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Wearable Devices in digital society: Recognition, use of and readiness for use by young consumers

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Abstract: This article presents the issue of using and recognizing Wearable Technology by young consumers. The review of literature and reports has shown that this type of devices is increasingly common, available and allows to support digital society in leading healthy lifestyle, by monitoring health parameters. In the perspective of these factors, the authors formulated the aim of the article, which is to identify the recognition, use of and readiness for use of Wearable Devices. The study was conducted on a sample of 173 representatives of young consumers. The technique of an Internet survey based on an electronic questionnaire was used for this purpose. This research aimed to find answers to questions focusing on finding factors on which recognition, use of and readiness for use of Wearable Devices depends. The results of the survey showed that most often dependencies occur in the case of variables such as gender of respondents, age and professional status. In terms of the most important functions, the respondents indicated measurement of steps, pulse and time in motion (on your feet). Respondents also showed the greatest willingness to use Wearable Devices such as smartwatch, smartglasses and smartband. The findings of this study provide several practical implications for developers and marketers of sports wearables that can be used to better design and promote their products as well as better satisfy users' needs.

Keywords: Wearable Technology, wearables market, data monitoring

1. Introduction

The evolution of information and communication technology (ICT) in recent years has dramatically reshaped people's behaviour. Compact mobile devices with robust computing power and battery life have become a common and universal good. One of the most popular representatives—Wearable Technology (WT), has gained traction in recent years to track data about everyday life and physical well-being for personal use (Khakurel et al., 2018). Moreover, the introduction and development of Wearable Devices (WD) have granted the any-

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where-anytime access to information (Kim and Shin, 2015), and thus they are emerging as the next-generation tools for ubiquitous communication (Park et al., 2016). These undoubted benefits affect the growing importance of wearables in the economy. According to the market research reports, the global Wearable Technology market is estimated to reach 56.8 billion USD by 2025, at a compound annual growth rate (CAGR) of 11.28% between 2016 and 2025 (Markets and Markets, 2017). A similar trend direction concerns the popularity of a healthy lifestyle, which has also been noticed by mobile device manufactures. Bearing in mind the research of the same market agency, the global wearable healthcare devices market size is projected to reach 46.6 billion USD by 2025 from 18.4 billion USD in 2020, at a CAGR of 20.5% from 2020 to 2025 (Markets and Markets, 2020). The interface between technology and a healthy lifestyle is a source of opportunities for the development of Wearable Devices, which is clearly visible in the behaviour of young people. Most transparently, Wearable Devices are defined as electronic devices that provide the functions of a computer or system and can be attached to or worn on the body (Buenaflor and Kim, 2012).

Currently, there are two main kinds of wearables available on the market—medical and fitness devices. Medical Wearable Devices are more likely to be adopted by the elder and unhealthy users. They are generally designed for certain disease such as diabetes and cancer (Gao et al., 2015). There are various methods used to monitor human health parameters, and the existing systems are costlier and are not easily affordable by various sections of people (Evangeline and Lenin, 2019). Moreover, the specific medical parameters are also limited in each device available on the market (Bloss, 2015; Chandana and Latha, 2014; Sivasankari et al., 2016), so there is a necessity to buy different types to measure and monitor specialist indicators by professionals. These limitations prompted the authors to focus in this research on the second type of wearables—fitness devices. It is worth mentioning here that regular physical activity is key to both the prevention and the treatment of lifestyle diseases such as cardiovascular diseases (Chomistek et al., 2015) and type 2 diabetes (Sigal, 2006), especially by modern, digital society.

Primarily fitness/ sports wearables were used by professional athletes to improve their performance. Currently, these devices have been widely adopted by health-conscious consumers, who want to track their daily activities (Kim et al., 2019). The wide penetration of smartphones and Wearable Devices has enabled society to track, store and transmit information related to their physical activities (heart rate, temperature, burned calories and elapsed time since the last physical activity) (Talukder et al., 2019). Understanding the phenomenon of the success of this technology requires emphasizing their basic features and systematics.

