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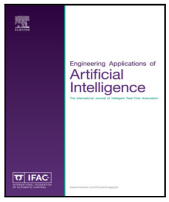

A comprehensive overview of smart wearables: The state of the art literature, recent advances, and future challenges ☆

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ABSTRACT

Smart wearables have gained considerable attention from Information Systems (IS) academics, business managers, and health practitioners. In spite of the availability of authentic research studies of smart wearables, there is still a lack of systematic review on the different aspects of smart wearables concept to find the current state of research, particularly from the perspective of IS field. Therefore, the predominant aim of this research is to review smart wearables literature, recent advances, and future challenges. Accordingly, a systematic literature review was conducted to explore smart wearables by reviewing previous studies from 2010 to 2019. For covering all related papers during these years, an integrated review protocol consisting of automatic and manual stages was pursued. 244 papers were identified to address smart wearables issues and challenges. According to the findings, it is observed that smart wearable studies have increased dramatically during the last years. Moreover, the results show that current studies covered different research themes which are related to smart wearables area, particularly user behavior, technology-focused, security and privacy, design, and social acceptability. Furthermore, based on the results of the weight analysis technique, perceived usefulness, attitude toward technology, social influence, and privacy concerns are identified as the best predictors of smart wearables adoption. Additionally, the results show that the Technology Acceptance Model (TAM) is the most commonly adopted theory in the smart wearable studies. The findings of this review would assist academics to realize the existing limitations and gaps as well as the future works for smart wearables research studies.

1. Introduction

The rapid evolution of the Internet of Things (IoT) has enabled the emergence of compact electronic and computing devices that could be embedded on the individuals' body. These devices are known as smart wearables, wearable technology or wearable devices. The emergence of these technologies has provided the ability to access the information anywhere and anytime (Kim and Shin, 2015; Perera and Vasilakos, 2016). Moreover, smart wearable devices are being introduced as the next-generation of ubiquitous technologies after smartphones (Liu et al., 2015; Park et al., 2016). These smart products are provided for being used in various end-user sectors such as lifestyle computing, medical, sports, and personal safety (Cheng and Mitomo, 2017; Peake et al., 2018).

The wide market penetration of smart wearables has empowered individuals to monitor, store, and transfer personal information about health, physical activity, and surrounding such as body temperature, blood pressure, heart rate, calories intake, calories burned, steps counters, sleep pattern, location, and so forth (Gayathri et al., 2017; Lupiani et al., 2017; Talukder et al., 2019; Wu et al., 2016a). Academics believe that individuals' physical activity is an amendable behavior, so there has been a growing interest among researchers in examining the strategies for improving physical activity among individuals with disabilities as well as elderlies through exploring smart wearables with the aim of minimizing the burden of disabilities and decreasing the incidence of chronic diseases (Noor et al., 2016; Rao, 2019). Thus, smart medical and wellness wearables have drawn academic researchers and practitioners' attention as a motivational solution for enhancing the individuals' health and well-being (Aliverti, 2017).

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Recently, smart wearables such as smartwatches and smart wristbands have engrossed many market attention. According to IDC (2019), the global shipment of smart wearables will extend to 222.9 million devices in 2019 and will hit 302.3 million devices in 2023. Furthermore, it is predicted that the shipment of smartwatches will be increased from 91.8 million devices in 2019 to 131.6 million in 2023 (IDC, 2019). Additionally, IDC (2019) forecasts that the earwear devices will be raised from 72 million devices in 2019 to 105.3 million in 2023. IDC (2019) assumes that the popularity of smartwatch and smart earwear devices will continue to sustain the smart wearables market forward. Accordingly, it could be concluded that the willingness of individuals toward using smartwatch and earwear devices will be significantly increased in the coming years.

Although reports express the increased demands for smart wearables, the adoption and diffusion of these technologies are relatively low (Adapa et al., 2017; Dehghani, 2018; Sultan, 2015). Since users may not gain the promised benefits of wearable devices, almost half of users would leave using of their devices during the first six months (Canhoto and Arp, 2017; Marakhimov and Joo, 2017; Talukder et al., 2019). Thus, it is critical for the community of Information Systems (IS) and business practitioners to understand smart wearables issues and challenges more deeply.

To the best of the authors' knowledge, there has not been a study to review and synthesize smart wearables research studies systematically. Thus, this research applied a Systematic Literature Review (SLR) approach to investigate the smart wearables concepts. Through this review, the prior published studies on smart wearables were extracted, analyzed, and synthesized in a systematic way and a mind map was provided to identify the current state of wearable technologies studies, theories, methodologies, and themes. To gain more effective outcomes, three main research questions were formulated. The findings of this SLR can help researchers to understand the recent trends and challenges of wearable technologies more clearly. The following four questions were created to assist the literature review of this study:

RQ1: What are the main studies on smart wearable technologies in IS domain and which themes have been highlighted in these studies?

RQ2: What are the theoretical adoption models and frameworks that applied in the previous smart wearables researches?

RQ3: What are the most potent factors that affect smart wearables behavioral intention and adoption?

This review provides two main contributions to the field of smart wearables. First, through analyzing 244 primary studies, this SLR provides an in-deep understanding of smart wearables concept and the research themes' mind map for academics who are seeking for the research topics that need more investigations. Second, this review provides a list of predictors (promising and best predictors) of behavioral intention toward adopting and using smart wearables.

The rest of the present study is laid out in the following design. The second section presents a brief background of smart wearables. The third section explains the review method and how this research was carried out. The fourth section provides the results of SLR. The answers to the research questions are presented in the fifth section. Section sixth provide discussions, challenges and issues, and some directions for future work. The conclusion of this systematic review is explained in the seventh section.

2. Background

An overview of the smart wearables, the core definitions and classifications along with the historical emergence of wearables are presented in this section.

2.1. Definitions and classifications of smart wearables

The term 'Smart' has no specific and unified definition among scholars and it is defined by different researchers in several ways. For example, Kortuem et al. (2010) defined 'smart objects' as independent digital objects that are enhanced by the sensors, processors, and network facilities. Smart objects transfer some chunks of application logic that permit them the ability to sense their location and interacting with humans. Wearable computing is covering both smart wearables and smart clothing. Essentially, smart wearables are devices that are equipped by wireless sensors and embedded in garments or accessories and could be worn by users persistently (Cheng and Mitomo, 2017). These devices are designed to measure users' personal information such as vital signs, locations, environments, and movements (Cheng and Mitomo, 2017). Poslad (2011) defined wearable computing as embedded computers in anything that individuals usually use to cover or accessorize their body. According to Jeong et al. (2017), wearables defined as electronic products that are designed to provide particular services that could be worn by the consumers. Table 1 presents some other definitions of smart wearables.

On the other hand, there is not any specific and standard classification of smart wearables. International Data Corporation (IDC, 2017) categorized wearables into five groups, namely: watches, wristbands, clothing, earwear, and others. Dimou et al. (2017) classified smart wearables in the following six categories, namely: entertainment, lifestyle, fitness, medical, industrial, and gaming. Entertainment includes wearables that are used for gesture, Augmented Reality (AR), control devices, and smart gloves. Lifestyle contains wearables that are used for video and voice calling or gesture control. Fitness includes wearables that are used for assessing distance traveled, heart rate, and body temperature. Medical includes wearables that are used for hearing aid, cardiac monitoring, patients' remote monitoring, and bionics. Industrial includes wearables which are used in remote and hands-free operations related to industrial and business goals. Gaming includes wearables that use AR for gaming. Moreover, Yang et al. (2016) classified wearables into three groups, namely: necklace or wristband-type, watch-type, and head-mount display-type. Watch-type wearable devices could receive the notifications of the smartphones, text messages, and e-mail without requiring to take out the smartphone from the pocket. Necklace or wristband-type wearables are essentially used to monitor the individuals' wellness condition in real time while head-mount display-type wearable devices are proper for Virtual Reality (VR) contents and three-dimensional (3D) games.

2.2. A brief history of smart wearables

IoT is a term that put forwards by Kevin Ashton during a presentation at a research center of Massachusetts Institute of Technology (MIT) in 1999 (Ashton, 2009). He visualized a fantasy world with connected objects via internet by using sensors and actuators that are able to produce real time information and enhance the quality of humans' daily life (Mishra et al., 2016). International Telecommunications Union (ITU) put this idea visible to everyone by reporting IoT concept in 2005 (ITU, 2005). Within the context of IoT, smart wearables are introduced as the next generation of market demands after smartphones.

However, smart wearables is not a novel concept. Various researchers have been tried to design and develop several types of wearables for different purposes in the last decades (Sultan, 2015). In 1981, one of the smart wearables pioneers, Steve Mann, designed and built 'EyeTap goggles'. This device could project a computer generated picture to one eye and reinforce user's visual perceptions with textual information (Mann, 2012). Fernandez (2012) stated that the first wearable computing devices were built in the size of a box of cigarettes by physicists and researchers at MIT with the aim of cheating at roulette games in the early of 1960s. Moreover, Bass (1985), explained the shoe-based computers built in the 1970s by professors in California to assist

Table 1
The definition of smart wearables.

No.	Wearables Definition	Reference
1	"Wearable computing is the study or practice of inventing, designing, building, or using miniature body-borne computational and sensory devices. Wearable computers may be worn under, over, or in clothing, or may also be themselves clothes"	Mann (2012)
2	"Self-powered, fully functional and self-contained computer that provides access to information, and interaction with human body at anytime and anywhere"	Barfield and Caudell (2001)
3	"A shift from digital simulation (separation and replication) to digital augmentation (responsiveness and connectivity)"	Viseu (2003)
4	"Electronic technologies or computers that are incorporated into items of clothing and accessories which can comfortably be worn on the body"	Tehrani and Michael (2014)
5	"Electronics and computers that are integrated into clothing and other accessories that can be worn comfortably on the body"	Wright and Keith (2014)
6	"Wearable digital devices that incorporate wireless connectivity for the purposes of seamlessly accessing, interacting with and exchanging contextually relevant information"	Bower and Sturman (2015)
7	"Every device which is worn for an extended period of time, processes and controls its user's inputs and enhances his experience"	Dimou et al. (2017)
8	"Embedded portable computers and advanced electronics that integrate seamlessly into people's daily lives and enable them to interact with a smart environment (i.e. home appliances) anytime and anywhere"	Dehghani and Dangelico (2018)
9	"Wearables include all forms of computational or sensory electronic devices that can be worn with clothing or on the body. In the broadest sense, any computer device that is carried with a person to assist them could conceivably be called a wearable".	Fernandez (2012)

them while playing roulette. Around two decades ago, in 1996, the first smart shirt was created when the U.S. Navy's Defense invested on a research project at a technology institution in Georgia to track the physical condition of soldiers (Park and Jayaraman, 2003; Wright and Keith, 2014). Since then, scholars began to extend the invention of wearables in the health domain to track vital signs and forward the biofeedback data to hospitals or physicians' clinics (Wright and Keith, 2014). Since their emergence, smart wearables have gradually improved from inconvenient, heavy, and large technologies to more comfortable, portable, and weightless devices.

3. Review method

A Systematic Literature Review (SLR) was applied as a review approach to answering the research questions by following Hanafizadeh et al. (2014) and Kitchenham and Charters (2007). Along with designating the three research questions, a review protocol was defined to perform the SLR that illustrated in Fig. 1.

