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Investigating the Moderating Role of Age and Gender on the Willingness to use IOT Technology in Sports based on the Technology Acceptance Model (TAM)

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Abstract
This research aimed to investigate the moderating role of age and gender in the willingness to use IOT technology in sports, based on the Technology Acceptance Theory (TAM). This research utilized a survey of the correlation type, with the statistical population consisting of all athletes who have received sports insurance cards and were active this year. Using Morgan's table, a sample of 394 individuals was selected. Standard questionnaires of willingness to use new technologies were employed as tools. Data analysis was conducted using SPSS version 22 and Warp PLS version 8.The research findings indicated that the variables of perceived usefulness, perceived ease of use, and attitude have an impact on athletes' willingness to use IOT technology in sports. Additionally, in the Technology Acceptance Model, perceived ease of use was found to have a significant effect on perceived usefulness. The study also examined the moderating role of age and gender on the willingness to use IOT devices in sports, revealing that only the relationship between age and perceived usefulness did not reach an acceptable level of significance. Therefore, in order to utilize IOT technology in sports, it is crucial to consider these factors as the use of Internet of Things can lead to highly favorable outcomes.
Keywords: *Athletes, Sports wearables, Sports industry, Technology acceptance model new technologies*

Introduction

Considering the remarkable speed and magnitude of technological advancements, it appears that the developments brought about by the fourth industrial revolution's technology are far more diverse and extensive compared to the previous three eras. These technologies and innovations have effectively transformed the present era into a digital age (Goldie, 2016; Shakouri et al., 2023). One such technology is the Internet of Things (IoT), which enables objects to communicate directly with other objects and people (Ashton, 2009).According to (De Cremer et al., 2017; Lee & Lee, 2015), wearable technologies represent a significant market for the Internet of Things, with a considerable portion of this market consisting of sports wearable technologies (Kim & Chiu, 2018). Sports wearables, such as sports watches, wristbands, and heart rate monitors, are designed to collect, provide data, record activities performed, and generate reports (Tholander & Nylander, 2015).These devices provide several advantages to users, such as evaluating player safety, preventing injuries during training, and monitoring fitness and performance metrics(Anzaldo, 2015).What sets these devices apart from other portable gadgets, like smartphones, is that they're specifically crafted to blend seamlessly into everyday life without attracting attention(Passos et al., 2021). Due to the rising

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demand for sports wearables, traditional sports companies are now developing and launching their own versions of these devices using information and communication technology. Some notable examples include Nike's Fuel Band, Adidas's mi Coach, and Under Armor Band(Kim & Chiu, 2018).

The literature review indicates that researchers are increasingly interested in understanding how users utilize wearable devices, with notable studies including those by (Canhoto & Arp, 2017; Zhao et al., 2023). Various theories have been proposed to explain user behavior and opinions towards new technologies and the adoption of accepted technologies. These include the Theory of Reasoned Action (TRA), Diffusion of Innovation (DOI), Unified Technology Acceptance and Use of Technology (UTAUT), Technology Acceptance Model (TAM), among others (Ahmad, 2014). The majority of studies in this field have used the Technology Acceptance Model (TAM) as the fundamental theory for investigating users' acceptance of wearable devices.

Davis (1989) originally proposed the Technology Acceptance Model (TAM), which defines perceived usefulness as the extent to which an individual believes that using a particular technology will improve their job performance. Perceived ease of use, on the other hand, refers to the degree to which a person believes that using a particular technology is effortless.Perceived usefulness and perceived ease of use are widely regarded as the primary factors influencing an individual's intention to use a particular technology(Al-Adwan et al., 2023; Davis, 1989; Davis et al., 1989).Several studies have explored the influence of gender in the testing of TAM. While some studies have found no significant gender differences (Whitley Jr, 1997), others suggest that such differences do exist (Papastergiou & Solomonidou, 2005).Furthermore, existing literature has shown that there are differences in age and gender regarding people's comprehension and usage of online technologies in general (Lian & Yen, 2014; Liebana-Cabanillas & Alonso-Dos-Santos, 2017).Given the conflicting findings and the importance of optimal technology usage in sports, this study aims to examine the moderating effect of age and gender on individuals' willingness to utilize IoT technology in sports, using the Technology Acceptance Model (TAM).