According to Liu and Guo (2017), Wearable Devices are wearable computers with a mobile Internet connection that are worn like dresses and personal adornments to display information for users intelligently and efficiently, such as wearable glasses and wearable watches (Liu and Guo, 2017). More broadly, Wearable Devices are smart electronic devices available in various forms, that are used near or on the human body to sense and analyze physiological and psychological data, such as feelings, sleep, movements, heart rate and blood, via applications either installed on the device or on external devices, such as smartphones connected to the cloud (Khakurel et al., 2018). Regardless of the adopted definition, these devices bring users several benefits. They allow continuous monitoring of individual's health and well-being sta-

tus, offer a scaling of measurement capability in the community, enable measurement of key parameters in new and direct ways, or also allow remote monitoring of lifestyle and medication adherence.

According to Kim and Shin (2015), wearables are typically classified into four categories: accessory (e.g., smartwatch, smartglasses), clothing (e.g., smartwear, sensors mounted in textile gods), body-mounted (skin-patch formed sensor or devices) and bio-implants (implantable sensors or devices). Wearable Devices can be also divided into three categories according to their functionality: *notifiers* that provide information about the world around the user (e.g., smartwatches), *eyeglasses* that create augmented reality seen by the wearer, and *trackers* that use sensors to record data (Lunney et al., 2016). Most of the sports wearables fall into the third category, which is responsible for about 50% share of the Wearable Technology market (Kim and Chiu, 2019). It may be attributed to several drivers of interest in Wearable Technology, which have been aggregated by Doughty and Appleby (2016) into the following:

- an increased consumer interest in medical technology, especially concerning prevention agendas and the need for greater fitness, and levels of activity for improved lifestyle;
- new interests in personalized and digital healthcare programmes, many prompted through apps for smartphones and tablet devices;
- the availability of nearly universal wireless connectivity through Wi-Fi and mobile networks;
- recent improvements in electronics and sensing technologies that have resulted in smaller, more lightweight and power-efficient devices and dispersed sensors;
- efficient and powerful wearable plus portable computing power and software.

As a fundamental component of a young customers lifestyle, being physically active is socially praised (Feng and Agosto, 2019). There are growing interests in consumer-facing mobile and Wearable Technologies that promise to help people become or stay physically active. Prevention is seen as perhaps the only sustainable way of managing the health and support needs and expectations in the future (Dought and Appleby, 2016). Considering the above, this paper focuses on fitness wearables concerning their recognition, use and readiness for use by the young people.

2. Materials and methods

The research was conducted using the Internet survey technique, with a measuring instrument in the form of a survey questionnaire. The research tool was designed using forms available on Google. It consisted of two parts—substantive and metric, in which questions based on both nominal and interval scales were placed. The first part made it possible to examine such aspects as knowledge and use of Wearable Devices together with the recognition of features important for the respondent. The question on general knowledge/ recognition of the term *Wearable Technology*, knowledge of its specific examples and general use of Wearable Devices contained a response cafeteria consisting of two possible dichotomous answers: Yes or No. The question about the use and readiness to use the Wearable Device was based on a scale with four possible answers: “I do not use, and I do not declare readiness to use”, “I don’t use, but I declare readiness to use”, “I use and I’m not satisfied” and “I use and I am satisfied”. The question

of significance assessment of health features of Wearable Devices was based on a seven-stage scale, where 1 meant completely unimportant, 4—hard to say, and 7—extremely important. The second part was focused on metric data such as: gender, age, education and professional status of the respondents. These questions contained a cafeteria consisting of two possible answers. The statistical analysis was performed using IBM SPSS statistics version 25. The data was presented using frequency, arithmetic mean and stretch marks analysis. Also, cross tables in the form of two-partite tables were used from which the value of statistics *p* of the Pearson's chi-square variable independence test was calculated. When any area of the table was lower than 9, the value of statistics including Yates correction was read, when the number was lower than 5, the value of Fisher's Exact Test statistics was read.

