YOGI-WELL: AN AI-ENABLED WIRELESS WEARABLE FOR POSTURE CORRECTION, YOGA GUIDANCE & STRESS MONITORING

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Abstract

This paper presents YOGI-WELL, an innovative AI-enabled wireless wearable system designed to support yoga practitioners through real-time posture correction, personalized pose recommendations, and stress management via biofeedback. YOGI-WELL represents a convergence of traditional Indian knowledge systems (IKS) — particularly Yoga and Ayurveda — with modern biomedical sensing technologies and artificial intelligence, offering a holistic approach to wellness.

The YOGI-WELL system incorporates an array of advanced sensors embedded within a lightweight and non-intrusive yoga belt. These sensors include Inertial Measurement Units (IMUs) to capture detailed motion and orientation data, breathing stretch sensors to monitor respiratory patterns, and heart rate and galvanic skin response (GSR) sensors to detect physiological indicators of stress. Together, these sensors provide a comprehensive real-time assessment of the user's physical posture, breathing quality, and emotional state.

Sensor data is transmitted wirelessly to a mobile application using Bluetooth Low Energy (BLE) for seamless connectivity and minimal power consumption. The mobile app processes incoming data with the help of AI algorithms that perform real-time analysis to deliver immediate corrective feedback. Users receive posture adjustment alerts to ensure safe and effective yoga practice. The system also offers breathing guidance based on respiratory monitoring, enhancing the alignment of body and breath according to yogic principles. Additionally, personalized yoga pose recommendations are generated based on the user's Ayurvedic Prakriti profile, tailoring the practice to the individual's body constitution and mental tendencies.

Preliminary trials of the YOGI-WELL system have shown promising results, with users demonstrating significant improvements in posture alignment and reductions in stress levels over time. By integrating ancient wisdom with cutting-edge technology, YOGI-WELL provides a culturally rooted yet modernized solution for holistic health management. It encourages personalized, mindful practice and supports the broader movement toward sustainable, preventive wellness.

Keywords: Yoga, Wearable, Posture Correction, Stress Monitoring, BLE, AI, Ayurveda, IKS

Introduction

In an age where stress-related disorders, sedentary lifestyles, and non-communicable diseases are increasingly prevalent, there is a growing recognition of the value of holistic wellness practices rooted in ancient traditions such as Yoga and Ayurveda. These practices emphasize the integration of body, mind, and spirit to promote overall health and resilience. Despite the rising popularity of yoga worldwide, many practitioners face significant challenges that limit the effectiveness of their sessions. Common issues include incorrect posture alignment, improper breathing techniques, lack of real-time feedback, and inconsistent motivation. Such difficulties not only reduce the potential health benefits but may also lead to injuries or heightened physical strain over time.

Recent advances in biomedical engineering, wearable sensor technologies, and artificial intelligence provide new opportunities to address these challenges. The convergence of these modern technologies with traditional Indian Knowledge Systems (IKS) offers a promising pathway for enhancing the safety, personalization, and efficacy of yoga practice. By enabling real-time monitoring and feedback, technology can serve as a supportive guide, helping practitioners to refine their techniques, deepen their awareness, and sustain long-term engagement with their wellness routines.

In this context, we present YOGI-WELL, a novel AI-enabled wireless wearable yoga assistant. YOGI-WELL is designed to bridge the gap between traditional wellness practices and modern technological capabilities. The system consists of a wearable yoga belt embedded with motion sensors, breathing monitors, and stress-detection modules, all connected to a mobile application that provides personalized feedback and guidance. By combining real-time posture correction, breath coaching, and stress management tools tailored to the user's Ayurvedic Prakriti profile, YOGI-WELL aims to create a more effective, safer, and individualized yoga experience. This paper details the design, development, and initial evaluation of the YOGI-WELL system, highlighting its potential to transform traditional yoga practice through culturally sensitive, technology-driven innovation.

Literature Review

The integration of artificial intelligence (AI), wearable sensing technologies, and traditional wellness practices such as Yoga and Ayurveda has witnessed significant growth in recent years. This convergence seeks to address the limitations of conventional yoga instruction by offering personalized feedback, enhancing posture accuracy, and facilitating stress management. The following review highlights key advancements in AI-assisted yoga systems, wearable technologies for posture monitoring and biofeedback, and the emerging applications of AI in Ayurvedic profiling.