Theoretical background

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was first introduced by Fred Davis in 1989 and is derived from Ajzen and Fishbein's Theory of Reasoned Action (TRA) from 1970 (Kim et al., 2008; Morales et al., 2023). The Technology Acceptance Model (TAM) is a theoretical framework for information and communication systems that explains the factors influencing the acceptance or rejection of a particular technology(Karami, 2006). TAM theory postulates that behavioral propensity toward technology adoption, which refers to a user's technology use behavior, can be evaluated by measuring their attitude toward technology use. Two primary predictors of attitude toward use have been proposed: perceived usefulness and perceived ease. Perceived usefulness pertains to an individual's belief that technology usage can improve task performance, whereas perceived ease defines a person's perception that using technology is effortless(Davis, 1985, 1989) Furthermore, it has been suggested that perceived ease also indirectly impacts the attitude toward perceived usefulness (Alsyouf et al., 2022). The attitude is regarded as a crucial determinant of behavioral intention and is influenced by individuals' beliefs (Venkatesh et al., 2003).

Hence, it is crucial to scrutinize people's actual attitudes towards products and services - especially for relatively new product groups such as wearable devices. This is because one

way of studying individual behavior that has not yet translated into action is by examining their attitudes (Holbrook et al., 2005).For instance, (Lunney et al., 2016) discovered that individuals with a favorable attitude towards wearable fitness devices are more likely to utilize the technology. In particular, numerous studies have explored the application of TAM in the domain of sports wearables. It has been demonstrated that TAM variables considerably influence the conduct of athletes and users, as evidenced by several published articles (Ahmad et al., 2020; Chang et al., 2023; Felea et al., 2021; Kastoriano & Halkias, 2020). Consequently, the acceptance and intention to use IoT technology in sports can be hypothesized as follows:

H1: Perceived usefulness has a significant effect on the willingness to use IOT technology in sports.

H2: Perceived usefulness has a significant effect on the willingness to use IOT technology in sports with a mediating role of attitude.

H3: Perceived ease has a significant effect on perceived usefulness.

H4: Perceived ease has a significant effect on the willingness to use IOT technology in sports with the mediating role of attitude.

H5: Attitude has a significant effect on the willingness to use IOT technology in sports.

Gender as a moderating variable

Gender differences in behavior can be explained by social psychology and gender role studies. Social psychology suggests that men are more pragmatic, task-oriented, and results-driven than women (Ramkissoon & Nunkoo, 2012; Yang et al., 2023).On the other hand, gender role research indicates that men exhibit various personal traits typically associated with masculinity, such as increased self-confidence, a greater inclination towards adventure, and a higher willingness to take risks. In contrast, women tend to prefer more straightforward and routine activities (Lynott & McCandless, 2000).

Thus, concerning the willingness to utilize IoT technology in sports and drawing upon social psychology and gender role theories, we postulate that the connection between perceived usefulness (PU) and attitude will be more robust for male users. This is because they are typically task-oriented, results-driven, and prioritize benefits. However, prior investigations on the moderating influence of gender on technology acceptance and behavioral intention in diverse online settings have produced varying outcomes across different programs and even within the same program.

For instance, research on online and mobile shopping (Amin et al., 2015; Lian & Yen, 2014) has revealed that gender does not moderate the connection between perceived usefulness, ease of use, and users' purchase intention. However, in a study on the Technology Acceptance Model (TAM) and the utilization of sports bracelets in physical education for first-year students - addressing the role of gender and self-efficacy - it was found that perceived usefulness (PU), perceived ease of use (PEOU), and attitude towards technology (ATT) significantly impact students' intention to use a sports bracelet. Moreover, gender moderates the relationships between variables, with the PU and intention to use relationship being more pronounced among men, but unchanged among women (Zhang et al., 2022) . Thus, we propose the following two hypotheses:

H6: The effect of perceived usefulness on the intention to use IOT technology in sports is moderated by gender.

H7: The effect of attitude on the intention to use IOT technology in sports is adjusted based on gender.

Age as a moderating variable

Age differences in customer behavior can be explained by self-efficacy, aging processes, and cumulative life experience. Studies have shown that older adults tend to feel too old to

learn or adopt new technologies compared to younger individuals (Fang et al., 2016; Parayil Iqbal et al., 2023; Phillips & Sternthal, 1977) . Due to their extensive experience, older individuals are more likely to rely on their own beliefs and therefore, less likely to seek and use additional information in their decision-making and adoption processes (Shin & Lee, 2014).