In the research process the following research questions were prepared:

- RQ1—What does declared recognition of Wearable Technology in the research group depend on?
- RQ2—What does declared use of Wearable Technology in the research group depend on?
- RQ3—What does declared recognition of specific Wearable Devices like smartglasses, smartband, smartwatch, smartjewellery, smartclothes, smarttattoo and smartchip, in the research group depend on?
- RQ4—Which Wearable Devices do the representatives of the examined group declare use and readiness to use?
- RQ5—What are the most important features of Wearable Devices in the study group?

The details of the sample are presented in Table 1.

Table 1. Sample characteristics (n = 173)

Variables	Number of respondents	Percent of respondents
Gender		
Male	74	42.8
Female	99	57.2
Age		
19–24 y.o.	130	75.1
25–30 y.o.	43	24.9
Education		
Secondary	98	56.6
Higher	75	43.4
Professional situation		
Student	141	81.5
Employee	32	18.5

S o u r c e: Authors' own elaboration

The research was conducted from February to April 2020 on a sample of 173 young customers. Almost 43% of the research group were men—the rest were women. The sample includes young people: Generation Z (19–24) and Y (25–30) representatives. In the literature, there is also a division of Y-generation into two subgenerations: online, also called generation C, and offline (Van den Bergh and Behrer, 2011). Generation boundaries are not clearly defined. The Y generation is sometimes defined as persons born between 1977 and 1995 (Bartlett, 2004; Dalton, 2003), and the lower limit for 1980 (Bolton et al., 2013; Huh and Chang, 2017; Kim et al., 2016) and 1982 (Paul, 2001) is also given. More than 75% of the study group are representatives of generation Z. These are people who spend their time in the social media world using mobile devices like smartphone, tablets, phablets and laplets (Hoxha and Zeqiraj, 2020), and have high technological competences (Tapscott, 1998). They are characterized by a much faster pace of life, they have to have everything on the line, for now, when something in the real world catches their attention—they check it on the Internet. They are well-informed and educated, have a low tolerance for errors. They are more and more aware of their position on the market, can actively communicate about their needs and participate in creating products or services of the brands they use (Kotler et al., 2016). This type of behaviour shows that the representatives of this generation are prosumers—a hybrid form of producer and consumer. They consume the goods offered by brands and, based on their opinions, become part of the chain of co-creating this market value (Seran and Izvercian, 2014; Fine et al., 2017). The representatives of generation Y (millennials), unlike Zs, do not live only in the virtual sphere. They can connect these spheres and move dynamically between them. Examples of such smooth transitions are ROPO consumer (research online, purchase offline), reverse ROPO effects (research offline, purchase online) (Szymanski and Stanislawski, 2018; Kowalczuk, 2018). They have unique attitudes towards brands, are consumption-oriented and take care of their health and physical condition (Lazarevic, 2012). More than 56% of respondents had secondary education, the rest—higher education. The majority of the respondents (81.5%) were students, the rest of them working daily.

3. Results

The data collected during the research process are presented in the tables below. Table 2 presents two factors: declared recognition and use of Wearable Technology in relation to gender, age, education status and professional situation in the research group.

Table 2. Declared recognition and use of Wearable Technology in the research group (n = 173)

Variables	Declared recognition of WT		Declared use of WT	
	Yes	No	Yes	No
Gender (Total)	77	96	38	135
Male	41	33	22	52
Female	36	63	16	83
p[1]	0.013[2]		0.033[2]	

Age (Total)	77	96	38	135
19–24 y.o.	64	66	30	100
25–30 y.o.	13	30	8	35
p[1]	0.030[2]		0.688[3]	
Education (Total)	77	96	38	135
Secondary	47	51	20	78
Higher	30	45	18	57
p[1]	0.297		0.572	
Professional situation (Total)	77	96	38	135
Student	67	74	34	107
Employee	10	22	4	28
p[1]	0.095		0.236[4]	

[1] Value of *p* statistics of chi-square test; [2] $p < 0,05$; [3] Yates correction; [4] Fisher's Exact Test

S o u r c e: Authors' own elaboration.