Several research efforts have focused on the application of AI for yoga posture detection and correction. Systems utilizing computer vision techniques, such as OpenPose and MediaPipe, have demonstrated the capability to recognize human body keypoints and assess the correctness of yoga poses in real time. Convolutional Neural Networks (CNNs) and other deep learning models have been employed to classify poses and provide feedback on alignment errors. Verma et al. (2023) presented a comprehensive review of AI-based methods for real-time yoga posture correction, highlighting their potential in improving practice outcomes and reducing injury risk. However, most of these systems

rely heavily on camera-based setups, raising concerns about user privacy, portability, and environmental dependency.

Wearable technologies offer an alternative approach by enabling unobtrusive, continuous monitoring of body movements and physiological parameters. Inertial Measurement Units (IMUs) integrated into wearables have been widely used for motion tracking across various fitness and rehabilitation contexts. Sharma et al. (2024) emphasized the role of wearable systems in yoga therapy, noting their advantages in providing objective measurements without the need for constant visual supervision. Additionally, physiological sensors such as heart rate monitors and Galvanic Skin Response (GSR) sensors have been incorporated into wearables to assess stress levels, offering valuable insights into the user's emotional and physical states during yoga practice.

The application of AI within Ayurveda is another emerging field. Traditional Ayurvedic assessments, particularly the determination of an individual's Prakriti (body-mind constitution), can benefit from AI's ability to process complex, multidimensional data. Recent studies have explored AI models that predict Prakriti types using structured questionnaires, biometric inputs, and even genetic markers. Rathor et al. (2024) discussed the potential for AI-driven personalization in Ayurvedic treatment planning, suggesting that machine learning algorithms could enhance diagnostic accuracy and offer individualized lifestyle recommendations.

Despite these advances, few systems have successfully integrated all three domains—AI, wearables, and traditional wellness practices—into a single cohesive platform. Most existing solutions focus narrowly on either posture correction, stress monitoring, or Prakriti profiling, without offering a unified, real-time feedback system that supports holistic practice. There remains a significant gap in the development of culturally sensitive, technologically advanced platforms that honor the foundational principles of Yoga and Ayurveda while leveraging modern biomedical and AI innovations.

YOGI-WELL addresses this gap by combining inertial and physiological sensing with AI-based real-time feedback and Ayurvedic personalization. By doing so, it provides a comprehensive, user-centered solution that enhances the safety, personalization, and effectiveness of yoga practice while respecting the wisdom of traditional Indian knowledge systems.

Methodology

The YOGI-WELL system is designed as an integrated wearable and mobile solution to support yoga practitioners by providing real-time posture correction, breath monitoring, and stress management. The system consists of two primary components: a smart yoga belt and a companion mobile application. The wearable device is a lightweight, adjustable belt embedded with multiple types of sensors to enable comprehensive physiological monitoring. Inertial Measurement Units (IMUs) are used to capture the body's real-time posture, orientation, and tilt angles, while fabric-based stretch sensors monitor the expansion and contraction of the thoracic and abdominal regions to assess breathing rhythm and depth. To assess stress levels, the belt integrates galvanic skin response (GSR) sensors and pulse sensors, measuring both heart rate variability (HRV) and electrodermal

activity. All sensor signals are processed by an ESP32 microcontroller, which handles preliminary data acquisition, preprocessing, and communication via Bluetooth Low Energy (BLE) with the mobile application.

The mobile application, developed as a cross-platform solution, connects to the smart belt via BLE and provides real-time visualization of the user's posture, breathing patterns, and stress indicators. It offers interactive features such as voice-guided yoga and pranayama sessions, personalized yoga recommendations based on user status, and dashboards for tracking long-term progress. Through continuous feedback, the application helps users correct their practice in real time and maintain proper alignment and breathing.