This study follows the search strategy used by Busalim and Hussin (2016) that includes two steps: automatic and manual searching strategy. For automatic search strategy, a search string defined based on the keywords used in the smart wearables research area. According to the research questions, the main keywords used are "Wearable technology", "Wearable devices", "Wearables", "Information Systems" and "influential factors". The operators "OR" and "AND" are used to connect the primary keywords, synonyms, and some related key terms. Then, after numerous tests, the following search string has been chosen: (("Wearable technology" or "Wearable Devices", or "Wearables") AND ("Information Systems" or "IS") AND ("Adoption" or "Behavioral Intention", or "Acceptance") AND ("Empirical" or "Quantitative" or "Qualitative")). It should be noted that the researchers used these keywords by shifting the position of the words or deleting some of them during each of the search processes to achieve the most relevant papers. In order to execute keywords, this study used the Thomson ISI's Web of Science (WoS) and Elsevier's Scopus databases (Fahimnia et al., 2015; Mishra et al., 2016). It should be a remark that for manual search strategy, the forward and backward searching method used that proposed by Webster and Watson (2002).

Table 2
Exclusion and inclusion criteria.

Criteria	Principles
Inclusion	Papers published from 2010 to 2019 Full text Peer-reviewed studies Papers focused on the wearables from the IS perspective Papers answer the defined research questions
Exclusion	Papers not in the English language Non-empirical or non-experimental studies Papers less than 4 pages Papers out of the IS scope Not peer reviewed studies

The focus of this research is on the English published articles from 2010 till the end of March 2019. The year 2010 has been determined as a starting point of the searching process for two reasons. First, this review seeks to consider the latest studies relevant to the smart wearables topic stored in online databases. Second, Fitbit trackers as the first smart wearable devices were released for the general public at the end of 2009 (Comstock, 2015). From that time onwards, empirical researches of smart wearables have gradually increased year-by-year. Apart from this, the inclusion and exclusion criteria of this review are demonstrated in Table 2.

In the first step of the searching process, the defined search string in the previous section was applied, and 783 articles returned from the automatic searching step. Fig. 2 exhibits the complete process of selecting primary studies. After the full-text scanning used by considering the inclusion and exclusion criteria, 279 papers remained as the primary studies of this systematic review. To guarantee the overall credibility of the primary studies, the quality assessment (QA) process was performed (Kitchenham and Charters, 2007; Nidhra et al., 2013). The following QA criteria were adopted from Busalim and Hussin (2016) to evaluate the quality of all the selected papers.

QA1: Is the subject addressed in the article relevant to the wearable technologies?

QA2: Is the research methodology clearly addressed in the article?

QA3: Is the data collection method addressed in the article?

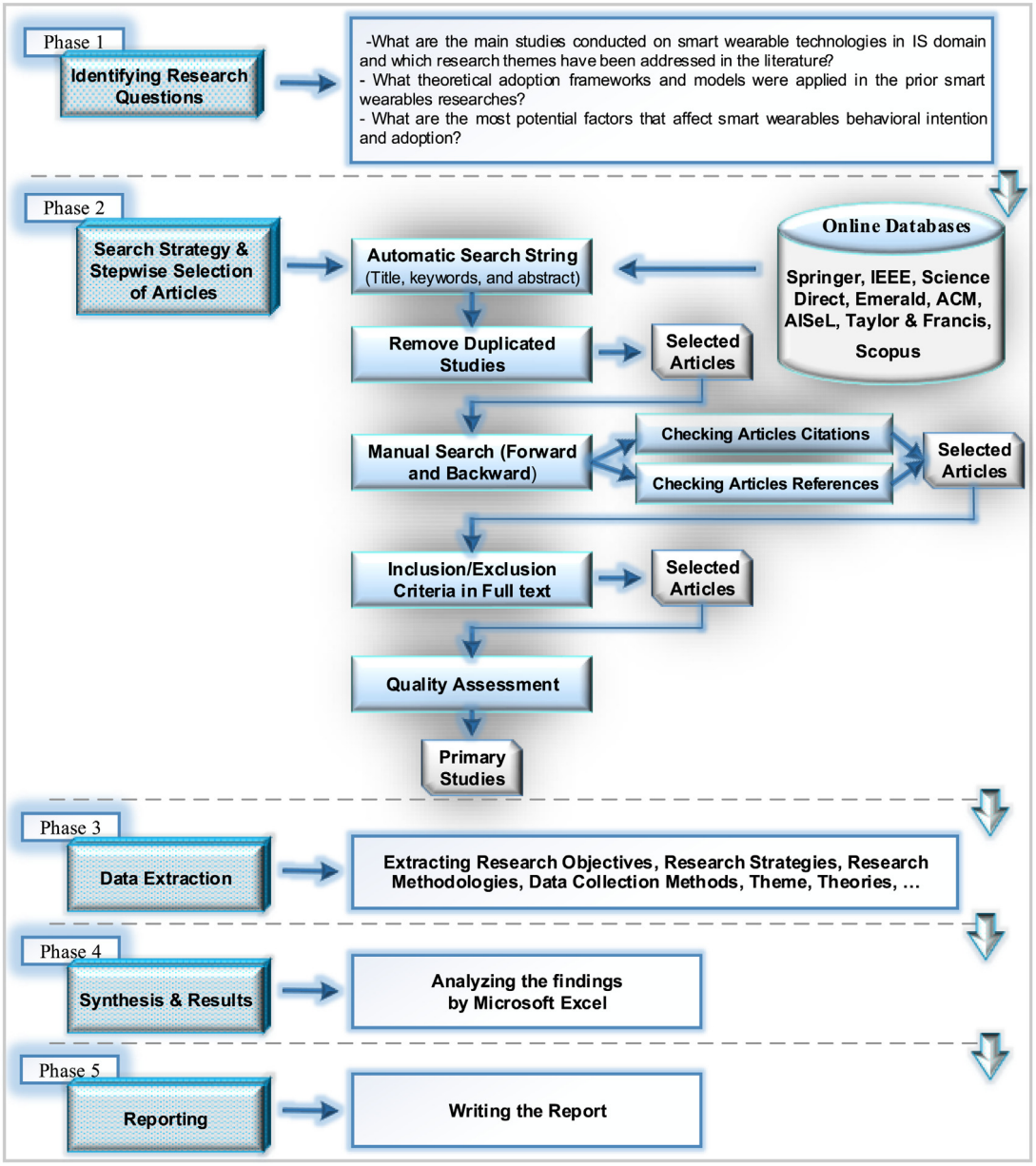

Fig. 1. Review protocol.

QA4: Is the process of data analysis clearly explained in the selected article?

All the aforementioned principles were checked for the 279 studies. Consequently, 35 articles excluded in this phase and finally 244 studies remained.

4. Results

4.1. Data extraction and synthesis

The aim of this section is to create an information extraction form to derive out the accurate data from the selected articles. In this step, each of the primary studies was read carefully and the relevant data were derived employing Microsoft Excel and Mendeley software.

The following columns were considered in Microsoft Excel as the extracted data of this systematic review: Study ID, Author(s), Publication Year, Title of the Study, Citation, Online Database, Source Type, Country, Source Name, Subject, Methodology, Research Strategy, Data Collection Method, Theory/Framework, Wearables Theme, Wearables Type, Objective, and Factors. These items were considered based on the defined research questions and the goals of this study. The description of these items is presented in Table 3.

4.2. The overview of publication sources

Fig. 3 presents the publication sources of primary studies. As depicted in this figure, from the total number of 244 papers, the bulk of studies (180 papers) were published in the trustworthy and high impact factor journals, followed by 60 papers in conferences, and 4 papers in a book.

Fig. 4 presents the entire distribution of papers from 2010 to 2019, categorized based on conferences and journals. As can be seen, the trend of studying wearable technologies has been constantly increasing year by year. As previously mentioned, this research has embraced articles published in the first quarter of 2019, consequently, it is sensible that the number of published articles in this year is downed. Moreover, four book chapters were published in a book, entitled "The Drivers of Wearable Device Usage" in 2016. The full name of journals and conferences are presented in Appendix A.

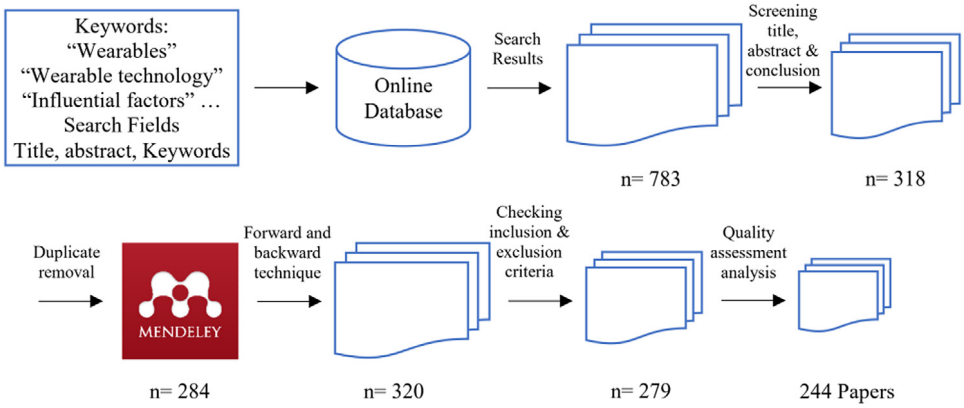

Fig. 2. Process of selecting primary studies.

Table 3
Extracted data from primary papers.

Data	Description
ID	Unique identifier for each primary study.
Author(s)	Name of the author(s).
Publication Year	The year of publishing the paper.
Title	The title of each paper that is visible in the searching step.
Citation	The number of papers that have cited the article. This is obtained by "Google Scholar".
Source Type	Journal, book chapter, and conference proceeding.
Country	The place where the empirical studies were conducted.
Subject	The representative group (subject) of data collection in empirical studies.
Methodology	Design science, quantitative, qualitative, mixed method etc.
Research Strategy	Case study, survey, experiment, action research, archival research etc.
Data Collection Method	Interview, questionnaire, observation, secondary data etc.
Theory or Framework	The theory or framework that the study was adopted such as TAM, DOI, UTAUT etc.
Wearables Theme	The categories of primary studies such as: adoption, concept, and practice.
Wearables Type	The type of wearables that explored in the primary studies such as Google Glass, fitness trackers, smart watches etc.
Objective	The main objective of papers.
Factors	The examined factors of empirical studies.

4.3. Temporal view of the publication

As mentioned before, this systematic review has selected the research papers that are published between 2010 and 2019. Fig. 5 presents the distribution of primary studies during this period of time.

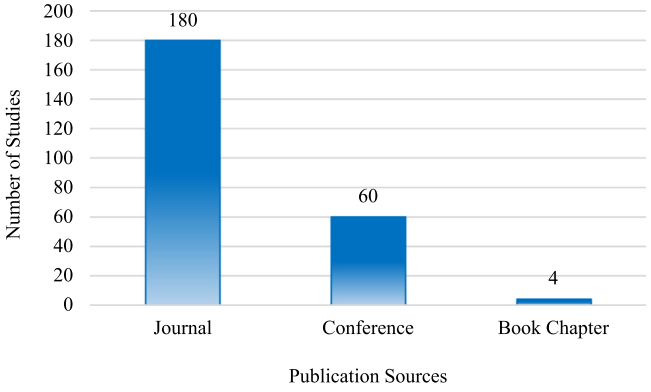

Fig. 3. The distribution of primary studies based on the publication source.

Most articles have been published in 2018 (74 papers) followed by 2017 (63 papers) and 2016 with 41 publications. Fig. 5 shows that 26 papers issued in the first three months of 2019. Out of the 244 published papers during 2010 and 2019, four studies released in 2010, five studies in 2011, three in 2012, seven in 2013, eight in 2014 and finally thirteen studies issued in 2015. According to this statistic, researchers' intention to study smart wearables has significantly increased in the last years.

