

Tech-Enabled Sportswear: Artificial Intelligence (AI), Internet of Things (IoT), and Consumer Engagement in Emerging Markets

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ABSTRACT : The high rate of convergence between Artificial Intelligence (AI) and the Internet of Things (IoT) has transformed the sportswear industry, especially in the emerging markets where people are increasingly adopting digital technologies. Smart sportswear is technology-powered, combining smart sensors, wearables, and data-driven applications to improve athletic performance, track health indicators, and customize consumer experiences. The paper will examine the contribution of AI to predictive analytics and personalization and how IoT allows connecting in real-time and engaging with communities. Special focus was made on consumer adoption trends in emerging markets where the cost factor, computer literacy, and connectivity issues contribute to market expansion. The results indicate that, as much as these regions have huge opportunities in regard to innovation and interactions, challenges like cost, privacy, and disparities in technological access should be eliminated. The paper emphasizes how the future of interactive sportswear is in the creation of inclusive, sustainable, and consumer-oriented solutions that can utilize AI and IoT to add value to dynamic and competitive markets.

KEYWORDS - Smart Sportswear, Wearable Technology, Artificial Intelligence, Internet Of Things, Consumer Adoption, Emerging Markets, Nigeria, and Brand Loyalty.

I. INTRODUCTION

IoT-enabled, AI-assisted sensors being incorporated into sportswear is driving a major shift in wearable technology. These cutting-edge sensors offer an effective means of tracking sports performance, opening up in-depth performance analysis to a wider audience. Diverse biometric signal monitoring and body motion tracking under a range of external stimuli, including stretching, compressing, flexing/bending, and twisting, are essential for real-world athletic applications [28], [19], and [29]. It is thus important to come up with cost-effective cost-sensitive and stable sensors that can handle the stringent needs of IoT and AI-assisted wearable devices [28], [4]. In addition, wearable devices containing such sensors, are normally exposed to wet conditions like sweat and rain, because they are worn on the human body. In turn, such sensors should be highly stable in their operations regardless of the circumstances. [6]. However, most sensors that are currently operational consist of semi-flexible polymeric materials or solid-state components and they do not fully integrate with sportswear and are often a bulky addition [7]. The need to have low-cost and simple sensors that will continue to be perfectly integrated into sportswear items and consume minimal energy is growing increasingly prominent.

To address these challenges, researchers are now focusing on the development of sensors, energy devices, electrodes and electronic components composed of textile materials such as yarns and fabrics in the major part [8] [21], [33] and [39].

With its increasing urbanization, the rise in the middle classes, and the rising health and fitness awareness, there are special opportunities of the adoption of sportswear in the emerging markets such as Nigeria facilitated by AI and IoT [3]. The increasing use of smart phones and the mobile internet connection also creates a favorable environment in the integration of the internet of things in the consumer devices.

Nevertheless, these markets are also challenged with adoption issues that involve price sensitivity, lack of consumer awareness, infrastructural limitations, cultural inclinations, and distrust in data privacy [10]. Nigeria, however, has seen increased openness on the part of younger demographics of consumers, especially Gen-Z-era fitness enthusiasts, to wearable technologies as long as the issue of affordability and trust are considered. It is against this background that the research question of the paper is: How is AI and IoT used in sports apparel to enhance customer engagement, adoption, and loyalty in emerging markets? To respond to this, it will review appropriate literature on AI-enabled wearables, and come up with a conceptual framework that identifies strategic implications and future research directions [10].

II. METHODOLOGY

The present paper follows a systematic literature review (SLR) approach to summarize literature on the applicability of AI and IoT to redesign sportswear and influence consumer behavior in new markets. The review process was performed according to the recommendations of Snyder (2019) on rigor and replicability, as it included three stages: literature identification, screening and eligibility assessment, and thematic synthesis. The searches were done in major academic databases, including Scopus, Web of Science, IEEE Xplore, ScienceDirect, and SpringerLink, and also in grey literature like white papers and preprints to have the latest innovations. Articles used were published during the years 2010 to 2025, which covers the last ten years and half of technological advancement in the field of wearables.

III. LITERATURE REVIEW

3.1 AI and IoT in Sportswear

The merging of AI and IoT in sportswear has turned the design of apparel to be more than just a performance-based sports item but a component of larger digital systems. The use of AI in sportswear can be seen through predictive analytics, movement classification through machine learning, and personalized training plans one, which enable athletes and consumers to get the personalized insights that can improve performance and prevent injury [2]. Wearable gadgets are a very important part of the IoT, and they are gradually becoming a part of our life. These gadgets, including electronic technologies installed in the products of clothing, watches, glasses, bracelets, and medical equipment, offer consumer services in many industries such as fitness and wellness, healthcare and medicine, and infotainment [12]. Designed to be miniature and lightweight, wearable devices enhance a more direct and intimate interaction between the user and the environment in various activities.

