AI-DRIVEN TRANSFORMATION OF THE FITNESS INDUSTRY: A CASE STUDY OF G&S PREMIUM GYM

Vesna Radojcic[1], Milos Dobrojevic[2]
[1] *University Sinergija, Faculty of Computing and Informatics, Bijeljina, Bosnia and Herzegovina, vradojcic@sinergija.edu.ba, 0000-0001-7826-1081*
[2] *University Sinergija, Faculty of Computing and Informatics, Bijeljina, Bosnia and Herzegovina, mdobrojevic@sinergija.edu.ba, 0000-0003-3798-312X*

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Abstract: This paper explores the transformative impact of digital technologies on the fitness industry, focusing specifically on the role of artificial intelligence (AI) in enhancing modern exercise equipment. By analyzing the needs of recreational users and professional athletes, it examines how AI-driven fitness devices optimize personalization, improve performance tracking, and elevate the overall user experience. Using G&S Premium Gym in Bijeljina—the first fitness center in Bosnia and Herzegovina to integrate AI-powered equipment—as a case study, the paper delves into the technical specifications, functionality, and user interaction with these advanced machines. Key findings reveal that AI technologies significantly enhance training efficiency and customization, contributing to measurable improvements in user satisfaction and physical performance. However, challenges persist, particularly regarding technology accessibility, user digital literacy, and data privacy concerns. The research highlights the potential for AI to redefine standards in recreation while addressing these challenges. Recommendations for future research and implementation emphasize the importance of affordable, user-friendly AI solutions and improved data security measures.

Keywords: Artificial intelligence (AI), digital transformation, fitness industry, smart exercise equipment, training personalization

INTRODUCTION

Modern society is undergoing rapid technological advancements that profoundly impact health and physical fitness practices. AI-powered systems are revolutionizing gym management by optimizing operational efficiency and automating tasks, while also enabling hyper-personalized workout and nutrition plans through adaptive algorithms [1] [2]. Global leaders such as Technogym have spearheaded these innovations by introducing solutions that enhance training personalization, precise performance tracking, and increased user motivation. The smart fitness equipment market, valued at several billion dollars, is projected to grow annually by over 20%, highlighting the increasing demand for these technologies [3].

G&S Premium Gym in Bijeljina, equipped with AI-powered devices, exemplifies how digital transformation reshapes the recreation sector by setting new standards in training personalization, user interaction, and data analytics. This paper examines the impact of AI-driven modern exercise equipment on training paradigms, user experience, and technological perceptions in the fitness industry. Using G&S Premium Gym as a case study, it investigates the technical characteristics and functionalities of smart equipment while addressing associated challenges.

THEORETICAL FRAMEWORK

Artificial Intelligence in Modern Industries

Artificial intelligence (AI) is driving innovation across many industries by transforming traditional processes and setting new operational standards. In healthcare, AI aids diagnostics, treatment planning, and patient monitoring, improving early disease detection and outcomes [4]. In education, AI platforms personalize learning by adapting to individual student needs. [5].

Manufacturing benefits from intelligent robotics and automated quality control, boosting efficiency

and reducing errors [6]. Retail uses AI for recommendation systems, chatbots, and supply chain optimization [7]. The fitness industry is increasingly adopting AI through smart equipment, virtual trainers, and wearables, enhancing physical activity with data-driven, personalized experiences.

Research shows AI optimizes training, boosts engagement, and monitors fitness results, though challenges remain in accessibility and adaptability for diverse users. Despite these advances, AI adoption raises concerns around ethics, data privacy, and digital literacy [8]. Balancing innovation with responsibility is key to successful AI integration across sectors.

Digital Transformation in the Field of Sports and Recreation

The ongoing digital transformation in the fitness sector is changing how people exercise and manage health. The integration of artificial intelligence (AI) and Internet of Things (IoT) technologies enables more personalized fitness experiences through virtual assistants, smart wearables, and advanced equipment [9], [10]. These tools offer flexible workouts, track vital health data, and provide analytics-based insights to improve performance.