4.4. Research methods

Fig. 6 presents the distribution of methodologies in the primary studies. Fig. 6 demonstrates that 69% of papers used the quantitative methodology (169 papers), 21% involved the qualitative methodology (51 papers), and 24 studies used the mixed method which included both

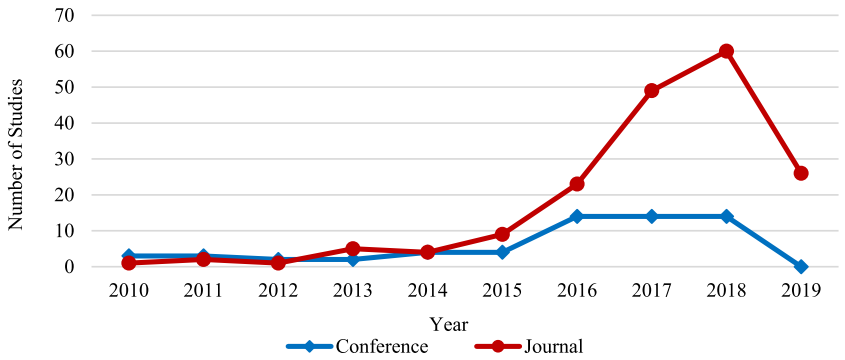

Fig. 4. Journal and conference trends from 2010 to 2019.

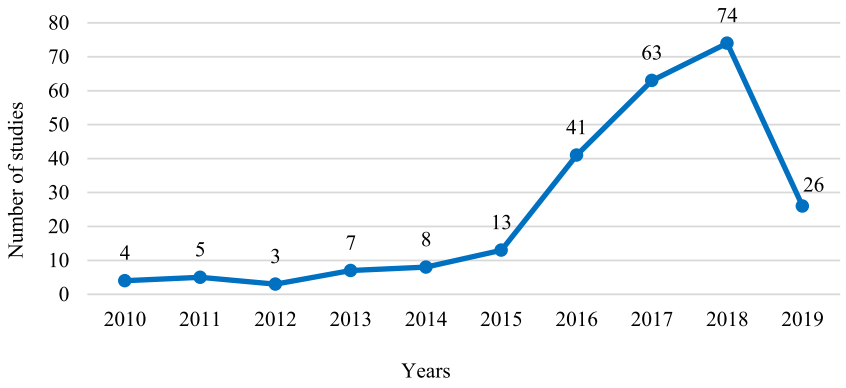

Fig. 5. Temporal view of primary studies.

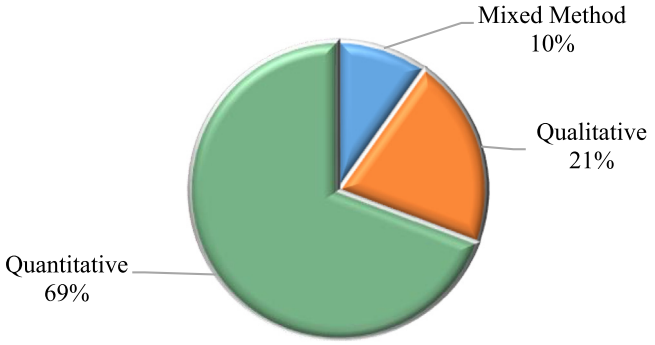

Fig. 6. Distribution of research methodologies.

qualitative and quantitative methodologies. Out of the total number of 169 quantitative studies, 69 papers used questionnaires as their only data collection tool. The rest of the quantitative studies used a combination of data collection tools such as observations, data extracted from wearable devices, and simulation. On the other hand, the majority of qualitative studies (40 papers) collected data through semi-structured and in-depth interviews. The rest of the qualitative studies used other data collection methods such as video recording and wearable devices' online comments.

As stated by Saunders et al. (2009), a research strategy is a general outline of the way in which academics try to fulfill the research questions. Fig. 7 shows that the majority of primary studies were employed experiment research strategy (129 papers), followed by the survey (65 papers) and case study (31 papers). Five studies applied ethnography strategy while 4 studies employed grounded theory research strategy.

As shown in Fig. 7, three studies (Potnis et al., 2017; Profita et al., 2016; Warraich et al., 2018) used two research strategies, namely: survey and grounded theory, while a study conducted by Shin (2017) applied ethnography and survey research strategies. Since these four studies used mixed method methodology, they applied grounded theory and ethnography strategies for analyzing the qualitative data and survey strategy for analyzing the quantitative data. Moreover, the research strategies of 6 studies were unclear.

4.5. Coverage of research region

Fig. 8 exhibits the distribution of primary studies based on region. Most smart wearables investigations have been done in the United States (58 papers) followed by Germany with 19 research studies and the United Kingdom with 16 studies. As depicted in Fig. 8, China is the next country which has 11 experimental research studies. Australia and South Korea conducted nine experimental research studies each while Canada completed seven research study in smart wearables domain. The rest of the countries have fulfilled five or fewer experimental studies on smart wearables domain. Four studies reported that their data were collected from all over the world while 46 studies did not reported the location of the research.

5. SLR questions results

The effort of this SLR is to answer three research questions about smart wearables from the perspective of IS. This section discusses each of the research questions distinctly.

5.1. First research question

Liang and Turban (2011) defined the research theme as a main and central topic that a research study intends to explore. Consequently, this study tries to answer the following research question "What are the main studies on smart wearable technologies in IS domain and which themes have been highlighted in these studies?"

Based on the findings of SLR, several themes have been identified in the primary papers, such as technology-focused, user behavior, security and privacy, social acceptability, and design. Fig. 9 presents an outline of the research themes of smart wearables. The next subsections delineate each theme and their affiliated primary studies.

5.1.1. Technology-focused theme

This theme includes studies that investigate the technical issues related to smart wearable devices. Technology-focused was the most addressed theme and covers 54% of the primary studies (131 papers). Most of the papers in this theme examined the technical issues such as feasibility/evaluation of smart wearables, the affordance of smart wearables, the pragmatic quality of smart wearables, remediation of technology, and users' perception of the smart wearables. Moreover, 111 studies were under the category of feasibility/evaluation and 14 papers explored the perception of users and experts about smart wearables technology issues. For example, Grym et al. (2019) investigated the feasibility of utilizing smart wristband wearables in twenty pregnant women for continuous monitoring daily activity, heart rate, and sleep data. The results attested that the daily use of the device decreased after delivery. By the same vein, Tonacci et al. (2019) evaluated the feasibility of using wearable sensors to examine the relationships between emotions and stress among non-addicted volunteers to the smartphone. In another study, Ricci et al. (2019) examined how a wearable device can render support to the recognition of motor coordination impairments in pupils with neuro-developmental disorders. Their findings revealed that data collected over a network of inertial measurement units (IMUs) and concentrating on particular features elected from the assessment of various motor tasks can provide quantitative criteria for evaluating motor coordination impairment. In an observational study, Babaoglu et al. (2019) evaluated the influence of familial Mediterranean fever illnesses on the patients' daily activities

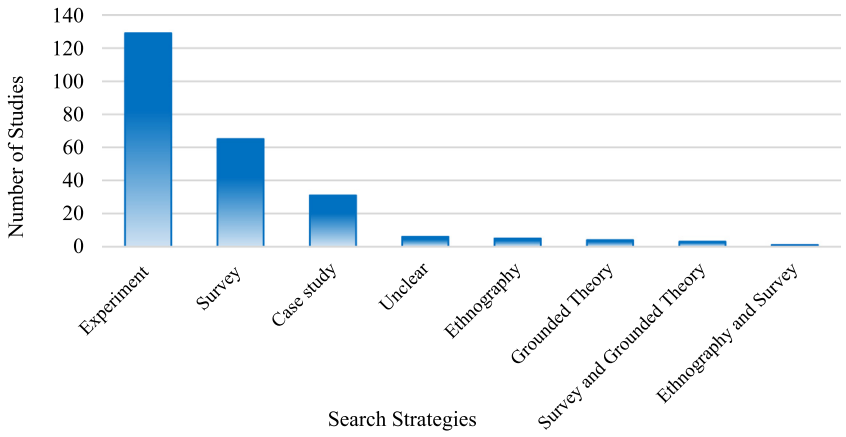

Fig. 7. Distribution of research strategies.

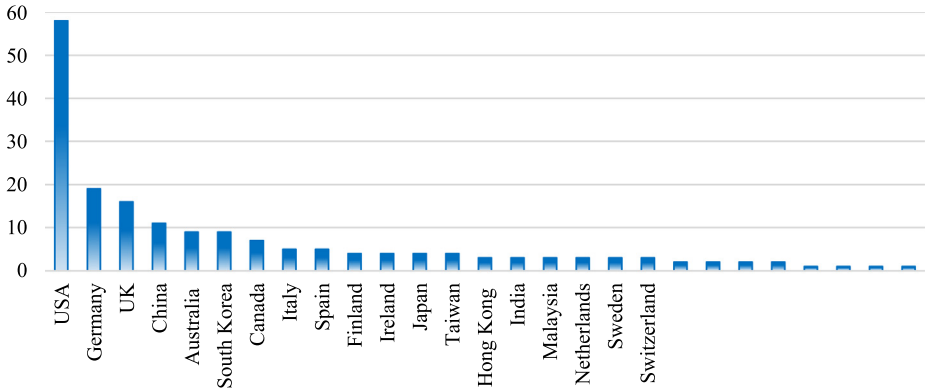

Fig. 8. Distribution of primary studies based on country.

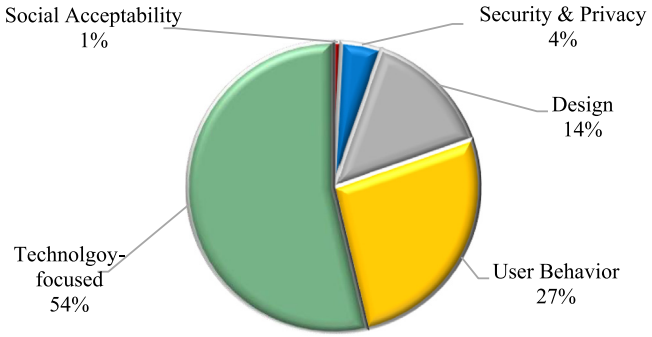

Fig. 9. Distribution of smart wearables themes.

and identified familial Mediterranean fever attacks applying an activity tracker. Table 4 presents a summary of primary studies that are located in this theme.

5.1.2. User behavior theme

Studies in user behavior theme examine users' willingness to perform an action such as adopting or using smart wearable devices. This theme includes the following categories: actual system use, user experiences, intention to use, intention to adopt, intention to purchase, extended use, technology adoption and influential factors of adoption. User behavior was the second most addressed theme with 65 studies that cover 27% of the primary studies. The majority of these studies (55%) have examined the users' behavioral intention toward adopting (10 papers) and using (26 papers) smart wearable technologies. Technology adoption subgroup covers 15% of the overall primary studies with 10 papers in the user behavior theme. For instance, Li et al. (2019) examined the significant factors of smart wearables acceptance among 146 elderly through a survey-based questionnaire. The findings designated that self-reported health status, compatibility, usefulness, and facilitating conditions potentially influence the elderly's intention to use smart wearables. In a qualitative study, Nunes and Arruda Filho (2018) examined users' behavior toward using Google Glass based on a netnographic approach. The outcomes conferred that Google Glass was incompatible with the existing standards in societies (privacy and fashion) at the time of conducting the investigation. In another study, Dehghani and Kim (2019) investigated the influence of the aesthetic appeal of smartwatches (design, screen size, and uniqueness) on the behavioral (purchase) intention of current and potential users. The results revealed that design aesthetics was the prominent factor of influencing behavioral intention in both current and potential users. Table 5 shows the primary studies that falling into this theme.

5.1.3. Design theme

Primary studies in this theme evaluate new prototypes and systems for designing smart wearables based on user preferences and requirements. This theme was the third theme with 35 papers that examined wearables' features, user requirements, users' preferences, and evaluate new smart wearables prototypes. The majority of studies in this theme developed and evaluated new prototypes for smart wearables (19 papers). User requirements and preferences have the next major number of papers in design theme, with 7 and 6 papers, respectively. Only 3 papers examined the features of smart wearable devices. For

Table 4
Primary studies in technology-focused theme.