Nevertheless, the adoption of wearable technology by consumers has not been as high as the market has grown or the industry itself [1]. According to a study conducted by the PwC Health Research Institute, 86 percent of the polled consumers said they were worried that medical wearable devices were prone to being hacked [22].

3.2 Wearables and Consumer Engagement

Today, AI-driven platforms are the key to success in e-commerce. AI has become an important part of digital marketing as it allows calculating the decisions based on the data through the implementation of deep learning algorithms to forecast the behavior of users in the entire purchasing process. Consequently, the behavioral aspect of customers has developed greatly within the present scenario. The artificial intelligence (AI) has a great impact on customer relationship management (CRM) and business-customer interactions. When applied to sports marketing, AI can help organizations improve the experiences of fans, operational efficiency, and create additional growth opportunities. To be competitive in this changing environment, the sports marketers should keep up with the new developments of AI in the CRM field and choose the most efficient CRM systems to help them in managing their relations with fans and other stakeholders. The use of AI is gaining momentum, and the trend has strong arguments to support this fact [27]. It can strengthen the functions of the existing business systems, and thus daily processes and workflows will become quicker and more productive. All of this combined with CRM software in the sports industry results in a higher relationship with fans and increased sales channels, which eventually creates a more engaged and loyal fan base as a whole through AI [26]. Furthermore, the introduction of AI causes the restructuring of strategies, programs, interactions, and relations in the business marketing process [11].

The cost of the product and its lifespan is particularly crucial in sustainable adoption because consumers will not adopt an expensive or delicate smart clothing in the situation where cost and the product life are primary considerations [10]. Moreover, the sense of engagement is reinforced by the fact that consumers view wearables as the extension of a more comprehensive digital identities, where both sharing the performance data and their accomplishments via social networks add to the motivation and attachment to the brand [1].

3.3 Emerging Markets Context

New markets like Nigeria are an unexplored opportunity in the use of AI- and IoT-powered sportswear. These environments have a number of demographic and technological factors that are appealing: high rates of urbanization, the population is becoming younger and more health-conscious, middle-income incomes are rising, and both smartphone penetration and mobile internet ubiquity is widespread [3]. These opportunities notwithstanding, adoption is still limited by various challenges. Pricing sensitivity has remained to be a major obstacle since most consumers cannot afford the expensive smart clothing, and unreliable electrical power and unstable internet connection may hinder the benefits of IoT-based products. Results of this also demonstrated that data inconsistency, challenges in wearing wearable devices because of complex user interface and user experience and low battery storage are common challenges that exist in the uptake of wearable fitness technologies among Gen-Z in Lagos State, Nigeria. [10].

IV. FINDINGS

4.1. Smart Clothing Market Overview

The smart clothing market is projected to be USD 21.48 billion by 2030 at a CAGR of 26.2% in the period 2025 to 2030. The size of the smart clothing market was estimated as USD 5.16 billion in 2024 and is projected to grow to USD 21.48 billion in 2030. Smart clothing also called high-tech clothing, smart wear, electronic textile, or smart fabrics is clothing aimed at measuring the health of the wearer, by using biometric data such as heart rate, body temperature, muscle tension, and pulse rate. The world market is growing at a high rate that is especially in the sports and healthcare industries due to the rising health and fitness awareness in the everyday life. Smart apparel has a diversity of capabilities: biometric to track, activity tracking, and performance optimization, which can help someone to track health indicators, optimize exercise sessions, and improve well-being. An interest in maintaining a healthy lifestyle in society coupled with an increased demand of keeping up with real-time health is also driving the uptake of smart clothing.

Development of wearable sensors, fabric technology, and data analysis has triggered the growth of smart clothing. The seamless integration of microcontrollers, sensors and connection technologies right into clothes characterizes this change and allows monitoring body movements, vital signs and other important biometric information in real-time. As technology continues to evolve, the smart clothing is becoming more comfortable, sophisticated and usable, which is increasing the adoption rate in all its applications [15].

Smart clothing has a great potential in the sports and fitness industry. The immediate display of such biometric parameters as oxygen saturation, heart rate, muscle activity, and movement patterns can benefit athletes and fitness enthusiasts. This information would be very useful in the refining of training programs, reducing the risk of injuries, and enhancing the overall performance. Also, intelligent clothing is capable of providing feedback about posture, technique, and form, which allows users to make the required changes and improve their workout habits. The following step in creating a complete ecosystem of fitness is the integration of smart clothing with wearable device and mobile application, which will provide people with customized insights and advice on how to maximize their health-related objectives [15].