Hence, we anticipate that the relationship between perceived usefulness and usage attitude will be more robust for younger individuals, who are usually results-driven but possess lesser experience. Conversely, the connection between perceived ease of use and usage attitude is expected to be stronger for older individuals who may find it challenging to learn new technologies and thus value the ease of use of IoT technologies in sports. However, prior research concerning the moderating influence of age on online adoption and technology acceptance has produced conflicting and diverse findings.For instance, in the context of online learning, (Tarhini et al., 2014) discovered that perceived usefulness had a more robust relationship with the intention to adopt e-learning technologies among younger students. In contrast, perceived ease had a more robust relationship with the adoption of e-learning technology among older students.On the other hand, research has shown that trust, expertise, and usefulness exert a stronger influence on purchase intention for younger adults than for older adults in online and mobile shopping. However, ease of use has an equal effect on both younger and older adults (Liébana-Cabanillas et al., 2014). Lian and Yen (2014) found similar results, with age moderating only the relationship between usefulness and online shopping, while it failed to moderate the PEOU relationship in online shopping(Lian & Yen, 2014). Therefore, this research proposes the following two hypotheses:

H8: The effect of perceived usefulness on attitude towards IOT technology in sports is moderated by age.

H9: The effect of perceived ease on attitude towards IOT technology in sports is moderated by age.

Proposed theoretical framework

Drawing on previous literature, particularly the Technology Acceptance Model (TAM), Figure 1 presents the complete hypothesized model that will be tested in this study. In addition to the conventional TAM constructs of perceived usefulness (PU) and perceived ease of use (PEOU), the proposed model also incorporates the moderating variables of gender and age.

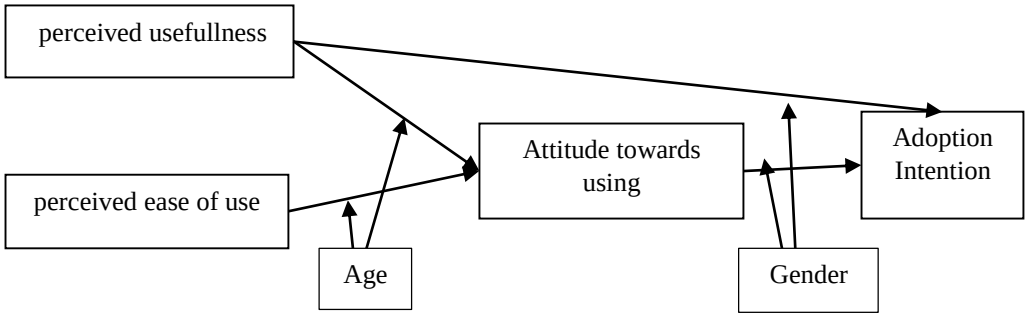

Figure 1. *The proposed theoretical model includes the moderating effects of gender and age on the relationships between perceived usefulness (PU), perceived ease of use (PEOU) and attitude in intention to use.*

Methodology

The aim of this research was to examine the factors influencing the adoption of IoT technology in sports, using the Technology Acceptance Model (TAM). The philosophical paradigm adopted for this study is positivist,

the approach is quantitative, and the research strategy is survey-based.The statistical population for this research comprised all athletes who were insured for sports insurance in the current year. Therefore, a convenience sampling method was employed, and a sample of 384 completed questionnaires was selected.The online questionnaire was distributed to athletes through email and social media channels. The questionnaire consisted of standard questions, which were validated by ten experts for face validity. Additionally, Cronbach's alpha was used to assess the reliability of the questionnaire. For data analysis, Warp PLS version 3 and SPSS version 22 software were utilized for structural equation modeling.

Results

Out of 394 questionnaires, 240 were completed by women and 154 by men. The distribution of respondents by age includes 183 participants under the age of twenty, 96 between the ages of 21 to 30, 72 between 31 to 40, 31 between 41 to 50, and 12 over the age of 51. Table (1) presents an overview of the research variables and their status. As shown in Table (1), the research variables exhibit favorable conditions.

Table 1.
Results of mean, standard deviation and significance level of research variables

Variable	mean	standard deviation	P value
Perceived usefulness	1.77	0.58	0.000
Perceived ease of use	2.16	0.62	0.000
Attitude to use	1.89	0.60	0.000
Adoption intention	2.14	0.70	0.000

According to some researchers, a measurement model is considered homogeneous if the absolute value of factor loadings for observation variables is at least 0.7, while others suggest a minimum of 0.4 and recommend removal of variables with lower factor loadings. As shown in Table (2), all variables have factor loadings exceeding 0.7, indicating favorable conditions for the research variables.