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S5	Wouwe et al. (2011)	This study reduced the number of measurement instruments to monitor physiological variables, especially with respect to adequate sleep prediction.	Quantitative	Netherlands	11 individuals	Equivital chest band, Sensewear Armband, & Actiwatch wristband	Experiment	Observation, Data extracted form wearables	–	Matlab	Feasibility/ Evaluation	Military
S13	David J. Cook et al. (2013)	This study investigated if activity trackers could be applied for measuring the mobility of patient during hospital recovery who had cardiac surgery.	Quantitative	–	149 patients	Activity Tracker (Fitbit)	Experiment	Observation and data extracted from wearables	–	Descriptive analysis, Kruskal–Wallis test	Feasibility/ Evaluation	Healthcare
S14	S. Vallurupalli et al. (2013)	This research investigated various scenarios in cardiovascular practice where individuals can improve their education.	Qualitative	–	A mock trainee	Google Glass	Experiment	Observation, simulated scenarios, data extracted from wearables	–	–	Feasibility/ Evaluation	Healthcare
S19	Meggan King et al. (2013)	This study explored the extent to which the sensors of a wearable device are observed as visible in binary interactions.	Quantitative	Dublin, Republic of Ireland	23 student and staff with normal or corrected-to-normal vision	Tobii eye tracking glasses	Experiment	Data extracted from wearables, questionnaire, observation	–	Heat Map Analysis–Fine-grained Analysis-ANOVA	Feasibility/ Evaluation	Higher Education
S21	Oliver J. Muensterer et al. (2014)	This experimental study investigated the applicability of Google Glass in human's daily life.	Qualitative	–	First author of the study wore the Glass in a University Children's Hospital to track patients	Google Glass	Experiment	Extracted data from wearables, Observation	–	–	Feasibility/ Evaluation	Healthcare
S23	Brent A. Ponce et al. (2014)	This article evaluated the feasibility of using Google Glass in a surgical setting.	Qualitative	Birmingham, Alabama	A 66 years old patient	Wearable Devices	Single Case study	Observation, Data extracted form wearables	–	–	Feasibility/ Evaluation	Healthcare
S26	Kathryn G. Tippey et al. (2014)	This study compared the performance of driving while texting via smartphone and using Google Glass.	Quantitative	Texas	7 male participants	Google Glass	Experiment	Questionnaire and Simulation, data collected from the wearables	–	SAS 9.3	Feasibility/ Evaluation	Automotive

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S31	Bower and Sturman (2015)	This study ascertained the affordances and issues of wearables among international educators.	Qualitative	Around the world	66 educators	Wearable Devices	Survey	Structured interviews	–	NVivo	Technology Affordances	Education
S33	Enrica Papi et al. (2015)	This study explored whether wearables can be used as an objective measurement of performance for applying them as persuaders to assist acceptance with osteoarthritis rehabilitation.	Qualitative	England	14 healthy participants	Wearable sensors	Experiment	Observation and data extracted from wearables	–	Matlab	Feasibility/ Evaluation	Healthcare
S35	Mark Patersona & Michael R. Glass (2015)	This study evaluated the potential of wearables in the integration of other computing devices to enhance research skills.	Qualitative	Singapore and Malaysia	Students	Smart Glasses	Experiment	Interview, observation	–	–	Feasibility/ Evaluation	Urban
S36	Rooh ul Amin, Irum Inayat, & Basit Shazad (2015)	This study evaluated the influence of wearable learning technology on the learning of student, especially on the spelling learning abilities, educating of basic language learning abilities, diagnosing shapes and reading of clock time.	Quantitative	China	24 Students, teachers and parents	Wearable learning technology — Smart Watches	Experiment	Observation and Questionnaire	–	–	Feasibility/ Evaluation	Education
S40	Xianjun Sam Zheng et al. (2015)	This paper examined the features of eye wearables which affect consumers' performance in the machine maintenance field.	Quantitative	USA	12 employees	Eye wearable device	Experiment	Data extracted from wearables and observation	–	ANOVA	Feasibility/ Evaluation	Automotive
S44	Mohammed Husnain Iqbal et al. (2016)	This study evaluated the efficiency of Google Glass in a surgical environment and recognize the potential uses of this technology.	Quantitative	England	24 beginner, 8 Intermediates and 5 Experts from healthcare industry	Smart Glasses	Experiment	Simulation and questionnaire	–	GraphPad	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S45	D. A. Zahl et al. (2016)	This research evaluated the perception of students about the capability to self and peer judge during standardized patient interactions seized by Google Glass in contrast with a traditional and static camera.	Mixed Method	USA	112 third-year students (survey) and 23 students (open-ended questions)	Smart Glasses	Experiment	Questionnaire and open-text questions — observation-video recording	–	Descriptive and inferential statistical analyses– inductive thematic analysis	Feasibility/ Evaluation	Healthcare
S46	Sameer Gupta et al. (2016)	This paper identified the potential advantage of an asynchronous, near-real-time protocol to record, upload, and observe high determination visual media by Google Glass in the emergency units to assist remote surgical consultations.	Quantitative	USA	276 emergency department patients	Wearable Devices	Survey	Questionnaire	–	R 3.1.1	Feasibility/ Evaluation	Healthcare
S54	Mary C. Hooke et al. (2016)	This study determined the effect of using Fitbit by kids with acute lymphoblastic leukemia and to identify the relationship between steps per day and fatigue prepulse.	Quantitative	USA	16 children with Acute Lymphoblastic Leukemia	Activity Tracker (Fitbit)	Experiment	Data extracted from wearables and questionnaire	–	SPSS	Feasibility/ Evaluation	Healthcare
S72	John A. Naslund et al. (2016)	This study examined whether the daily step counter using activity trackers related to weight loss and to improve fitness among individuals with serious mental illness.	Quantitative	USA	34 individuals with serious mental illness.	Activity tracker	Experiment	Observation-Data extracted from wearables	–	Linear regression models, & penalized functional regression	Feasibility/ Evaluation	Healthcare
S73	John M. Jakicic et al. (2016)	This study investigated the impact of adding wearables to a behavioral intervention and check if it would enhance weight loss.	Quantitative	USA	470 adult participants	Arm worn device	Experiment	Observation and data extracted from wearables and questionnaire	–	SAS version 9.3	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S76	David G. Glance et al. (2016)	This study examined users' physical activity and measure changes in health issues such as blood glucose, lipid profile, renal function, blood pressure, and weight.	Quantitative	Australia	353 staff members of a university	Activity Trackers (Fitbit and Jawbone)	Experiment	Questionnaire, observation and extracted data from devices	–	STATA	Feasibility/ Evaluation	Healthcare
S79	Sungjoo Hwang et al. (2016)	This paper examined the heart rate monitoring at a construction sites by an activity tracker from construction workers.	Quantitative	Michi-gan/USA	7 healthy construction workers in masonry	Activity Tracker (Basis Peak™) and Heart rate monitor (Polar H7®)	Experiment	Collected dataset from wearables and Observation	–	–	Feasibility/ Evaluation	Occupational safety in construction
S81	Neis and Blackstun (2016)	The goal of this study is to examine two identified use-cases for wearable devices by simulating a flight setting and sending Air Traffic Control commands to pilots graphically and textually.	Quantitative	Germany	Eight male pilots	Sony Smart Watch 3	Experiment	Simulation	–	Microsoft Excel with the Real Statistics Resource Pack and ANOVA tests	Feasibility/ Evaluation	Airline
S82	Yuqiuge Hao & Petri Helo (2017)	This study made a general understanding of Cloud Manufacturing management activities by using Smart Glasses and to clarify the business and technological requirements.	Qualitative	–	Domain experts and workers (machine operators, maintenance technicians, and helpdesk units)	Smart Glasses	Case study	Interview, observation	–	–	Feasibility/ Evaluation	Manufactur-ing
S86	Yu et al. (2017)	This study addressed the capabilities of online wearable guides in improving the situational profits of learners and learning achievement in comparing with traditional audio guides in museums.	Quantitative	Taiwan	96 university students	Smart Glasses	Experiment	Observation, and questionnaire, data extracted from wearables	Conceptual Framework	SPSS	Feasibility/ Evaluation	Education
S88	Jared M. Kutzin, Zach Milligan, & Shalinee Chawla (2017)	This study evaluated the perceived ease of use and usability of a head-mounted display (HMD) in the healthcare industry.	Quantitative	–	31 internal medicine residents	Head mounted display (Smart glasses)	Experiment	Simulations and data extracted from the wearables	TAM	–	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S93	Ki Joon Kim (2017)	This study examined the effects of screen shape and size of smartwatches on users' hedonic and pragmatic qualities.	Quantitative	Hong Kong	160 University students	Smart Watches	Experiment	Questionnaire	Conceptual Framework	SPSS	Pragmatic Quality	General
S96	Tomas William Miller (2017)	This examined the effectiveness of employing a fitness tracker in self-tracking behavior change in accordance with prescribed therapy.	Qualitative	–	a 68-year-old male	Activity Tracker (Fitbit)	Single Case study	Observation and data extracted from the wearables	–	–	Feasibility/ Evaluation	Healthcare
S98	Aneesha Singh et al. (2017)	This study investigated the opportunities presented by wearables in promoting practical activity at home.	Qualitative	England	4 Chronic Pain Patients	Wearable Devices	Case Study	Diary entries, interviews, sensor data and videos	–	Microsoft Excel	Feasibility/ Evaluation	Healthcare
S99	Fan Mo et al. (2017)	This experimental research analyzed the influence of user movements and navigation aids in smartwatches on consumers' performance and their subjective feedback via an experiment.	Qualitative	China	Twenty-eight college students	Smart Watches	Experiment	Questionnaire and extracted data from wearables	–	ANOVA and multiple comparison methods (LSD-Test)	Feasibility/ Evaluation	General
S103	Taehyun Ha et al. (2017)	This research examined whether the restrictions of the smart watches are linked to perceptual discomforts.	Qualitative	–	Reddit website users	Smart Watches	Ethnography	User Reviews Opinions	Dynamic topic models	–	Technology Remediation	General
S106	Casey A Cole et al. (2017)	This study examined the possibility of identifying smoking behavior applying smartwatches. Moreover, this study compared the success of tracking smoking behavior with smart sports watches to that of traditional self-reporting.	Quantitative	–	10 smokers	Smart Watches	Experiment	Data extracted form wearables, Observation	–	–	Feasibility/ Evaluation	Healthcare
S108	Brent D. Winslow et al. (2017)	This study used wearables to collect sleep information, evaluate multi-construct cognitive efficiency, and predict changes to mental acuity.	Quantitative	Orlando, FL, USA	30 adult participants	Activity Tracker — Fitbit	Experiment	Data extracted from wearables, Observation	–	Kruskal–Wallis test	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S109	Aku Visuri et al. (2017)	This study quantified the smartwatches usage and compare the similarities and differences of smartwatches with smartphone usage.	Quantitative	Around the world	307 smart watch users	Smart Watches	Unclear	Observation-Data extracted from wearables	–	Chi-Square test	Feasibility/ Evaluation	General
S110	Stephen Gillinov et al. (2017)	This study evaluated the accuracy of 5 Heart Rate Monitors in different types of aerobic exercises.	Quantitative	USA	50 healthy adults	Wrist-worn Monitors	Experiment	Observation-make tex Data extracted from wearables	–	SAS version 9.4 and R software version 3.2.3	Feasibility/ Evaluation	Sport and Healthcare
S111	Jenny Chum et al. (2017)	This study examined the relationship of participants who perceived benefit from the fitness trackers and themes which leads to positive and negative experiences with activity trackers.	Qualitative	Canada	36 patients with major depressive disorder	Activity tracker — Fitbit	Grounded Theory	Semi-structured interview — Questionnaire and data extracted from wearables	–	Thematic analysis and SPSS	Feasibility/ Evaluation	Healthcare
S112	Matteo Cella et al. (2017)	This study introduced a novel Mobile Health method applying wearables to evaluate autonomous activity in users' everyday life.	Quantitative	UK	30 individuals with schizophrenia and 25 healthy individuals	Wrist-worn wearable device	Experiment	Questionnaire and Observation	–	ANOVA and t-test	Feasibility/ Evaluation	Healthcare
S115	Alice Bellicha et al. (2017)	This qualitative study explored how specialist physicians prescribe electronic activity monitors to patients by presenting cardiometabolic conditions, and to better understand their motivation and barriers when prescribing such monitors.	Qualitative	France	11 senior physicians	Electronic Activity Monitors	Case study	Interview	–	Thematic analysis	Users perception about Technology	Healthcare
S117	Ryan R. Kroll et al. (2017)	This study examined the feasibility of using Fitbit to monitor patients recovering from critical illness.	Quantitative	On-tario/Canada	50 ICU patient	Activity tracker	Case study	Data extracted from wearables, Observation and Questionnaire	–	R 3.2.2	Feasibility/ Evaluation	Healthcare
S118	E. Whitney Evans et al. (2017)	This study assessed the acceptability of activity trackers on school students.	Quantitative	Rhode Island/USA	32 fifth-grade students–42 sixth-grade students	Activity tracker — Fitbit Zip monitor	Experiment	Data extraction from wearables, Observation	Goal-setting theory	SAS Version 9.4	Feasibility/ Evaluation	Fitness and Physical Activity