According to the above, results factor "declared recognition of Wearable Technology" depends on two variables: gender (*p*-value = 0.013) and age (*p*-value = 0.030). Relatively more men (55.4%) declare knowledge of Wearable Technology than women (36.4%) and relatively more people aged 19–24 (49.2%) declare knowledge than people aged 25–30 (30.2%). The second factor "declared use of Wearable Technology" depends on one variable: gender (*p*-value = 0,033). In the research group, relatively more men (29.7%) than women (16.2%) declare the use of Wearable Technology.

The next aspect researched was "declared recognition of specific Wearable Devices". The results are presented in Table 3.

Table 3. Declared recognition of specific Wearable Devices (*n* = 173)

Declared recognition of	**Gender**		**Age**		**Education**		**Professional situation**	
	Male	**Female**	**19–24 y.o.**	**25–30 y.o.**	**Secondary**	**Higher**	**Student**	**Employee**
Smartglasses (Total)	74	99	130	43	98	75	141	32
Yes	58	59	91	26	72	45	99	18
No	16	40	39	17	26	30	42	14
p[1]	0.009[3]		0.247		0.061		0.128	

Smartband (Total)	74	99	130	43	98	75	141	32
Yes	67	81	112	36	84	64	123	25
No	7	18	18	7	14	11	18	7
p[1]	0.163[5]		0.886[5]		0.944		0.296[5]	
Smartwatch (Total)	74	99	130	43	98	75	141	32
Yes	73	95	128	40	96	72	139	29
No	1	4	2	3	2	3	2	3
p[1]	0.394[6]		0.099[6]		0.654[6]		0.045[2, 6]	
Smartjewellery (Total)	74	99	130	43	98	75	141	32
Yes	28	32	47	13	31	29	44	16
No	46	67	83	30	67	46	97	16
p[1]	0.451		0.479		0.335		0.044[2]	
Smartclothes (Total)	74	99	130	43	98	75	141	32
Yes	31	19	38	12	27	23	39	11
No	43	80	92	31	71	52	102	21
p[1]	0.001[4]		0.868		0.654		0.449	
Smarttattoo (Total)	74	99	130	43	98	75	141	32
Yes	13	4	11	6	8	9	12	5
No	61	95	119	37	90	66	129	27
p[1]	0.004[3, 6]		0.451[5]		0.560[5]		0.373[5]	
Smartchip (Total)	74	99	130	43	98	75	141	32
Yes	53	54	89	18	61	46	90	17
No	21	45	41	25	37	29	51	15
p[1]	0.022[2]		0.002[3]		0.903		0.260	

[1] Value of p statistics of chi-square test; [2] $p < 0,05$; [3] $p < 0,01$; [4] $p = 0,001$; [5] Yates correction; [6] Fisher's Exact Test

S o u r c e: Authors' own elaboration

Accordingly, as indicated in this table, factor "declared recognition of smartglasses" depends on gender (p-value = 0.009). In the research group, more men (78.4%) than women

(59.6%) declare the recognition of smartglasses. Factor "declared recognition of smartwatch" depends on professional status (p-value = 0.045). Relatively more students (98.6%) declare knowledge than working people (90.6%). Factor "declared recognition of smartjewellery" depends on professional status (p-value = 0.044). Relatively more employees (50%) declare knowledge than students (27.7%). Factor "declared knowledge of smartclothes" depends on gender (p-value = 0.001). Relatively more men (41.9%) declare knowledge than women (19.2%). The next factor—"declared knowledge of smarttattoo"—depends on gender (p-value = 0,004). Relatively more men (17.6%) declare knowledge than women (4%). Factor "declared knowledge of smartchip" depends on gender (p-value = 0.022) and age (p-value = 0.002). In the research group, relatively more men (71.6%) declare knowledge than women (54.5%) and relatively more people aged 19–24 (68.5%) declare knowledge than people aged 25–30 (41.9%). No dependencies have been identified for variables in the case of a smartband.

Next, the aspect of declared use and readiness to use Wearable Devices was examined. The results are presented in Table 4.