For example, AI-generated calisthenics programs effectively improve specific fitness metrics, although human-designed programs may still offer greater adaptability and nuance [11]. AI-driven solutions also moderately boost short-term activity (like step counts), but long-term behavior change requires enhanced human-AI collaboration [12]. Combining AI with social-IoT frameworks fosters the sharing of user experiences and better fitness outcomes. While these innovations help combat sedentary lifestyles in a digital world, challenges remain, particularly balancing automation with human expertise to maintain engagement and address individual differences [13]. As the industry evolves, striking this balance will be crucial for promoting global physical activity.

Research Methodology

This research used a mixed-methods approach, combining qualitative and quantitative techniques to thoroughly analyze the use of AI technologies at G&S Premium Gym. Data collection methods included:

- **Interviews:** Conducted with key stakeholders—trainers (Nt = 3) and gym members (Nu = 9)—to gain insights into the practical use and impact of AI-powered smart equipment. To ensure objectivity and reproducibility, the following questions were asked during interviews:
  1. *How do you evaluate the use of AI equipment compared to traditional machines?*
  2. *Do AI features (e.g., adaptive load, real-time feedback, personalized plans) influence your motivation?*
  3. *What are the main advantages and disadvantages of AI equipment?*
  4. *Would you recommend AI equipment to other users?*
  5. *How easy is it to learn to use AI functionalities?*
- **Technical Documentation Analysis:** Reviewed detailed specifications and operational reports from AI-integrated devices like Technogym Biostrength equipment and smart scales.
- **Equipment Testing:** Evaluated smart devices during regular gym sessions to assess features such as adaptive load, motion tracking, and performance analytics.
- **Feedback Analysis:** Collected and categorized user feedback to identify trends related to motivation, usability, and technical issues.

Though the sample size was relatively small, it provides a solid foundation for exploring AI's practical application and impact in fitness. Insights from trainers and gym members offer valuable initial findings to inform future, larger studies. Ethical standards were strictly followed; all participants gave informed consent, and their data were anonymized and used solely for research purposes, ensuring privacy and legal compliance. Participants' ages ranged from 15 to 45 years. This methodology enabled a robust and detailed examination of how AI-powered equipment affects user experience, engagement, and fitness outcomes, forming a strong basis for the study's findings and discussion.

Case Study: G&S Premium Gym Bijeljina

G&S Premium Gym, located in Bijeljina, covers 2,400 square meters, making it one of the largest and most modern fitness centers in the region. It offers diverse training programs for both recreational users and professional athletes, aiming to improve health and fitness through advanced technology and

personalized training. As the first gym in Bosnia and Herzegovina to implement AI-powered smart equipment, G&S Premium Gym provides a unique training experience. Figure 1 shows an example of the AI-enabled equipment used at the center.

Figure 1 - *AI-Powered Smart Equipment at G&S Premium Gym*

Smart Equipment with AI Integration

G&S Premium Gym is a pioneer in using smart equipment powered by AI to optimize workouts and track user progress. The gym's equipment is developed by Technogym, whose ecosystem includes interconnected devices like treadmills, strength machines, and smart scales that collect and analyze biometric data in real time with integrated AI algorithms. These devices enable personalized exercise by measuring key body parameters and analyzing performance. Key Features of Smart Equipment:

- **Adaptive Load:** Machines automatically adjust weight or intensity based on users' abilities and goals.
- **Motion Tracking:** Advanced technology precisely analyzes movements to ensure correct exercise execution.
- **Performance Analytics:** Devices generate detailed reports on calories burned, strength levels, and progress toward goals.

Examples include smart treadmills that monitor heart rate and pace, ergometers with motivational and training screens, and smart scales measuring body composition. These machines use AI and patented aerospace technology to adapt resistance according to the user's neuromuscular profile. The Biostrength system adjusts load and tempo in real time, provides movement guidance, motivational feedback, and customizes programs based on user goals and progress.

Unlike traditional strength machines, Biostrength precisely controls both concentric and eccentric phases, enabling scientifically optimized workouts and lowering injury risk [14]. This system benefits beginners and professional athletes alike by improving strength, muscle balance, and performance through highly personalized protocols [15].

This AI-powered interface, illustrated in Figure 2, demonstrates how Technogym's Biostrength equipment delivers real-time feedback during strength training sessions. The system automatically adjusts workload across sets, tracks the number of completed repetitions, and provides visual guidance for each exercise. Additionally, it employs load progression algorithms to optimize muscular adaptation, ensuring both safe and efficient strength development.