Table 2.
Factor loading of the research model

	Variable	questions	The amount of factor load
pu	**Perceived usefulness**	PU1	0.774
		PU2	0.853
		PU3	0.820
		PU4	0.737
PEOU	**Perceived ease of use**	PEO1	0.859
		PEO2	0.813
		PEO3	0.590
AT	**Attitude to use**	AT1	0.838
		AT2	0.750
		AT3	0.849
		AT4	0.788
AI	**Adoption intention**	AI1	0.804
		AI2	0.823
		AI3	0.874
		AI4	0.804

In general, combined reliability index and Cronbach's alpha values for each latent variable should exceed 0.7, while convergent validity should be above 0.5. As shown in Table 3, the research variables exhibit favorable conditions as their values exceed the acceptable thresholds.

Table 3.
Composite reliability, Cronbach's alpha and convergent validity

Variable	combined reliability	Cronbach's alpha	Convergent validity
Perceived usefulness	0.874	0.808	0.636
Perceived ease of use	0.803	0.630	0.582
Attitude to use	0.882	0.821	0.652
Adoption intention	0.896	0.845	0.684

The next criterion for assessing model fit is divergent validity. The results of this research exhibit acceptable values, as shown in Table 4.

Table 4.
Divergent validity

Variable	1	2	3	4
Perceived usefulness	0.797	-	-	-
Perceived ease of use	0.396	0.763	-	-
Attitude to use	0.571	0.487	0.807	-
Adoption intention	0.562	0.490	0.518	0.827

Table 5 presents the results of the analysis of path coefficients and significance levels. The findings indicate that the path coefficient for perceived usefulness on adoption intention to use IoT technology in sports and attitude towards its use is 0.363 and 0.435, respectively, which are both significant. the path coefficient for perceived ease of use is also significant with respect to perceived usefulness and attitude towards its use (0.436 and 0.279, respectively). The path coefficient for attitude towards use on willingness to use technology is 0.282. The path coefficient for the moderating role of gender on perceived usefulness and attitude towards its use is -0.09 and 0.28, respectively, both of which are significant. Additionally, the age modifier variable exhibits a significant coefficient of determination on perceived ease of use (-0.12) and attitude towards its use. However, the relationship between perceived usefulness and attitude towards use does not exhibit an acceptable level of significance.

Table 5.
Examining the path coefficients and significance level of the research

Direction	Path coefficient	P value	Result
Perceived usefulness → Willingness to use IOT technology in sports	0.363	0.01	confirm
Perceived usefulness → attitude towards the use of IOT technology in sports	0.435	0.01	confirm
Perceived ease of use → Perceived usefulness	0.436	0.01	confirm
Perceived Ease of Use → Attitude towards the use of IOT technology in sports	0.279	0.01	confirm
Attitude to use → Willingness to use IOT technology in sports	0.282	0.01	confirm
Perceived usefulness → Gender → Willingness to use IOT technology in sports	-0.09	0.04	confirm
Attitude to use → Gender → Willingness to use IOT technology in sports	-0.28	0.01	confirm
Perceived usefulness → age → attitude towards the use of IOT technology in sports	-0.01	0.426	rejection
Perceived Ease of Use → Age → Attitude towards the use of IOT technology in sports	-0.12	0.01	confirm

Table 6 presents the determination coefficient, which is used to measure the goodness of fit of the model, and the phi coefficient, which indicates the severity of the predictive power of the model.

Table 6.
Investigating the coefficient of determination and phi in two studies

Variable	R2	chi-square
Perceived usefulness	0.190	0.189
Attitude to use	0.354	0.422
Adoption intention	0.412	0.413

As presented in Table 7, the significance level for the average path coefficient and

coefficient of determination are both less than 0.05. The explanatory power criterion of the Ten Howes model is 0.522, and the average variance inflation factor is less than 3.3. These results indicate a good fit of the model. Therefore, it can be concluded that the research model is well-fitted and approved. With the confirmation of the model, the structural results can be used to test and interpret hypotheses.

Table 7.
Appropriateness indicators of the research model

Criterion	Calculated value	Acceptable value	Result
Average Path Coefficient (APC)	0.235	The smaller significance level is equal to 0.05	confirm
Average Path Coefficient (APC)	0.319	The smaller significance level is equal to 0.05	confirm
The measure of the explanatory power of the Ten Howes model (GOF)	0.522	Strong in a larger range equal to 0.36 The average in the larger interval is equal to 0.25 Weak in the larger interval equal to 0.1	Strong
Average Variance Inflation Factor (AVIF)	1.351	The smaller ideal interval is equal to 3.3 The smaller acceptable interval is equal to 5	confirm