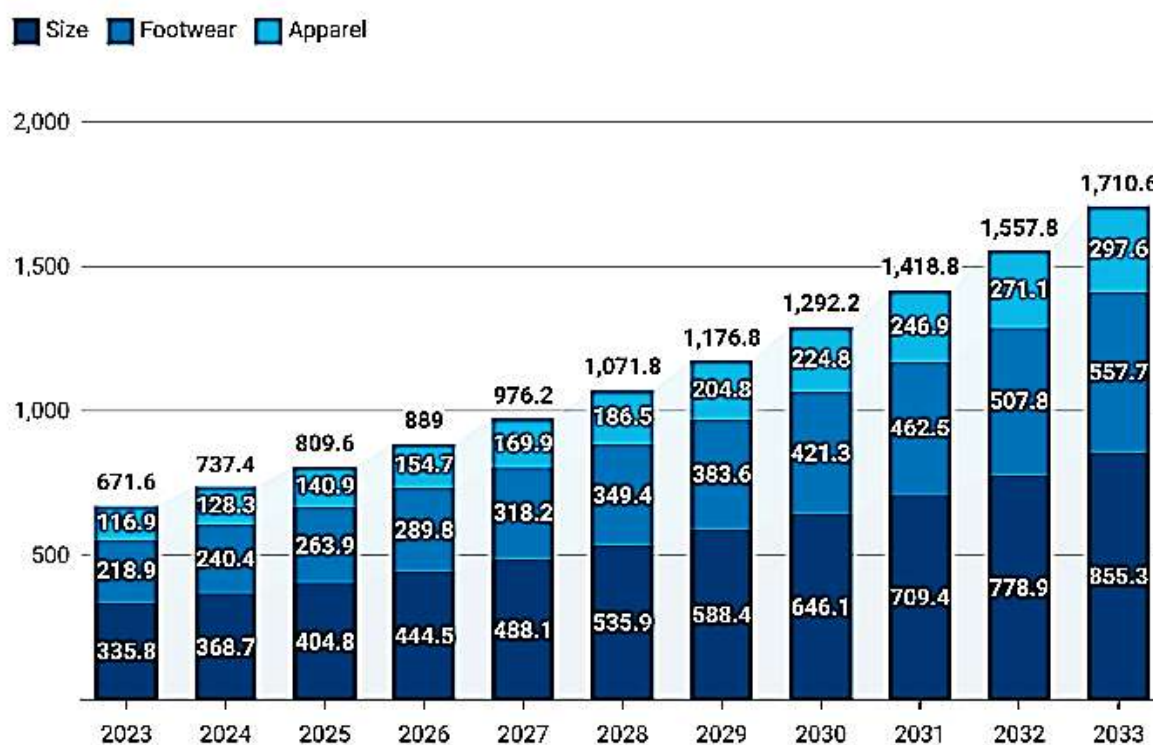


Figure 1: Global Sportswear Market Size (in USD billions)

(Source: *Market.us.News*, 2025)