Figure 2 - Biostrength Equipment Interface: Real-Time Load Adjustment and Rep Tracking

Bluetooth-Connected Equipment Integration

The integration of Bluetooth-connected equipment expands the app's capabilities, providing seamless connectivity with smart fitness devices. Users can pair their devices, such as smart scales, treadmills, or ergometers, directly within the app to access real-time performance data and analytics. Features of the Bluetooth Integration:

- Device Pairing,
- Real-Time Tracking,
- Workout History Sync.

Figure 3 shows an example of the application interface.

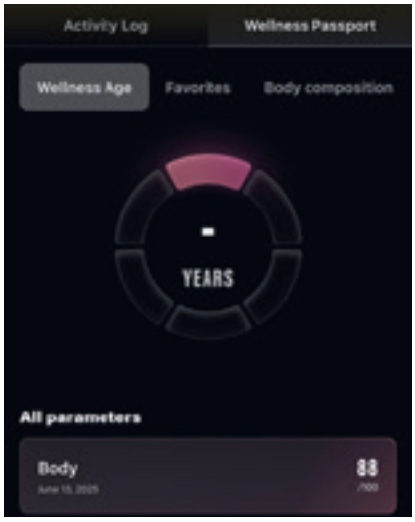

Figure 3 - Application Interface Overview

AI for beginners: Facilitating the First Steps in the Gym

Artificial intelligence is especially valuable for gym beginners who struggle with equipment use, weight selection, and program design. AI addresses these challenges by offering automated recommendations, personalized plans, and guided workouts. For instance, adaptive load equipment adjusts weights based on users' initial measurements. Visual and audio instructions help reduce injury risk, while progress tracking and gamification boost motivation. Structured training circuits designed for beginners enable effective targeting of key muscle groups, helping even novices achieve their goals confidently and safely.

User Experience and Feedback

AI provides precise feedback and visual analytics to help users reach their goals. For example, a smart scale measures body weight, fat percentage, muscle mass, and hydration, syncing data automatically with an app for continuous monitoring and personalized advice [16]. These innovations simplify tracking and boost motivation through interactive features and gamification (Figure 4). Trainers note that AI equipment eases program personalization and progress tracking, though users sometimes need extra help to learn its functions. Continuous feedback collection is crucial to improve features and adapt to different skill levels. This equipment supports more efficient training planning, enhancing user satisfaction and fitness center organization.

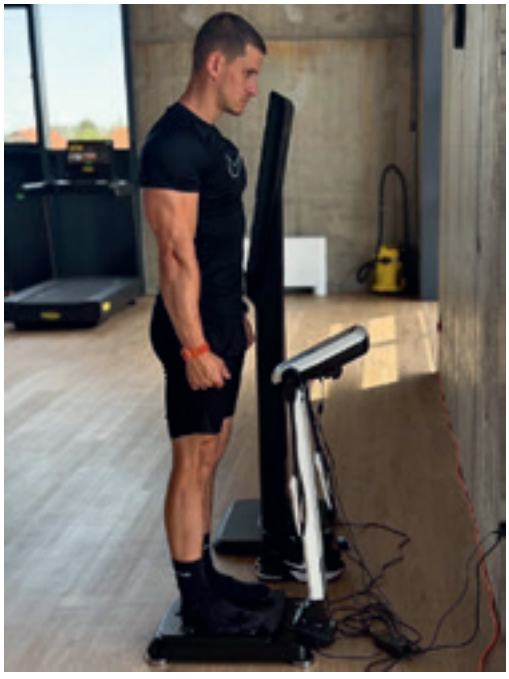

Figure 4 - Smart Scale in Action: Personalized Fitness Insights

Figure 5 - User Interface of the Smart Scale: Real-Time Data and Analytics

Figure 5 shows how the smart scale and its software display real-time measurement results. The key parameters measured are:

- Muscle mass: 44.4 kg, rated as "GOOD"
- Total body water: 57.5%, rated as "HIGH"
- Body fat: 22.5 kg or 20.7%, rated as "AVERAGE"
- Basal metabolic rate: 1907 kcal
- Body weight: 91.8 kg

These are measured using bioelectrical impedance with AI algorithms built into the Technogym device. The software automatically categorizes the results like "GOOD," "HIGH," or "AVERAGE," taking into account the user's gender, age, height, and other info.