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S119	Alexander H. K. Montoye et al. (2017)	This research compared the accuracy of the Hexoskin smart shirt and Fitbit Charge HR.	Quantitative	Michi-gan/USA	18 healthy men and 14 healthy women	Activity tracker — Fitbit Charge HR and Hexoskin	Experiment	Observation and data extracted from wearables	–	SPSS and Microsoft Excel	Feasibility/ Evaluation	Fitness and Physical Activity
S120	Ruben T. Azevedo et al. (2017)	This paper examined the effectiveness of wearables on calmness through a task which causes high anxiety.	Quantitative	London/UK	52 volunteers	Wrist band — Doppel	Experiment	Observation and Questionnaire	–	SCRalyze	Feasibility/ Evaluation	Healthcare
S121	Elizabeth J. Lyons et al. (2017)	This study identified the acceptability and influence on physical activity with combining tablet device, a wearable physical activity, and telephone counseling.	Quantitative	USA	40 adults between 55 and 79 years old.	Activity Tracker (Jawbone Up24)	Experiment	Observation and data extracted from wearables	–	R version 3.3.1	Feasibility/ Evaluation	Healthcare
S123	Anna Shcherbina et al. (2017)	This work evaluated the accuracy of 7 wrist-worn wearables in assessing heart rate and energy expenditure.	Quantitative	California/ USA	60 healthy adult volunteers	Apple Watch, Basis Peak, Fitbit Surge, Microsoft Band, Mio Alpha 2, PulseOn, Samsung Gear S2	Experiment	Observation, Data extracted form wearables	–	R version 3.2.21	Feasibility/ Evaluation	Healthcare
S124	Gorny et al. (2017)	This research investigated the sensitivity and accuracy of an activity tracker in assessing heart rates and recognizing one-minute bouts of moderate to vigorous physical activity under free living conditions.	Quantitative	Singapore	10 participants (9 students, 1 university staff)	Fitness Trackers (Fitbit Charge HR, Polar H6 heart rate monitor)	Experiment	Observation, Data extracted form wearables	–	STATA Version 13.1	Feasibility/ Evaluation	Healthcare
S125	Yang Bai et al. (2017)	This investigation examined the reliability of steps, heart rate, and energy consumption measured with the fitness trackers such as Fitbit Charge and Apple Watch.	Quantitative	USA	39 healthy adults	Smart Watches (Apple Watch 1 and Fitbit Charge HR)	Experiment	Observation, Data extracted form wearables	–	Bland–Altman plots	Feasibility/ Evaluation	Healthcare
S126	Kwok Ng et al. (2017)	This article investigated the ownership and the usage of fitness trackers among teenagers.	Quantitative	Finland	4575 adolescents aged between 11 and 15 years	Activity Trackers (Heart rate monitors and sports watches)	Survey	Questionnaire	–	SPSS	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S127	Massimiliano de Zambotti et al. (2017)	This study evaluated the performance of Fitbit tracker versus polysomnography in assessing sleep and wake states and sleep level among healthy individuals.	Quantitative	California/ USA	44 healthy adults	Activity Trackers (Fitbit Charge 2)	Experiment	Observation, Data extracted form wearables	–	Bland–Altman plots, Paired t-tests, and epoch-by-epoch (EBE)	Feasibility/ Evaluation	Healthcare
S128	Jocelyn Dunn et al. (2017)	This paper developed impartial sleep quality measures from wearable devices data in a simulated Mars mission for analyzing patterns of sleep and wakefulness in the night.	Quantitative	Hawaii/USA	6 astronaut-like crews	Activity Trackers (Jawbone UP)	Experiment	Observation, Data extracted form wearables	–	ANOVA, Tukey post-hoc tests, Bonferroni adjustment	Feasibility/ Evaluation	Healthcare/ Astronaut
S130	Yash Shah et al. (2017)	This study examined the data output from Fitbit Charge HR and Jawbone UP4 for measuring heart rate, calories intake/burned, and step-counts.	Quantitative	Hawaii/USA	3 crewmembers	Activity Tracker (Fitbit firmware and Jawbone firmware)	Experiment	Observation, Data extracted form wearables	–	Tukey Honest Significant Differences and Post-hoc test	Feasibility/ Evaluation	Astronaut
S132	Annuska Zolyomi et al. (2017)	This study explored the use of a head mounted device by early adopters with low vision to provide the basis for analysis of technology mediated sight.	Qualitative	USA	13 participant with vision loss	Head-mounted devices	Case Study	Interview	–	NVivo	Feasibility/ Evaluation	Healthcare
S133	Ashley Miller et al. (2017)	This article examined whether American Sign Language interpretation accessible in Smart Glasses could facilitate the understanding of mainstream classroom speeches for deaf and hard of hearing scholars.	Qualitative	Rochester/ USA	15 hard of hearing and deaf students	Smart Glasses	Experiment	Interview, Extracting log data from wearables	–	–	Feasibility/ Evaluation	Healthcare
S135	Yuhang Zhao et al. (2017)	This study distinguished what people with low vision can see by wearing ordinary commercial smart glasses even with their visual limitations and smart glasses restrictions.	Quantitative	–	18 healthy sighted participants and 20 low vision participants	Smart Glasses (Epson Moverio BT-200)	Experiment	Observation (video recording) and data extracted from wearables	–	ANOVA	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S139	Yu et al. (2017)	This study evaluated the effect of involvement with a physical activity monitoring program on changes in users' vital signs in an employer community.	Quantitative	USA	36 882 employees	Smart Pedometer	Experiment	Observation and data extracted from wearables	–	–	Feasibility/ Evaluation	Healthcare
S143	Sungjoo Hwang & SangHyun Lee (2017)	This research examined the efficiency of percentage of heart rate reserve-based physical measurement by a wristband from construction sites.	Quantitative	Michi-gan/USA	19 construction workers	Activity Trackers (an off-the-shelf wristband-type)	Case Study	Extracted data from wearables, Observation	–	–	Feasibility/ Evaluation	Occupational safety in construction
S144	Wonil Lee, Ken-Yu Lin, Edmund Seto, Giovanni C. Migliaccio (2017)	This paper investigated the reliability and efficiency of wearables for tracking construction roofing workers' activities.	Mixed Method	Washing-ton/USA	6 roofers	Smart chest band	Experiment	Extracted data from wearables, Observation, questionnaire	Job Stress and Health Model	Kubios HRV, SPSS	Feasibility/ Evaluation	Occupational safety in construction
S146	Charlotte Romare, Ursula Hass, Lisa Skär (2018)	This research clarified the professionals' opinion about the quality of using smart glasses in an intensive care unit and to recognize the situations that smart glasses can be applied to improve the safety of patient.	Qualitative	Sweden	36 healthcare professionals	Smart Glasses	Case study	Focus group interviews	–	Thematic content analysis	Users perception about Technology	Healthcare
S149	Milad Dehghani, A. Mohammed Abubakar, Mohsen Pashna (2018)	The paper identified and described the drivers of successful marketing and lean approaches in wearables start-ups companies.	Qualitative	–	10 managers from Start-ups companies	Wearable Devices	Case study	Semi-structured interviews	–	–	Users perception about Technology	Start-ups companies (Multi-industry)
S151	Antonio Sarmento et al. (2018)	This study evaluated a new smart shirt based on qualitative and quantitative analysis.	Mixed Method	Milan, Italy	30 cardiorespiratory patients and 10 healthy individuals	Smart Shirt	Experiment	Data extracted from the wearables, Observation	–	–	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S153	Raquel Benbunan-Fich (2018)	This paper examined a particular fitness tracker device affordance from consumers' perspective by analyzing online users' comments qualitatively and proposing a theoretical affordance framework.	Qualitative	–	Fitbit users in Amazon.com	Fitbit	Ethnography	Online reviews of wearables consumers on Amazon	Activity Theory (AT)	Thematic analysis	Technology Affordances	Fitness and Physical Activity
S154	Jessica Castner and Heidi Suffoletto (2018)	This paper evaluated the feasibility of a smart wearable device to assess the contact of clinician and patient and examined the relationship between Emergency Department (ED) occupancy and the contact time between clinician and patient.	Mixed Method	–	Quantitative (3237 patient records) Qualitative (39 participants)	Wearable Devices	Experiment	Data extracted from the wearables and focus group	–	t-test and analysis of variance (ANOVA)	Feasibility/ Evaluation	Healthcare
S155	Rob Argent et al. (2018)	This study investigated the orthopedic clinicians' opinion about the challenges and opportunities of using wearables in rehabilitation.	Qualitative	Dublin, Ireland	10 orthopedic clinicians	Wearable Devices	Case Study	Semi-structured interview	–	Thematic analysis based on grounded theory approach	Users perception about Technology	Healthcare
S156	Jessica Castner et al. (2018)	This article tested the feasibility, explored equivalence and examined the concordance of an activity tracker with standard actigraphy regarding the assessment of sleep patterns in 47 females with asthma.	Quantitative	Erie County/New York	47 women who have poorly asthma from a university-affiliated primary health center	Fitness trackers (Fitbit Charge, Actigraph wGT3X+)	Case Study	Data extracted from the wearables, Observation	–	STATA	Feasibility/ Evaluation	Healthcare
S157	Babak Boroojerdi et al. (2018)	This study assessed the accuracy of a wearable biosensor device to record patients' body movements in the home and clinic settings in compare with motor symptom's clinical measurement.	Quantitative	–	25 patients with PD	A wearable sensor	Experiment	Data extracted form wearables, Patient Data Presentation Questionnaire, Observation	–	–	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S160	Amerigo Rossi et al. (2018)	This study evaluated the feasibility of Fitbit among endometrial cancer survivors for socio-culturally diverse.	Mixed Method	New York/USA	25 endometrial cancer survivor	Fitbit Alta™	Experiment	Questionnaire and Interview	–	STATA	Feasibility/ Evaluation	Healthcare
S161	Roberto López-Blanco et al. (2018)	This clinical study evaluated the feasibility, reliability and correlation of using a new system based in a smartwatch to assess tremor in ET patients and examined the acceptance of the system as a clinical tracking tool.	Quantitative	Madrid/Spain	34 Essential Tremor (ET) patients	Smartwatch3 Sony	Experiment	Data extracted from the wearables and observation	–	Rstudio	Feasibility/ Evaluation	Healthcare
S162	Xianta Jiang, Kelvin H.T. Chu, Mahta Khoshnam and Carlo Menon (2018)	This study explored the feasibility of employing a FMG technique for a wearables step detection system.	Quantitative	Canada	9 healthy individuals	Force myography (FMG) wearable	Experiment	Data extracted from the wearables and observation	–	MATLAB (Kolmogorov–Smirnov and ANOVA test)	Feasibility/ Evaluation	Healthcare
S163	Mohammad Hossein Jarrahi, Nicci Gafinowitz and Grace Shin (2018)	This qualitative study explored the various types of pre-existing incentives of using activity trackers that formed individuals' perception and adoption of these devices.	Qualitative	USA	29 university staff	Fitbit trackers	Case Study	Semi-structure interviews and data extracted from the wearables	–	–	Technology Affordances	Fitness and Physical Activity
S164	Mark W. Orme et al. (2018)	This article explored the feasibility and acceptability of activity trackers and education for reducing the sedentary behavior for patients with obstructive pulmonary diseases.	Mixed Method	Leicester/England	33 patients	Wearable Devices	Experiment	Data extracted from the wearables and interview	–	SPSS and NVIVO	Feasibility/ Evaluation	Healthcare
S165	A. Ozanne et al. (2018)	This qualitative study investigated the patients and health professionals perceptions for the use of wearables for monitoring and managing	Qualitative	Gothenburg/Sweden	40 participants including 25 patients and 15 health professionals	Smart t-shirts with multisensor -wrist-worn sensors	Case Study	Focus group semi-structured interviews	–	Content analysis based on an inductive approach	Users perception about Technology	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S166	Tobias Mettler and Jochen Wulf (2018)	This study explored what limitations and affordances do staffs associated with the usage of physiolytics in their working environment.	Mixed Method (Q-methodology)	Switzerland	12 open-ended interviews with experts - 20 employees	Wearable Devices	Unclear	Interview and Statements similar to a questionnaire	–	STATA software and Microsoft Excel	Technology Affordances	Healthcare
S168	Felix P. Bernhard et al. (2018)	This study examined the usefulness and feasibility of wearable technologies for neurological inpatients.	Quantitative	Tubingen/ Germany	384 inpatients	Wearable Devices	Survey	Questionnaire	–	–	Feasibility/ Evaluation	Healthcare
S169	Francisco de Arriba Pérez et al. (2018)	This research examined if wearable technology could be applied to determine the sleep indicators automatically.	Quantitative	–	5 individuals	Wearable Devices	Experiment	Data extracted from wearables and observation	–	–	Feasibility/ Evaluation	Healthcare
S170	Francisco de Arriba Pérez et al. (2018)	This study evaluated the various solutions for assessing the stress of students with wrist wearables.	Mixed Method	Vigo/Spain	12 students	Commercial-off-the-shelf wrist wearable devices	Experiment	Quantitative (data extracted from wearables), Qualitative (open ended questions)	–	Data analytics package — machine learning algorithms	Feasibility/ Evaluation	Healthcare
S171	H.M. Sajjad Hossain et al. (2018)	This study proposed and evaluated an intelligent algorithm for detecting the good and bad state of sleeping behaviors.	Quantitative	–	17 participants (one unemployed, three professionals, and thirteen students)	EZ430-Chronos device and wActiSleep-BT	Experiment	Data extracted from wearables and observation	–	–	Feasibility/ Evaluation	Healthcare
S173	Anika Steinert et al. (2018)	This study examined whether elderly adults will be encouraged to enhance their physical activities with the assistance of a wearable training system includes a fitness tracker and a training application.	Quantitative	Germany	Twenty older adults	Fitness trackers and fitness applicaitons	Experiment	Questionnaire, observation, and the data extracted from wearables	–	IBM SPSS Statistics 21.0	Feasibility/ Evaluation	Fitness and Physical Activity
S174	Laurent Degroote et al. (2018)	This study evaluated the accuracy of Fitbit Charge, Huawei Watch, Polar M600, and Asus Zenwatch3 through ActiGraph GT3X+.	Quantitative	Ghent/ Belgium	36 healthy participants	ActiGraph GT3X+, Fitbit Charge, Polar M600, Huawei Watch, and Asus Zenwatch 3	Experiment	Data extracted from wearables, questionnaire, and observation	–	IBM SPSS Statistics 24.0	Feasibility/ Evaluation	Fitness and Physical Activity

