al. (2024). AI-Driven Digital Well-being: Developing Machine Learning Model to Predict and Mitigate Internet Addiction. Latia Journal of Artificial Intelligence, 2(1), 1-15. https://doi.org/10.62486/latia202573(ResearchGate)
3. [3] León - Figueroa, D. A., Barboza, J. J., Siddiq, A., Sah, R., Valladares-Garrido, M. J., Adhikari, S., Aguirre-Milachay, E., Sah, S., & Rodriguez- Morales, A. J. (2024). Prevalence of Computer Vision Syndrome During the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. BMC Public Health, https://doi.org/10.1186/s12889-024-17636-5
4. [4] Thanalakshmi, S., Geethamahalakshmi, G., Azath, H., Prabu, K., Kumanan, T., & Srinivasan, C. (2025). Intelligent Eye Strain Relief Glasses using IoT and Naive Bayes Solutions for Digital Wellness. In 2025 International Conference on Emerging Systems and Intelligent Computing (ESIC), Bhubaneswar, India. IEEE. https://doi.org/10.1109/ESIC64052.2025.10962598
5. [5] McMonnies, C. W. (2025). The pervasive contributions of blink inefficiency to dry eye disease and computer vision syndromes. Expert Review of Ophthalmology, 20(1), 41–54. https://doi.org/10.1080/17469899.2024.2407618
6. [6] Oikawa, D., Manabe, Y., & Yata, N. (2025). Development of an emotion prediction system combining eye tracking and blink detection. In Proc. SPIE 13510, International Workshop on Advanced Imaging Technology (IWAIT) 2025, 135100V. https://doi.org/10.1117/12.3057917C.
7. [7] Graumüller, N., Gis, C., Geiger, F., Soodmand, I., Kebbach, M., Bader, R., Haubelt, C., & Grützmacher, F. (2025). Towards Human Posture Detection Based on Differential Measurements Using Wearable Barometric Pressure Sensors. In Proceedings of the 18th International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2025), Vol. 1, pp. 1002–1011. https://doi.org/10.5220/0013273000003911

8. [8] Rane, M., Mohole, S., Pahade, Y., Kurandale, G., & Munjale, A. (2025). SmartPosture: Real-Time Posture Detection and Feedback System Integrating IoT and Machine Learning. IEEE, 1–6. https://doi.org/10.1109/icaet63349.2025.10932211
9. [9] Tlili, F., Haddad, R., & Bouallegue, R. (2024). SPLIGN: Smart-belt Posture Monitoring System Based on AI-algorithms for Sitting Persons. International Journal of Advanced Engineering and Management Research, 9(02), 86–113. https://doi.org/10.51505/ijaemr.2024.9207
10. [10] Keles, B., McCrae, N., & Grealish, A. (2020). A systematic review: The influence of social media on depression, anxiety and psychological distress in adolescents. International Journal of Adolescence and Youth, 25(1), 79–93. https://doi.org/10.1080/02673843.2019.1590851

Future Scope:

The future scope of this project includes:

1. Investigate advanced deep learning architectures, such as hybrid CNN-Transformer models, for finer-grained analysis of posture dynamics and pressure patterns based on expanded datasets.
2. Incorporate supplementary physiological modalities (e.g., heart-rate variability or skin conductance via wearables) to enrich wellness insights.
3. Scale the system into comprehensive corporate wellness programs and ergonomic office designs to address the physical and psychological challenges posed by excessive device use in workforces.
4. Develop specialized parental control features tailored for mitigating long-term physiological risks in developing children.