Table 4. Declared use and readiness to use Wearable Devices (n = 173)

Wearable Technology	I do not use, and I do not declare readiness to use	I don't use, but I declare readiness to use	I use and I'm not satisfied	I use and I am satisfied
Smartglasses	73	89	3	8
Smartband	51	84	9	29
Smartwatch	49	93	1	30
Smartjewellery	122	46	3	2
Smartclothes	110	63	0	0
Smarttattoo	153	20	0	0
Smartchip	131	41	1	0

S o u r c e: Authors' own elaboration

According to the results:
- more consumers declare readiness to use devices related to the measurement of sports functions (smartband and smartwatch);
- fewer consumers declare their readiness to useless known devices such as smartjewellery, clothes, tattooing;
- the vast majority of consumers do not declare readiness to use chips.

In Table 5 significance assessment of health features of Wearable Devices in the research group was presented.

Table 5. Significance assessment of health features of Wearable Devices (n = 173)

Health Features	Calories burnt	Time in motion (on your feet)	Time at rest (sitting)	Sleep	Steps	Pulse	ECG
			Significance assessment				
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	30	21	31	23	19	19	33
6	16	23	28	31	16	25	39
7	127	129	114	119	138	129	101
Mean	6.56	6.62	6.48	6.55	6.69	6.64	6.39
Range	2	2	2	2	2	2	2

S o u r c e: Authors' own elaboration

According to these results, all the mentioned functions were marked for the respondents as very important. Their arithmetic mean was between 6.39 and 6.69. The highest mean was for steps (mean = 6.69), pulse (mean = 6.64) and time in motion (on your feet) (mean = 6.62), which means that these three features were the most important for the respondents. The dominant answers for each of the individual functions were 7, which is the most significant value for respondents of the research group.

4. Discussion

Concerning the first research question RQ1—declared recognition of Wearable Technology in the research group depends on gender and age. In contrast, when comparing research results with RQ2—declared use of Wearable Technology in the research group depends on gender. For RQ3—declared recognition of specific Wearable Devices in the research group depends on gender (for smartglasses, smartclothes, smarttattoo and smartchip), age (for smartchip), professional situation (for smartwatch and smartjewellery). Our study explored the differences between gender groups and the results of the research show that male consumers have higher mean values for awareness and using Wearable Technology. This coincides with the results of Kim and Chiu (2019) research, who identified those values for positive: technology readiness, perceived ease of use and perceived usefulness, are significantly higher in the male group. This shows a broader context in which females tend to be more concerned and anxious about using new technologies. Several studies proved possession of higher learnability and adaptability when using new technology services or products by

males (Li and Kirkup, 2007; Jackson et al., 2001; Venkatesh and Morris, 2000; Orji, 2010; Nysveen et al., 2005). Male consumers are more technologically adept, although positive and negative beliefs of using technology are critical influencers of acceptable behaviour towards new technology by them (Kim and Chiu, 2019). It may be due to the earlier adoption of sports wearables by males (Canhoto and Arp, 2017). Also, higher males sensitivity to the functionalities of sports wearables may be due to the higher level of their technological affinity and prior technological experience (Kim and Chiu, 2019).

Another important finding of the study is the significance of age as a control variable in the context of sports wearables. Since individuals from different age groups can behave differently when accepting a technology or its recognition, improving the results by controlling for even more focused age groups would be beneficial.

Due to technology's expanding role in people's daily lives, it is necessary to explore consumers' readiness to use technology-based products and services (Parasuraman, 2000), as people's dispositions towards using technology-based products and services differ (Kim et al., 2019). Comparing the results from Table 4 of RQ4, it can be concluded that in the study group the highest number of people declare readiness to use smartwatch (93 indications), smartglasses (89 indications) and smartband (84 indications). A review of the literature indicates that researchers are paying increasing attention to understanding users adoption of Wearable Devices. Most extant literature of Wearable Devices emphasizes the segment of smartwatches (Kim and Shin, 2015; Chuah et al., 2016). However, the sports wearables segment, which possesses the most growth potential, was overlooked in the extant literature (Lunney et al., 2016; Canhoto and Arp, 2017). The findings of Aksoy, Alan, Kabadayi and Aksoy (2019) study support the positive effects of performance expectancy, effort expectancy, facilitating conditions, social influence on attitude towards sports wearables. In this regard, their study provides evidence both for the studies where Wearable Technologies are specifically examined and studies that are conducted in other sports products-related contexts.