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S175	Ravi Kondama Reddy et al. (2018)	This study validated the accuracy of heart rate and energy expenditure for Garmin vívosmart HR+ and Fitbit Charge during dynamic activities such as high-intensity interval training, resistance training and aerobic training.	Quantitative	Port-land/Oregon and Toronto/ Canada	Twenty healthy individuals	Fitbit Charge 2 and Garmin vívosmart HR+	Experiment	Data extracted from wearables and observation	–	R version 3.4.2 and GraphPad Prism 7	Feasibility/ Evaluation	Fitness and Physical Activity
S178	Mary T. Imboden et al. (2018)	This study compared measures of energy expenditure, steps taken, and active minutes of 4 activity trackers with an ActiGraph in a semi-structured environment.	Quantitative	Indiana/USA	30 healthy adults	Fitbit One, Fitbit Zip, Fitbit Flex, Jawbone UP24 and ActiGraph	Experiment	Data extracted from wearables and observation	–	ActiLife 6 software	Feasibility/ Evaluation	Fitness and Physical Activity
S179	Pallav Deka, Bunny Pozehl, Joseph F. Norman, and Deepak Khazanchi (2018)	This study examined the feasibility, acceptability and practicality of using the Fitbit Charge HR device and to assess the validity of this device for monitoring physical activities among heart failure patients.	Quantitative	USA	30 heart failure patients	Fitbit® Charge HR	Experiment	Data extracted from wearables, questionnaire, and observation	–	Descriptive analysis	Feasibility/ Evaluation	Healthcare
S180	Wonwoo Byun, Jung-Min Lee, Youngwon Kim and Timothy A. Brusseau (2018)	This experimental study investigated the accuracy of a fitness tracker for measuring the diverging intensities of physical activity and sedentary behavior among 3–5 years old children.	Quantitative	Fargo and Moor-head/USA	28 healthy children (3–5 years old)	Fitbit Flex	Experiment	Data extracted from wearables and observation	–	STATA Version 14	Feasibility/ Evaluation	Fitness and Physical Activity
S181	Lynne M. Boddy, et al. (2018)	This study compared the sedentary time of children in daily life through GENEActiv device and ActiGraph.	Quantitative	Liverpool/UK	108 children (10–11 years old)	GENEActiv and ActiGraph GT3X+	Experiment	Data extracted from wearables and observation	–	IBM SPSS, Microsoft Excel and R software	Feasibility/ Evaluation	Fitness and Physical Activity

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S182	Joanne DiFrancisco-Donoghue et al. (2018)	This study investigated the utilizing of fitness trackers alone or incorporated with communication via email to enhance activity and body composition among first-year medical students.	Quantitative	New York/USA	113 medical students	Fitbit	Experiment	Data extracted from wearables, questionnaire, observation	–	–	Feasibility/ Evaluation	Fitness and Physical Activity
S183	Sarah J. Gilmore, Megan Davidson, Andrew J. Hahne & Jodie A. McClelland (2018)	This study evaluated the validity of Jawbone, ActivPAL3, and Fitbit Flex activity trackers to measure step count among 40 inpatients after lumbar fusion surgery.	Quantitative	Melbourne/ Australia	40 patients who have experienced the lumbar spinal fusion operation	Jawbone UP Move, ActivPAL3, and Fitbit Flex	Experiment	Data extracted from wearables and observation	–	SPSS version 24	Feasibility/ Evaluation	Healthcare
S184	Charlotte Jacquemin, Hervé Servy et al. (2018)	This study assessed the feasibility of physical activity in patients with rheumatoid arthritis and axial spondyloarthritis using the 'Withings Activité Pop' as the activity tracker devices.	Quantitative	Paris/France	157 patients (rheumatoid arthritis and axial spondy-loarthritis)	Withings Activité Pop	Experiment	Data extracted from wearables, questionnaire, observation	–	R version 3.2.2	Feasibility/ Evaluation	Healthcare
S185	Joshua Twiggs, Lucy Salmon, Elizabeth Kolos, Emily Bogue, Brad Miles, Justin Roe (2018)	This study examined the physical activity of patients who underwent total knee arthroplasty surgery through Fitbit Flex.	Quantitative	Australia	91 patients with knee osteoarthritis who underwent total knee arthroplasty surgery	Fitbit Flex	Experiment	Data extracted from wearables and observation	–	R software	Feasibility/ Evaluation	Healthcare
S186	Neill Van der Walt et al. (2018)	This study examined the feasibility of Garmin Vivofit 2 for enhancing the levels of activity among patients who underwent total knee arthroplasty or total hip arthroplasty in the first 6 weeks after surgery.	Quantitative	Australia	163 patients who underwent hip arthroplasty or total knee arthroplasty	Garmin Vivofit 2	Experiment	Data extracted from wearables, questionnaire and observation	–	–	Feasibility/ Evaluation	Healthcare

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Table 4 (*continued*).