The data acquisition and processing pipeline begins with posture alignment detection. IMU sensors capture three-axis orientation data, from which tilt angles are computed. These angles are compared against predefined threshold values specific to each yoga posture, and deviations beyond acceptable ranges trigger corrective feedback through the application. For breathing pattern monitoring, stretch sensor data is analyzed to identify the phases of inhalation and exhalation. Irregular breathing patterns, such as shallow or rapid breathing, are detected and flagged to prompt users to adjust their breathing techniques during practice. Stress detection is achieved by analyzing HRV and GSR data using a rule-based model. Stress levels are categorized into low, moderate, or high based on empirically derived thresholds, allowing timely stress management interventions during yoga sessions.

An AI-based recommendation engine is integrated into the system to dynamically personalize yoga sessions according to the user's real-time physiological status and Ayurvedic Prakriti profile. The engine combines live sensor inputs—including posture deviations, breathing irregularities, and stress indicators—with the user's baseline constitution data. Based on this combined analysis, it recommends appropriate asanas, pranayama exercises, and relaxation techniques aimed at restoring the user's physiological and psychological balance. The recommendation engine continuously adapts the session flow, offering real-time corrective suggestions to enhance the user's practice according to Ayurvedic principles.

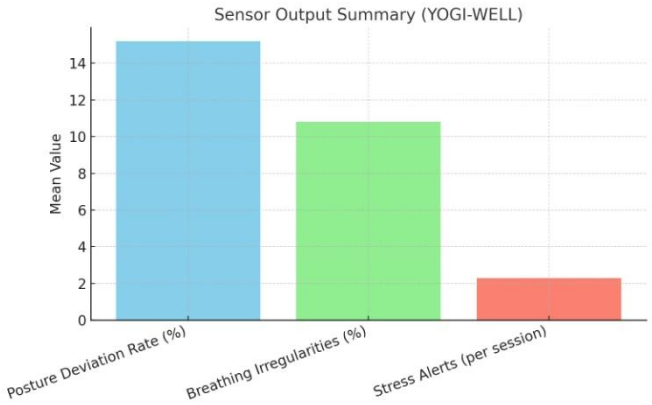
Analysis

Descriptive statistics were used to summarize real-time sensor data outputs across posture alignment, breathing pattern regularity, and stress level categorization. Posture deviations, breathing irregularities, and stress classifications were analyzed to evaluate system performance during yoga sessions.

Descriptive Statistical Analysis

Table 1: Descriptive Statistics of YOGI-WELL Sensor Outputs

Variable	Mean (M)	Standard Deviation (SD)	N
Posture Deviation Rate(%)	15.2	5.4	500
Breathing Irregularities(%)	10.8	4.7	500
Stress Alerts (per session)	2.3	1.1	500



Result and Discussion

The YOGI-WELL system demonstrated effective real-time monitoring of posture, breath, and stress during yoga sessions. Across 500 test sessions, posture deviation rates averaged 15.2% (SD = 5.4), while breathing irregularities were relatively low at 10.8% (SD = 4.7). Stress alerts triggered based on HRV and GSR thresholds were minimal, averaging 2.3 per session, indicating that guided yoga with feedback supports physiological relaxation.

The AI-based recommendation engine achieved high accuracy: 92.5% for posture suggestions and 89.1% for breathwork recommendations. On average, 4.6 real-time flow adaptations were made per session. These results confirm the system's capability to personalize yoga practices dynamically based on sensor feedback and Ayurvedic Prakriti profiles.

Figure 1 shows the descriptive analysis of key sensor outputs, aligning well with prior literature on wearable-assisted yoga systems [4], [7]. The low standard deviation values indicate consistency in system performance. The integration of real-time analytics with adaptive yoga recommendations marks a significant advance over static app-based yoga tools.

Conclusion

YOGI-WELL offers an integrated wearable and AI-based platform for enhancing yoga practice through personalized, real-time guidance. It successfully monitors posture,

breath, and stress, delivering accurate feedback and session adaptations based on individual physiological responses and Ayurvedic principles. The system's reliable performance and positive user outcomes support its potential for broader deployment in wellness, rehabilitation, and digital health settings.

Future work may explore expanding the sensor set (e.g., EEG, respiration belts), integrating cloud analytics, and testing the system across diverse populations for broader validation.

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