In response to RQ5, the most important features in Wearable Technology are steps, pulse, time in motion (on your feet). These three functions are related to fitness activities like jogging, running, etc. Our results correlate with other studies and show a significant role in improving sports performance by devices like smartwatch or smartband. Feng and Agosto (2018) examined amateur runners' needs and find that two main goals they want to achieve through their planned physical exercises are: "live a healthy lifestyle" and "improve physical health". The most prominent theme in their qualitative data was a special type of health/fitness-related needs aiming at improving running performance (Feng and Agosto, 2019). Their respondents expressed needs to improve running performance by accurately tracking advanced types of data like heart rate (pulse), cadence, pace, etc. Extant literature proved that users usually exhibit a positive attitude towards the product of healthcare Wearable Devices (Gao et al., 2015). Also, perceived ease of use is very important in determining consumers adoption of healthcare Wearable Devices (Hensel et al., 2006).

The findings of this study provide several practical implications for developers and marketers of sports wearables that can be used to better design and promote their products as well as better satisfy users' needs. Marketers should aim mainly at young male consumers (generation Z) with their products, but also persuade females that their products are easy to learn

and use at the same time. Sport and health functions should be developed as it is appreciated by users. As a relatively new market segment, Wearable Technology has huge development potential, considering their positive impact devices on a digital society. While wearable practices motivate users to stay fit, it is still not clear what privacy consequences they can bring for its users (Pingo and Naryan, 2020). In the past researchers have found that wearable trackers transmit data including consumers identifiers, address, diet and workout information to third parties (Lupton, 2016). Despite the invaluable benefits of Wearable Devices, we should not forget about the risks of privacy and the risk of depriving us of self-control. In our opinion, these threats should become the subject of future research, along with new Wearable Devices functions and the improvement of their ergonomics.

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Wearable Devices w społeczeństwie cyfrowym – znajomość, użytkowanie i gotowość do użycia przez młodych konsumentów

Abstrakt: Niniejszy artykuł porusza kwestie rozpoznawania, użytkowania oraz gotowości do użycia technologii noszonej (Wearable Technology) przez współczesnych konsumentów. Przegląd literatury przedmiotu oraz raportów branżowych wykazał, że ten typ technologii oraz urządzeń jest coraz bardziej rozpowszechniony, dostępny i odgrywa coraz większą rolę w życiu codziennym współczesnego społeczeństwa cyfrowego. W związku z tym autorzy sformułowali cel badawczy, jakim była identyfikacja poziomu rozpoznawalności, użytkowania oraz gotowości do użycia urządzeń noszonych (Wearable Devices). Badanie zostało przeprowadzone na próbie 173 respondentów, będących młodymi konsumentami (pokolenie Z i Y), przy zastosowaniu elektronicznego kwestionariusza ankiety. Pytania badawcze były nakierowane na rozpoznanie czynników, które determinują wykorzystywanie oraz gotowość do stosowania technologii noszonej. W świetle wyników badania istotne zależności odnotować można w przypadku zmiennych takich jak płeć, wiek i status zawodowy respondentów. Najważniejsze funkcje opisywanej technologii zdaniem młodych konsumentów koncentrują się wokół pomiaru pulsu, liczby wykonywanych kroków oraz obliczania czasu spędzanego w ruchu. Respondenci wykazali również, że najbardziej interesującymi ich produktami w tym zakresie są smartwatch, smartglasses oraz smartband. Szczegółowe wyniki opisywanego badania niosą szereg implikacji dla twórców i sprzedawców tego typu technologii oraz urządzeń, w szczególności przedstawiając profil potencjalnych konsumentów oraz oczekiwania użytkowników.

Słowa kluczowe: technologia noszona, społeczeństwo informacyjne, monitorowanie danych