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S187	Yue Liao and Susan Schembre (2018)	This study assessed the feasibility of using Dexcom G4 Platinum as a continuous glucose monitor among 30 healthy nondiabetic persons.	Quantitative	Houston/Texas/ USA	30 nondiabetic healthy adults	Dexcom G4 Platinum	Experiment	Data extracted from wearables and observation	–	SPSS version 24.0	Feasibility/ Evaluation	Healthcare
S190	Huong Ly Tong, Enrico Coiera, and Liliana Laranjo (2018)	This study examined the consumers' perspectives regarding using Fitbit Flex 2 with a mobile social network site for promoting physical activity.	Qualitative	Sydney/Australia	55 healthy university students and staff	Fitbit Flex 2	Case Study	Interview, focus group	–	NVivo 11	Users perception about Technology	Fitness and Physical Activity
S191	Michelle Takemoto et al. (2018)	This study explored the significance of using smart wearables regarding sedentary behavior by conducting focus group interviews.	Qualitative	San Diego/ California/ USA	15 adults	Wearable Devices	Case Study	Interview, focus group	–	Dedoose software	Users perception about Technology	Fitness and Physical Activity
S192	Julià Camps et al. (2018)	This study proposed and evaluated a deep learning approach to detect freezing of gait among Parkinson's disease patients by using a waist-worn device.	Quantitative	–	21 Parkinson's disease patients	Inertial measurement unit as a waist-worn wearables	Experiment	Data extracted from wearables and observation	–	Matlab	Feasibility/ Evaluation	Healthcare
S193	Eliasz Kańtoch (2018)	This study developed and evaluated a method regarding automatic detection of sedentary behavior correlated with cardiovascular disease using smart clothing.	Quantitative	–	5 adults	Smart Clothing	Experiment	Data extracted from wearables and observation	–	–	Feasibility/ Evaluation	Healthcare
S194	Sarah J. Hardcastle et al. (2018)	This paper explored the usefulness, acceptability, and preference of cancer survivors regarding using activity trackers in rural areas of Australia.	Qualitative	Western Australia	16 cancer survivors	Fitbit Alta, Garmin Vivofit 2, Garmin Vivosmart, Polar Loop 2 and Polar A300	Unclear	Interview	–	Thematic analysis	Users perception about Technology	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S195	Dimitri Gavriloff et al. (2018)	This paper examined the feasibility of giving sham feedback regarding sleep patterns to people with insomnia based on smart actigraphy-diary watches.	Quantitative	UK	63 participants	PRO-Diary Actiwatch	Experiment	Data extracted from wearables, questionnaire, & observation	–	SPSS	Feasibility/ Evaluation	Healthcare
S198	Ilaria Carpinella et al. (2018)	This paper instrumented the evaluation of stair ascent using a single magneto-inertial measurement unit as a wearable device.	Quantitative	Milan/Italy	20 healthy individuals and 30 individuals with neurological disease	magneto-inertial measurement unit wearable device	Experiment	Data extracted from wearables and observation	–	STATISTICA and MATLAB	Feasibility/ Evaluation	Healthcare
S199	Fatih Incekara et al. (2018)	This study examined the clinical accuracy and feasibility of Hololens as a mixed-reality wearable for preoperative planning of neurosurgical.	Quantitative	Netherlands	25 patients with tumors	Smart Hololens	Experiment	Data extracted from wearables and observation	–	SPSS version 21.0	Feasibility /Evaluation	Healthcare
S200	Jing Wang, Chin-Fun Chu, Chengdong Li, Laura Hayes, Linda Siminerio (2018)	This paper explored educators' perception about using chronicle diabetes system for transferring vital signals information from diabetes patients to educators for facilitating behavioral goals monitoring.	Qualitative	Pennsylvania and Texas	8 diabetes educators	Jawbone UP24	Unclear	Individual interview and focus group interview	–	Thematic Analysis	Users perception about Technology	Healthcare
S201	Sungjoo Hwang et al. (2018)	This study examined the feasibility of assessing emotions of workers in the work environment applying a wearable electroencephalogram sensor.	Quantitative	Michigan and Indiana/USA	10 healthy workers	Electroen-cephalogram wearable sensors	Experiment	Data extracted from wearables and observation	–	Kruskal–Wallis test	Feasibility/ Evaluation	Construction
S203	Martin Aidan O'Reilly, Patrick Slevin, Tomas Ward, Brian Caulfield (2018)	This study evaluated the Formulift system (a new mobile health app) among healthy and potential users.	Mixed method	Ireland	15 healthy individuals	Inertial Measurement Unit wearables	Experiment and Survey	Semi-structured interview, video-record and Questionnaire	–	System Usability Scale and the user version of the Mobile Application Rating Scale	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S204	Karina Lebel et al. (2018)	This quantitative study evaluated the effect of the spine fixity and prepare objective feedback at the training period using a 3D wearable Inertial Sensors.	Quantitative	Québec/ Canada	An uninjured individual	A 3D wearable Inertial Sensors	Case Study	Data extracted from wearable and observation	–	MATLAB version 8.5	Feasibility/ Evaluation	Healthcare
S205	Christopher L. Pulliam et al. (2018)	This research utilized the motion wearable devices to evaluate the dose–response of bradykinesia, tremor and dyskinesia in patients with Parkinson's Disease.	Quantitative	USA	13 individuals with Parkinson's Disease	Wrist and ankle wearable motion sensors	Experiment	Data extracted from wearables and observation	–	–	Feasibility/ Evaluation	Healthcare
S207	Yiran Shen et al. (2018)	This study developed and evaluated a new Shake-n-Shake system to collect motion data from users' handshaking through smartwatches and fitness trackers.	Quantitative	–	20 volunteers	Smart Watches and fitness bands	Experiment	Data extracted from wearables and observation	–	Principal Component Analysis	Feasibility/ Evaluation	General
S208	Garcia et al. (2018)	This research proposed a method for smartwatches as an assistant tool for situated reflection among students in elementary schools.	Mixed Method	Texas	18 elementary students	Smart Watches	Experiment	Data extracted from wearables, questionnaire, observation, interview and voice record reflections	–	Quantitative (SPSS) and Qualitative (open coding process)	Feasibility/ Evaluation	Education
S209	Martin Gjoreski, Mitja Luštrek, Veljko Pejovìc (2018)	This paper examined the significance of inferring individuals' cognitive load applying Microsoft Band 2 as an inexpensive wearable device.	Quantitative	–	25 individuals	Microsoft Band 2	Experiment	Data extracted from wearables, questionnaires and observation	–	Scattered X's test, Pursuit test, Number Comparison test, Finding A's test, Hidden Pattern test, and Gestalt Completion test	Feasibility/ Evaluation	Fitness and Physical Activity
S210	Luisa Schulz, Ton Spil, Sjoerd de Vriess (2018)	This study explored the gamified wearable devices as an effective solution for losing weight and changing behavior in children.	Qualitative	Germany and Netherlands	3 clinicians and 18 obese and overweight teenagers and children	Smart gamified wearables	Grounded Theory	Interview and literature review	–	MAXQDA	Users perception about Technology	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S211	Kyungock Yi and Hyeonjung Oh (2018)	This study examined the influence of the absence or the presence of the insole on the intralimb coordination within the left and right wrists assessed by Inertial Measurement Unit wearable devices.	Quantitative	–	A female who had a golf career and a male who had golf experience and foot deformity	Inertial Measurement Unit wearables	Experiment	Data extracted from wearables and observation	–	–	Feasibility/ Evaluation	Sport
S212	Jessica Conradi, Martin Westhoven, and Thomas Alexander (2018)	This study compared 3 interaction styles for devices with a touch-sensitive feature and a head-mounted device to examine the impact of various interaction styles.	Quantitative	–	16 right-handed volunteer	Dikablis as a head-mounted wearable and a smart wrist band	Experiment	Data extracted from wearables and observation	–	Kolmogorov–Smirnov-test, ANOVA, pair-wise comparisons and Bonferroni-correction	Feasibility/ Evaluation	Healthcare
S214	Warraich et al. (2018)	This study found the role of wearables regarding promoting emotional wellness among the elderly.	Mixed Method	Turku/ Finland	24 elderly	Wearable Devices	Survey and Grounded Theory	Questionnaire and Interview	Conceptual Model	–	Users perception about Technology	Healthcare
S216	Stijn Verwulgen et al. (2018)	This paper evaluated a smart EEG headset that sets electrodes at regulated and standardized points on the individuals' head where these electrodes are employed equivalent pressure.	Quantitative	Antwerp/ Belgium	12 healthy individuals	EEG headset	Experiment	Data extracted from wearables and observation	–	SPSS	Feasibility/ Evaluation	Healthcare
S217	Trace Forkan, Theresa Stack, and Daniel Autenreith (2018)	This study examined if Fitbit wearables can differentiate between standing and sitting positions at customizable workstations and specified whether sit-to-stand workstations utilization were correlated with greater activity levels.	Quantitative	Mon-tana/USA	Study 1 (16 office workers), Study 2 (16 faculty and staff members)	Fitbit	Experiment	Data extracted from wearables, questionnaire, and observation	–	Minitab 17 Statistical Software	Feasibility/ Evaluation	Fitness and Physical Activity
S218	Liuxing Tsao, Liang Ma, and Christian-Thomas Papp (2018)	This study offered a new method employing smart wearables to collect vital signals such as electrodermal activity and respiration to estimate physical fatigue perception.	Quantitative	–	6 volunteer individuals	A non-invasive wearable sensors	Experiment	Data extracted from wearables	–	Linear regression Modeling	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S220	Rob Argent et al. (2019)	This article evaluated an exemplary sensor-based biofeedback wearable device and investigated the usability, feasibility, user experience and perceived impact of the device through 15 patients.	Mixed Method	Dublin, Ireland	15 patients who had knee replacement surgery	Wearable inertial measurement units	Experiment	Semi-structured interview and questionnaire	–	Thematic analysis and standard scoring procedure	Feasibility/ Evaluation	Healthcare
S221	Irina Galperin et al. (2019)	This study evaluated the relation of disease's conventional measures and motor severity, based on laboratory measures of balance and gait, and daily physical activities' measures individuals with Parkinson's disease.	Quantitative	Belgium, Israel, Italy, the Netherlands, and United Kingdom	125 patients with Parkinson's disease (PD)	Activity trackers	Experiment	Data extracted from the wearables, Observation	–	SPSS	Feasibility/ Evaluation	Healthcare
S222	Stuart H. Isaacson et al. (2019)	This study evaluated the PD patients via Kinesia devices to find out whether using these devices enhance motor symptom management at home.	Quantitative	–	39 patients with PD	Kinesia ONE (Smart finger-worn device)	Experiment	Data extracted form wearables, Observation	–	Analysis of covariance (ANCOVA)	Feasibility/ Evaluation	Healthcare
S223	Chantal M. Koolhaas et al. (2019)	This study examined the relationship between body mass index and sleep patterns.	Quantitative	Rotterdam/ Netherlands	1031 individuals from the general public	Wrist-worn actigraph	Experiment	Data extracted from the wearables and observation	–	–	Feasibility/ Evaluation	Healthcare
S224	Aner Weiss et al. (2019)	This study evaluated the strategies used by patients with PD while transitioning from turning to sitting.	Quantitative	Tel Aviv/Israel	96 patients with PD	A body-fixed wearable	Experiment	Data extracted from the wearables and observation	–	SPSS (Student's t-tests, Chi-square tests and ANCOVA)	Feasibility/ Evaluation	Healthcare
S225	Yuanyuan Feng and Denise E. Agosto (2019)	This paper surveyed how amateur runners manage their health information produced by fitness trackers to find out how these technologies will promote personal health information management in future.	Mixed Method	USA	182 amateur runners	Fitness trackers and fitness applications	Survey	Quantitative (close-ended questions) - Qualitative (open-ended questions)	Personal Information Management (PIM) theory	Qualitative analysis (NVivo) Quantitative analysis (descriptive statistics)	Users perception about Technology	Sport and Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S226	Dongni Johansson et al. (2019)	This research evaluated the performance of the Shimmer3 wrist-worn to identify tonic–clonic seizures and examined the validity of various seizure detection algorithms.	Quantitative	Gothenburg/Sweden	11 patients who candidate for epilepsy surgery	An accelerometer-based wearable (Shimmer3 wrist-worn)	Case Study	Data extracted from wearables — Observation	–	MATLAB	Feasibility/ Evaluation	Healthcare
S228	Jeong-Whun Kim et al. (2019)	This research examined the influence of using personal health record on health outcome enhancement and sustained use of such devices in patients.	Quantitative	Seoul/South Korea	43 male patients	Fitness tracker (Samsung Charm)	Experiment	Data extracted from wearables and questionnaire	–	R version 3.0.2	Feasibility/ Evaluation	Healthcare
S229	Francisco de Arriba Pérez et al. (2019)	This experimental research evaluated the possibility of tracking the individuals stress through smart wearables.	Quantitative	Vigo/Spain	19 students	Commercial-off-the-shelf wrist wearable devices	Experiment	Data extracted from wearables and questionnaire	–	Machine learning techniques	Feasibility/ Evaluation	Healthcare
S230	Jenny Leese et al. (2019)	This study compared the viewpoints of rehabilitation clinicians and patients with arthritis about starting and sustaining the use of physical activity tracker devices.	Qualitative	Ontario, Alberta and British Columbia/ Canada	40 patients with arthritis and 25 rehabilitation clinicians	Physical activity trackers	Unclear	Focus group interviews	–	QSR NVivo 10	Users perception about Technology	Healthcare
S231	Babaoglu et al. (2019)	This investigation examined the feasibility of detecting Familial Mediterranean Fever attacks using activity trackers.	Quantitative	Ankara/ Turkey	12 patients with Familial Mediterranean Fever	Jawbone®	Experiment	Data extracted from wearables and observation	–	SPSS version 15.0	Feasibility/ Evaluation	Healthcare
S232	Laura D Ellingson et al. (2019)	This paper examined the usefulness of activity trackers alone or combined with sustained behavior strategies for improving the sedentary and active behaviors.	Quantitative	USA	91 healthy adults	Fitbit Charge, ActiGraph and activPAL	Experiment	Data extracted from wearables and observation	–	Descriptive statistics, chi-square tests, t tests	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S233	Valerio Sperati et al. (2019)	This study evaluated the acceptability of a smart neck-worn toy for typically developed children with autism spectrum disorders and pervasive developmental disorders.	Quantitative	–	15 typically developed kids (8–34 months)	A smart neck-worn toy (teddy bear)	Experiment	Video-recording	–	Wilcoxon rank-sum test	Feasibility/ Evaluation	Healthcare
S234	Jennifer Runkle et al. (2019)	This research examined the pregnant women's perception as well as the health providers' perception about utilizing smart wearables during pregnancy.	Quantitative	Western North Carolina	103 pregnant women and 28 healthcare providers	Wearable Devices	Survey	Questionnaire	–	SAS software Version 9.4	Users perception about Technology	Healthcare
S235	Volkan Senyurek et al. (2019)	This study used a wearable device and proposed a method for integrating the information of a smart lighter with a wrist-worn inertial measurement unit to detect smoking events more accurately.	Quantitative	Al-abama/USA	35 medium and heavy smokers	Personal Automatic Cigarette Tracker 2.0 (smart wrist device)	Experiment	Data extracted from wearables and observation	–	–	Feasibility/ Evaluation	Healthcare
S236	Bethan Everson et al. (2019)	This paper examined and validated questions of self-reported lifestyle and health behaviors in pupils (9–11 years old) through a wearable camera, an accelerometer and kids' activity and health tool.	Mixed Method	UK	14 pupils	Hip-worn accelerometer and autographer	Case Study	Interview, video recording, and observation, Data extracted from wearables	–	–	Feasibility/ Evaluation	Education
S237	Tonacci et al. (2019)	This research assessed the feasibility of applying a new approach through unobtrusive wearables and psychological questionnaires for examining the relationships between stress and emotions among healthy and non-addicted young people.	Quantitative	Italy	17 healthy individuals	An unobtrusive wearable device	Experiment	Data extracted from wearables, questionnaire and observation	–	SPSS Version 23	Feasibility/ Evaluation	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S238	Moira Smitha et al. (2019)	This study examined the essence and extent of kid's beverage (healthy and unhealthy) availability and consumption in daily life (at home and school) through wearables cameras.	Quantitative	New Zealand	158 Kids aged from 11 to 14 years old	Wearable Cameras	Experiment	Photo and video extracted from wearables camera	–	Stata 14	Feasibility/ Evaluation	Healthcare
S239	Inbal Maidan et al. (2019)	This study examined the electroencephalographic changes in an auditory task during walking among some older adults, patients with Parkinson's disease and young adults through a smart cap (Enobio 20 Neuroelectrics).	Quantitative	Tel Aviv/Israel	21 healthy adults–10 Parkinson's disease patients	3D-accelerometers (Opal, APDM) and smart cap (Enobio 20 Neuroelectrics)	Experiment	Data extracted from wearables and observation	–	SPSS version 22	Feasibility/ Evaluation	Healthcare
S240	Ricci et al. (2019)	This experimental research examined how an inertial measurement units wearable device can render support to the diagnosis of motor disability in pupils.	Quantitative	Rome/Italy	17 patients children with attention-deficit hyperactivity disorder and developmental coordination disorder and 20 healthy children	Inertial measurement units wearables	Experiment	Data extracted from wearables, questionnaire and observation	–	Wilcoxon–Mann–Whitney test	Feasibility/ Evaluation	Healthcare
S241	Grym et al. (2019)	This article evaluated the feasibility of using Garmin Vívosmart HR as a smart wristband to collect activity, heart rate and sleep data among pregnant nulliparous women.	Mixed Method	Southwest Finland	20 pregnant nulliparous female	Smart wrist band (Garmin Vívosmart HR)	Experiment	Data extracted from wearables, Interview, and observation	–	SAS Version 9.4 and qualitative content analysis	Feasibility/ Evaluation	Healthcare
S242	Ryan S. McGinnis et al. (2019)	This study explored a novel method for detecting internalizing disorders in children using a belt-worn inertial measurement unit.	Quantitative	USA	63 children	A belt-worn inertial measurement unit	Experiment	Interview, Questionnaire Observation, and data extracted from wearables	–	Matlab	Feasibility/ Evaluation	Healthcare