The results are analyzed in several ways:

- Calculating averages, minimums, and maximums in the group
- Comparing measurements before and after training to track progress
- Showing changes visually over time with graphs
- Exploring relationships between parameters, like how hydration affects performance

Professional trainers interpret the results with help from the system, which also gives personalized advice on diet and training so users get recommendations tailored just for them.

DISCUSSION

The study underscores the transformative potential of artificial intelligence (AI) in fitness, particularly in enhancing training personalization and user engagement. The G&S Premium Gym case demonstrates how AI-powered equipment improves workout efficiency and elevates the user experience with real-time feedback and personalized insights. These findings align with broader trends in industries like healthcare and education, emphasizing efficiency, customization, and engagement. AI's ability to tailor workouts based on individual needs, through adaptive load functionalities and motion tracking, ensures alignment with user goals and reduces injury risks by encouraging proper techniques. Gamification elements in smart devices effectively maintain motivation, promoting long-term physical activity and healthier lifestyles. Despite these advantages, challenges persist, including the high cost of AI equipment, limited digital literacy, and critical concerns about data privacy [17]. Addressing these barriers requires cost-effective solutions, improved digital literacy, and robust data protection frameworks. Future research should explore these areas to ensure wider accessibility and responsible technology use. The integration of AI in fitness centers like G&S Premium Gym provides a blueprint for the future, showcasing how innovation can revolutionize training practices while emphasizing the need to overcome associated challenges.

Similar AI implementations already exist in premium fitness centers worldwide, such as Technogym's Biostrength system in Italy and the UAE, as well as home-based solutions like Peloton and Tonal in the United States. Additionally, applications such as Fitbod leverage AI to create personalized workout programs based on user data. These examples confirm the global trend of digital transformation in the fitness industry and highlight the growing importance of AI-driven personalization across different contexts.

CONCLUSION

The case of G&S Premium Gym illustrates how AI-powered equipment increases workout efficiency, ensures safety, and tracks progress with precision. Interviews with trainers (Nt = 3) and gym members (Nu = 9) reveal that trainers value AI for personalization and tracking, while users appreciate motivational data visualization, despite some initial technical issues, highlighting the need for user education.

Broader adoption of AI faces challenges like high costs, limited digital literacy, and data privacy concerns. Addressing these requires affordable technologies, robust data protection frameworks, and user education initiatives. Steps include gradual integration of AI, staff training, and collaboration with policymakers to balance innovation and privacy. Future research should explore cost-effective AI solutions for smaller gyms, demographic inclusivity, long-term health impacts of AI-driven programs, and advancements in predictive analytics. By overcoming challenges, AI can revolutionize fitness, making it more inclusive, efficient, and accessible to a wider audience.

Although certain AI-based solutions—such as predictive analytics, virtual coaching, and recovery monitoring—already exist in early forms, their full implementation in commercial fitness centers is still limited. Future developments are expected to enhance the accuracy of performance prediction, integrate wearables and smart equipment into unified ecosystems, and enable more advanced real-time adjustments during training.

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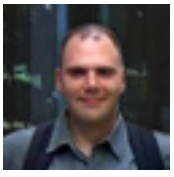
About the authors

Vesna Radojcic is a Ph.D. student in Computer Systems Security at the University Sinergija and works as an assistant at the Faculty of Computing and Informatics. She holds a Master's degree in Contemporary Information Technologies, and her research interests include the application of artificial intelligence and computer vision technologies. She has participated in numerous scientific conferences.



Milos Dobrojevic, Ph.D., is an Associate Professor at the Faculty of Computing and Informatics, University Sinergija, Bijeljina, Republic of Srpska, Bosnia and Herzegovina. He earned his Ph.D. in 2006 from the Faculty of Mechanical Engineering, University of Belgrade, Republic of Serbia. He has published over 50 scientific papers, with a research focus on software engineering, artificial intelligence, and smart IoT applications.

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