Conclusion

In today's fiercely competitive world, the pace at which competitors enter the market and the multitude of products available have reached unprecedented levels, both domestically and internationally (Zarif Sagheb et al., 2019). Consequently, possessing a comprehensive understanding of consumer behavior and providing distinctive solutions and features that set goods and services apart is paramount. This not only helps to mitigate risks but also enhances the prospects of achieving product success. Marketing strategies can focus on highlighting the functionality of IOT technology in sports and showcasing the benefits of integrating these products into both athletic and everyday activities. This study examined how gender and age influence the relationship between TAM constructs (perceived usefulness, perceived ease of use, and attitude toward use). The results indicated that perceived usefulness played a more significant role than perceived ease of use. Attitude should be given more weight in evaluations and planning. Previous studies have indicated that the perceived usefulness of wearable technology is positively correlated with fitness indicators such as steps taken and calories burned (Lunney et al., 2016). The findings of this research align with those of previous studies (Kim & Chiu, 2018; Tan et al., 2014).

As a rule, consumers weigh the costs and benefits of purchasing a product or service. Therefore, logical arguments that highlight the advantages of IOT technology in sports — such as progress monitoring, performance measurement, and data collection from wearables and connected equipment to enhance game strategy — help increase perceived usefulness. In the 21st century, one of the primary challenges faced by most industries is how to gain and maintain a competitive advantage that ensures organizational survival, growth, and success (Ahmadi et al., 2023). Contemporary trends in the world, such as Industry 4.0, artificial intelligence, and the Internet of Things, have made digital media an essential tool for understanding consumer behavior. Therefore, "digital marketing" has become an essential paradigm that must be taken into account by marketers and anyone interested in staying up-to-date with market trends in the field of business (Shakouri et al., 2023; Vidal-Tomás, 2022).

The results of this research indicate that perceived ease of use has a positive and significant impact on perceived usefulness, which is consistent with previous studies

(Gong et al., 2004; Karami, 2006; Tan et al., 2010). Perceived ease of use refers to the degree to which a technology requires little physical or mental effort to understand, learn, and operate. Perceived usefulness, on the other hand, pertains to extrinsic motivation with an emphasis on the outcomes (both tangible and intangible rewards) of using a system. Perceived ease of use is related to intrinsic motivation as it addresses the enjoyable user experience that can help achieve desired outcomes (Venkatesh et al., 2003). To increase the desire to use this technology, it is recommended that special attention be given to its ease of use. This can provide athletes with a comfortable, time-efficient, and user-friendly environment.Previous research has investigated the factors influencing technology adoption in the General Directorate of Sports and Youth of Isfahan province using the Technology Acceptance Model (TAM) structures, and has found that attitude toward use had the strongest impact on information technology acceptance. This is supported by the opinions of employees in the Department of Sports and Youth (Kehrizsangi et al., 2017). Several other studies have also demonstrated that individuals with a positive attitude toward IOT technology are more likely to use it (Ajzen, 1991; Dodson, 2003; Lunney et al., 2016). These findings align with the results of the present study.

Understanding people's attitude towards IoT technology holds great significance in terms of consumer behavior. Attitude serves as a crucial precursor to intention, determining actual behavior and being influenced by individuals' beliefs. Therefore, analyzing people's true attitude towards products and services becomes highly important, with numerous studies confirming a strong association between attitude and intention to consume. This holds particular relevance for new or emerging technologies, like sports wearables, as attitudes can offer valuable insights into behaviors that may not have translated into action yet (Mohammadpour Yaghini et al., 2019; Sardar Donighi & Nour Mohammadi, 2015). Therefore, the examination of individuals' attitudes is essential. Based on the findings of the studies, it is recommended that manufacturers of sports products capitalize on the green marketing mix as a means to boost sales and gain a greater market share in this emerging technology era (Khorsandi-Fard & Ismaeelzadeh, 2018).

Although there was no age limit, the majority of participants in this study were under 20 years old. However, due to the generation gap and differences between generations, it is still possible to compare the attitudes and intentions across different age groups. One of the obstacles in this research was the internet outage and lack of nationwide coverage in the country, which can impact the acceptance of internet-based technologies. In future studies, it may be beneficial to explore data collection methods other than questionnaires. This would allow for comparative studies or evaluations of pre-admission and post-admission behaviors.Using a qualitative approach can provide the opportunity to obtain and observe diverse experiences related to this technology, which is very important (Ahmad et al., 2020). To achieve richer results, integrating the Technology Acceptance Model with other acceptance models can be considered. Furthermore, future research should include variables such as trust and perceived pleasure in the model for a more comprehensive understanding of psychological processes. Additionally, since sports wearables are relatively expensive, investigating users' perception of their value and quality could be beneficial.

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