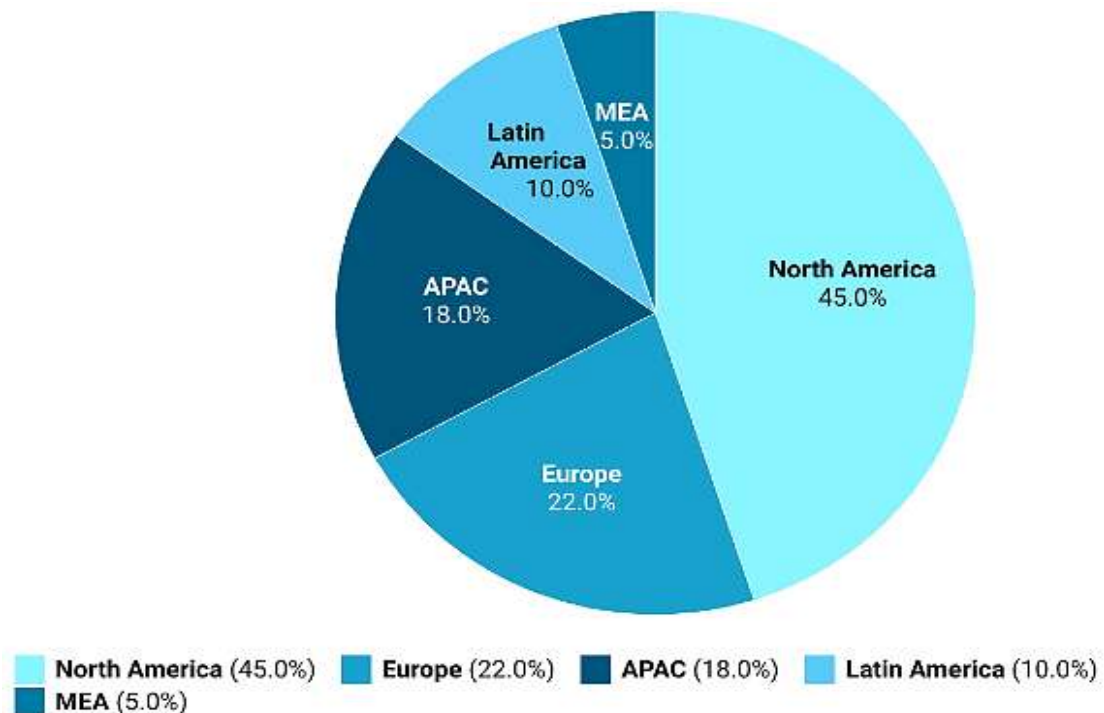


Figure 2: Tech-Enabled Sportswear Market by Region
(Source: Market.us.News, 2025)

In 2022, the global sportswear market exhibited a diverse regional distribution of market share, with North America leading significantly at 45.0%. This dominance reflects the region's robust consumer base and strong preference for active lifestyles, as well as the presence of major global brands. Europe follows, accounting for 22.0% of the market share. Indicative of the region's established demand for sportswear and the influence of athleisure trends.

The Asia-Pacific (APAC) region holds an 18.0% share. Driven by rising health consciousness and growing interest in sports and fitness, particularly in emerging economies. Latin America represents 10.0% of the market, showing steady growth as consumer interest in sportswear increases across various segments. The Middle East and Africa (MEA) region, with a 5.0% share, completes the distribution. Marking a smaller but gradually expanding market as fitness awareness and participation in sports rise.

4.2 Smart Clothing Market Trends

Over the last couple of years, a variety of smart wearables, including smartwatches, smart wristbands, smart glasses, smart garments and smart jewelry, have been launched around the world. Although, as it can be concluded after reading the previous section, smart clothing can be used in multiple applications, its global market is still in a nascent stage, with the major market traction for wearables being predominantly witnessed in North America and Europe [32]. However, increasing ICT spending, rising health concerns and more smartphone users are driving demand for smart wearables and clothing in other countries like China (e.g., 43% of urban Chinese consumers would buy wearable devices [32]). Consequently, major smart wearable and clothing players are focusing on offering technologically advanced products at low price points to increase their market globally. In the case of wearables, market prospects are very promising: wearable shipments are forecast to increase to US\$150 bn by 2026 from the estimated level of US\$30 bn in 2016. For instance, the AR technology market is expected to grow significantly in the next years together with the Virtual Reality (VR) technology market, creating a market of US\$80 bn in 2025 [14].

In addition, a BusinessWire report found a growing global market for smart wearables that was projected to generate revenue worth \$41 bn by 2020 with a Compound Annual Growth Rate (CAGR) of 65% (CAGR represents the mean annual growth rate of an investment over a period of years) [32]. A research report from Juniper Research forecasts that fitness garments and ear-based wearables will grow from 4.5 million shipped in 2018 to nearly 30 million in 2022, an increase of more than 550% [32]. It is also worth pointing out a forecast from IDTechEx that projects that 3 bn sensors will be sold for wearable devices in 2025. One of the fastest growing segments is in stretch and pressure sensors, which, for instance, are essential for detecting motion of individual body parts. IDTechEx predicts that this segment will have a CAGR of 40% over the next 10 years [16].

TechSci projects that the demand for smart garments will continue to grow, driven particularly by athletes and diabetic patients. Other technologies presented as emerging are smart undergarments or inner-wear, smart tattoos and hologram projector-based smart wearables. Analysts believe that companies will increasingly focus on advanced technology, compatible and lightweight smart wearables [35].

