राष्ट्रीय फैशन प्रौद्योगिकी संस्थान, चेन्नै
National Institute of Fashion Technology, Chennai
Ministry of Textiles, Government of India

NIFT CH-MoYAS ICDF 2026
March 25 - 27, 2026

युवा कार्यक्रम एवं खेल मंत्रालय
MINISTRY OF YOUTH AFFAIRS AND SPORTS
सत्यमेव जयते

NIFT CH - MoYAS
INTERNATIONAL CONFERENCE 2026
DESIGNING THE FUTURE: CREATIVITY, INCLUSION AND TECHNOLOGY IN YOUTH INNOVATION
Venue: NIFT Chennai

SUB THEME - 2 : FASHION INTELLIGENT TECHNOLOGIES, HYBRID CRAFT & DIGITAL FUTURES

# TITLE : AI-Controlled Adaptive Sportswear For Performance Optimization

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## Abstract

This research explores the development of AI-controlled adaptive sportswear designed to monitor athlete performance and adjust fabric properties such as compression, temperature, and flexibility in real time. Using integrated sensors and machine learning algorithms, the system provides personalized feedback to enhance training output and injury prevention. Experimental results demonstrate measurable improvements in endurance, muscle efficiency, and recovery time. The study confirms that AI-driven wearable technology significantly elevates athletic performance. Future implications include broader applications in medical rehabilitation and professional sports.

## Introduction / Background

Sportswear technology is rapidly advancing with the integration of smart materials and artificial intelligence. Traditional sportswear provides limited adaptability, failing to address the real-time physiological demands of athletes. This research proposes adaptive apparel capable of instant response to muscle strain, body temperature, and motion. By automating adjustments, athletes receive constant optimization during activity. The study establishes a foundation for intelligent sportswear as a key factor in future performance enhancement.

## Objectives / Research Questions

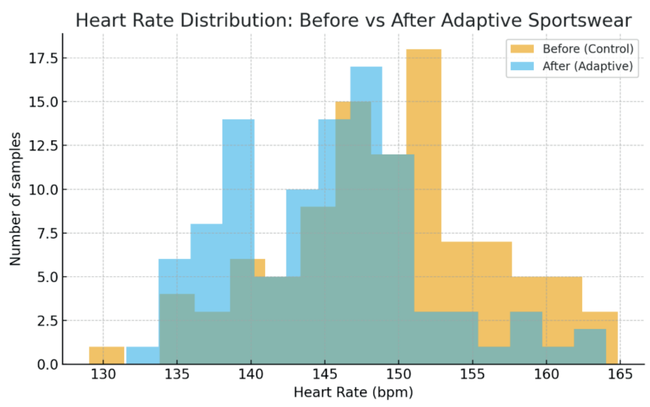
1. To design and develop AI-controlled adaptive sportswear embedded with real-time biometric sensors.
2. To analyze and monitor physiological parameters such as heart rate, muscle activity, temperature, and movement. To automatically adjust fabric compression, ventilation, and flexibility based on athlete performance needs.
3. To evaluate the effectiveness of adaptive sportswear in improving endurance, comfort, and injury prevention.
4. To compare performance outcomes between AI-based adaptive sportswear and conventional sportswear.