4.3 Key Challenges and Barriers to the Adoption of IoT-Enabled Smart Clothing

More developments are needed to boost functionality, allow for adaptation, and lower energy usage before smart clothing may be fully implemented in new application areas [32]. The next generation of IoT-based wearables and clothing will replace today's single-purpose wearables (such as stiff electronics and peripheral mobile phones), with the primary obstacles being summed up as follows:

- Battery life and charging continue to be research issues [32].
- Before the Internet of Smart Clothing becomes widely used, a lot more research needs to be done, particularly in the areas of battery power, energy harvesting, and hardware miniaturization [34].
- Careful consideration should be given to the effects of washing procedures, temperature, perspiration, moisture, mechanical impacts, frequent bending and compression, and light, particularly sunshine [32].
- Clothes must be flexible and easy to wear.
- Concerns about data security and privacy will arise when IoT smart garment technologies proliferate because of the ability to access data produced by millions of garments [32].
- Higher Technology Readiness Levels (TRLs) are required for clothing [32].
- One of the main issues facing smart textiles and sensors that employ clothes or fabric as a substrate for integrating electronics is durability against deformation, which ensures a long lifetime and sustainable performance [18].
- The businesses who manufacture the clothing and offer online platforms for monitoring those data will have access to them and be able to sell the data to marketing firms, insurance providers, or medical facilities. People may feel that they need to have more control over who can view their data and where it goes [32].
- Another issue with smart fabric is its cost, although from an implementation perspective, demand is driven by the product's necessity, which determines the market price. The cost of pricing these things is only one of several considerations. However, it must be less expensive than the wearable technology now on the market if a company wants to create a platform that is accessible to everyone in our community. Made-to-measure will eventually drop to a price where it reaches volume [32].

Another major constraint is infrastructure constraints. Inconsistent internet connectivity and unstable electricity supply is still a problem in many areas, which is essential in terms of IoT-enabled functions. In contrast to developed economies, where the uninterrupted connectivity forms the basis of wearable performance, the Nigerian consumers might be affected by the interruptions in transferring data, tracking in real-time, or charging their devices. This is because these infrastructural limitations introduce usability disjuncture that deters long-term engagement. Moreover, the lack of distribution channels of tech-enabled clothes lessens accessibility in semi-urban and rural areas, which, nonetheless, are slowly developing the demand of affordable workout solutions [7].

V. DISCUSSION

AI and IoT in sportswear are an opportunity to transform consumer engagement, in particular in the new markets where the fitness culture is growing. Through personalization, real-time feedback, and community-based interactions, smart clothing can develop experiences that are more immersive to consumers than standard product utility. To brands, this is an opportunity to innovate and distinguish themselves and reach into aspirational consumer segments that more and more seek modern and technology-capable lifestyles. Notably, the young and digitally savvy population of Nigeria makes the country a key frontier towards the mass adoption of the same innovations so far that the products will be made to reflect local realities [3].

These opportunities, however, cannot be achieved in full without the structural issues of accessibility, affordability, and awareness. The excessively high prices of products and infrastructural shortages will contribute to supporting inequality in technology use, with benefits of AI and IoT sportswear being confined to high-income consumer groups [10]. Unchecked, it might halt the growth of the market and destabilize the

sustainability of tech-enhanced sportswear in the long term. By working on the issue of affordability with local production, price adjustment, and financing systems, new avenues to mass-market share might be available. Concurrently, digital literacy and awareness efforts will be critical in enhancing the establishment of consumer confidence and guaranteeing prolonged usage.

Finally, the results indicate that a brand aiming to succeed in a new market needs to have a glocalized approach based on global innovations in AI and IoT and localize product characteristics, prices, and engagement approaches to local consumers. This two-sided strategy does not only increase adoption and loyalty but also makes brands enablers of inclusive innovation. Further studies in the future should be done on comparative adoption between established and new markets in order to fine-tune models of technology adoption in sportswear:

VI. CONCLUSION

The combination of Artificial Intelligence (AI) and the Internet of Things (IoT) in sportswear is a paradigm shift in the fashion and technology sectors, especially in the emerging markets. The AI personalization will help improve the consumer experience with correct sizing, customized recommendations, and virtual try-on functionalities, and IoT-based sensors in clothes will go beyond fashion to performance analysis, health tracking, and real-time feedback. A combination of these innovations is changing the expectations of consumers by providing interactive, data-driven, and immersive experiences with sportswear products. The opportunities are particularly high in emerging markets as the mobile adoption is high, the e-commerce environment is growing, and the role of digital community rises. These factors offer fertile ground for the adoption of smart apparel, although the issues of affordability, lack of infrastructure, and privacy issues of the data are key considerations that must be avoided. Effective market penetration shall thus be based on balancing technology savvy with cost, durability of products in the various environments, and a sense of trust by means of clear data governance.

All in all, sportswear facilitated by technology has great potential to not just enhance sporting performance and health but also change the consumer experience in the emerging economies. Using AI and IoT as strategic tools, businesses will develop inclusive, accessible, and sustainable solutions, which are relevant to the local market dynamics and global trends. This convergence of fashion, technology, and consumer behavior is set to open up new commercial possibilities and redefine the future of sportswear in a digitally connected world as even more people adopt it.

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