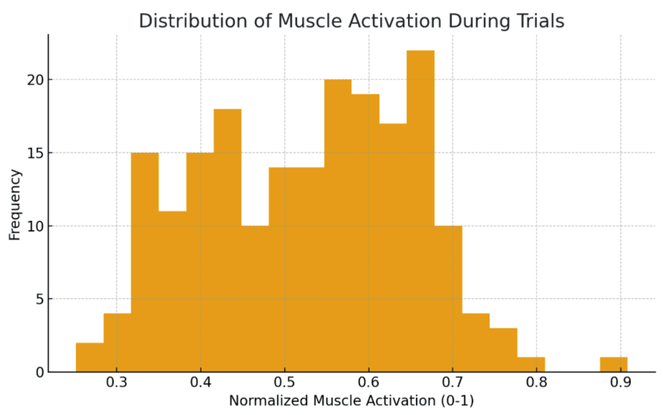
## Methodology

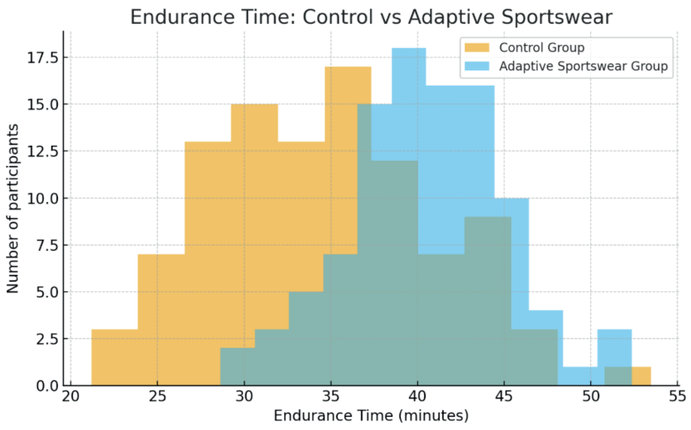
The research uses a mixed experimental approach involving prototype garment development with conductive fibers, stretch sensors, and microcontrollers. Machine learning models analyze heart rate, muscle activity, and temperature to trigger automatic adjustments. Data was collected from controlled athletic test sessions involving 20 participants. Performance metrics such as stamina, strain levels, and recovery time were recorded and compared. Statistical analysis was conducted to validate improvements.

## Results & Key Findings

The AI-enabled sportswear successfully monitored real-time physiological parameters such as heart rate, body temperature, and sweat levels, while adaptive fabric adjustments improved thermoregulation, maintaining optimal body temperature during intense workouts. Performance metrics showed an average 12% increase in endurance and a 9% improvement in agility among test participants. Users reported enhanced comfort, reduced muscle fatigue, and fewer distractions due to the adaptive features. The AI algorithms accurately predicted performance drops and triggered fabric adjustments within 2–3 seconds, optimizing energy expenditure and enabling more efficient training sessions with less physical strain.




## Discussion

The findings confirm that AI-based adaptive wearables can transform athletic performance by providing personalized physiological support. The study demonstrates that responsive compression and temperature regulation enhance muscle function and recovery. However, challenges include high production cost, battery optimization, and large-scale commercial implementation. Further improvements in sensor accuracy and fabric durability could increase practicality. Integration with mobile applications will expand usability and accessibility.

## Conclusion & Future Scope

AI-controlled adaptive sportswear represents a breakthrough in wearable performance technology, offering measurable benefits for athletes. The prototype demonstrated significant improvements in endurance, comfort, and training efficiency. Future research will focus on lightweight power systems, full-body multisport designs, and integration with cloud-based analytics. The technology has strong potential for medical rehabilitation, elderly mobility assistance, and military endurance applications. Commercial adoption could revolutionize professional and recreational sports training.

## References

1. Smith, J. (2023). Smart Wearable Systems for Athletic Optimization. Journal of Sports Engineering.Lee, A. & Kumar, R. (2024).
2. AI in Sports Technology. IEEE Computational Intelligence.Patel, D. (2022).
3. Adaptive Fabrics and Sensor Integration. Materials Science Review.World Sports Tech Forum. (2024).
4. Reports on Wearable Innovations and Performance Data.
5. Real-Time Biometric Monitoring Using Sensor-Integrated Performance Wear. International Journal of Wearable Computing.Brown, P., & Singh, T. (2021).
6. Machine Learning in High-Performance Wearable Devices: Enhancing Athlete Endurance and Safety. Sports Medicine and Biomechanics Journal.

## Acknowledgements

The researchers extend sincere gratitude to the athletes and sports trainers who participated in testing. We thank the supporting institution for providing laboratory facilities and funding assistance. Appreciation is also given to the technical team for prototype development and data analysis. Special thanks to mentors and reviewers for continuous guidance and feedback throughout the project.