Table 5
Primary studies in user behavior theme.

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S1	Edward L. Mahoney & Diane F. Mahoney (2010)	This study identified the challenge of Alzheimer's people toward accepting the wearable technologies.	Qualitative		7 experts (4 customer representatives, 1 CEO, 1 COO, and a project developer)	Wearables that track Alzheimer's patients	Case Study	literature reviews, Internet product searches, and telephone interviews	–	–	Technology adoption	Healthcare
S2	Ying Su and Raj Gururajan (2010)	This study proposed an adoption model of wearable computing system for healthcare industry.	Quantitative	China	136 physicians	Wearable computer system	Survey	Questionnaire	TAM	SPSS	Intention to Use	Healthcare
S15	Stuart Moran et al. (2013)	This study presented Britons principal thoughts and viewpoints toward smart wearable tracking devices.	Quantitative	U.K	101 Britons	Wearable ubiquitous monitoring device	Survey	Questionnaire	PSA-BI model	AMOS	Intention to Adopt	General
S18	Stuart Moran, Toyoaki Nishida, & Keiichi Nakata (2013b)	This effort examined factors of PSA-BI model based on a survey in Kyoto University.	Quantitative	Japan	164 office workers	Wearable ubiquitous monitoring device	Survey	Questionnaire	PSA-BI model	AMOS	Intention to Adopt	Higher Education
S28	José Lebrón, Kimberly Escalante, Dr. Jean Coppola, Chris Gaur (2015)	This study observed how providing a smart fitness tracker affects the awareness of health attitudes and behaviors in the case of elderly participants who settle in an assisted living department.	Quantitative	Westchester, USA	7 elderly individuals	Activity Tracker	Experiment	Observation, Questionnaire and data extracted from wearables	–	–	Technology Adoption	Healthcare
S29	Kim and Shin (2015)	This paper identified the main psychological factors of smartwatch adoption and extend the original TAM with the findings of the study.	Quantitative	Republic of Korea	363 smart watch users	Smart watches	Survey	Questionnaire	Extended TAM	AMOS	Intention to Use	General
S30	Laurie Wu, Alei (Aileen) Fan, Anna S. Mattila (2015)	This research investigated how staffs' adoption of smart wearables affects users' service encounter assessments and revisit intentions.	Quantitative	–	103 Mturk users	Wearable Devices	Experiment	Questionnaire	Technology Objectification Effect, theory of person sensitivity bias and gendered technology stereotypes	–	Technology Adoption	Hospitality

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S32	Philipp A. Rauschnabel, Alexander Brem, Bjoern S. Ivens (2015)	Study 1 identified the personality features linked with users' self-reported perception about Google Glass. Study 2 identified expected social conformity, the role of personality, and functional advantages of Smart Glasses.	Quantitative	Germany	Study 1 (146 University students), Study 2 (201 respondents in shopping centers.)	Smart Glasses	Survey	Questionnaire	Big Five Model of human personality	Mplus	Intention to Adopt	General
S39	Gao et al. (2015)	This paper examined the constructs linked to the user's intention to adopt wearables in healthcare and examined the moderate influence of device type on adoption intention.	Quantitative	China	462 healthcare wearable devices users	Healthcare wearable devices	Survey	Questionnaire	UTAUT2, PMT theory, PCT theory	AMOS	Intention to Adopt	Healthcare
S43	Müge Göken, A. Nuri Başoğlu, & Marina Dabic (2016)	This paper explored the intention of physicians to use smart glasses in healthcare industry.	Quantitative	Turkey	75 physicians	Smart Glasses	Survey	Questionnaire, literature review, interview	TAM	SPSS	Intention to Use	Healthcare
S47	Abbey Lunney, Nicole R. Cunningham, Matthew S. Eastin (2016)	This study is to better understanding of why, how, and with what impact individuals are employing smart activity trackers.	Quantitative	USA	206 MTurk workers	Fitness trackers	Survey	Questionnaire	TAM, TPB	–	Intention to Use	Healthcare
S48	Chanmi Hwang, Te-Lin Chung, Eulanda A. Sanders (2016)	This study examined factors influencing users' attitudes toward and purchase intentions behavior for smart wearables, particularly solar-powered clothing based on the TAM.	Quantitative	USA	720 college students at Midwestern university.	Smart Clothing	Survey	Questionnaire	Extended TAM	Mplus	Purchase Intention	Textiles
S49	Li et al. (2016)	This paper investigated the predictors of users' adoption behavior of wearable devices in healthcare.	Quantitative	China	333 healthcare wearables' actual consumers	Healthcare wearable devices	Survey	Questionnaire	Privacy Calculus Theory (PCT)	AMOS	Intention to Adopt	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S50	Yang et al. (2016)	This research analyzed users' perceived value of wearables and examined how their attributes influence consumers' perceived benefit.	Quantitative	Republic of Korea	375 wearable devices users	Wearable Devices	Survey	Questionnaire	Value-Based Adoption Model	Smart PLS	Intention to Use	General
S51	Kim (2016)	This article explored whether screen shape influences smartwatch adoption by proposing an extended technology acceptance model that integrates an empirical comparison between round and square screens with utilitarian and hedonic motivations for higher usage intention.	Quantitative	Hong Kong	200 East Asian university students	Wearable Devices	Experiment	Questionnaire	TAM	SEM-AMOS-R software	Intention to Use	General
S56	Kwee-Meier et al. (2016a)	This study developed a model for describing and predicting the behavioral intention of using the wristbands with a locating system feature among the passenger in the ships in the cases of emergency.	Quantitative	Germany	2086 passengers' ships	Wearable locating systems	Survey	Questionnaire	TAM	SPSS	Intention to Use	Marine
S57	Chuah et al. (2016)	This research examined the effect of smartwatches adoption by non-users.	Quantitative	Malaysia	226 business students at a Malaysian University (non-users of smartwatches)	Smart watches	Survey	Questionnaire	Extended TAM	Mplus	Intention to Adopt	Fashion
S58	Alexander W. Ernst and Claus-Peter H. Ernst (2016)	This study evaluated the impact of Past Product Expectation–Confirmation on using smartwatches.	Quantitative	Germany	229 participants	Smart watches	Survey	Online Questionnaire	Expectation–Confirmation Theory	Partial-Least-Squares approach-SmartPLS	Intention to Use	General
S59	Bastian Stock et al. (2016)	This paper evaluated the significant impact of Perceived Health Risk on smart glasses usage.	Quantitative	Germany	109 participants	Smart Glasses	Survey	Questionnaire	Conceptual Framework	SmartPLS	Intention to Use	Healthcare
S61	Claus-Peter H. Ernst, Alexander W. Ernst (2016)	This study evaluated the influence of privacy risks on smartwatch usage.	Quantitative	Germany	229 Apple Watch users	Smartwatch	Survey	Questionnaire	Conceptual Framework	Smart PLS	Intention to Use	General

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Table 5 (*continued*).

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S62	Florian Rheingans, Burhan Cikit and Claus-Peter H. Ernst (2016)	This study evaluated the potential influence of Perceived Privacy Risk on the behavioral usage of an activity tracker.	Quantitative	Germany	115 German-language participate	Smart watches	Survey	Online Questionnaire	Conceptual Framework	Partial-Least-Squares approach-SmartPLS	Intention to Use	Fitness and Physical Activity
S63	Claus-Peter H. Ernst, Bastian Stock, Tiago Patrick dos Santos Ferreira (2016)	This study evaluated the potential influence of perceived substitutability on the usage of augmented reality smart glasses.	Quantitative	Germany	109 German-language participate	Smart Glasses	Survey	Online Questionnaire	Conceptual Framework	Partial Least-Squares approach-SmartPLS	Intention to Use	General
S64	Daniel Weiz, Gagat Anand and Claus-Peter H. Ernst (2016)	This research evaluated the relationship of subjective norm and the use of smart glasses.	Quantitative	Germany	111 English-language participants	Smart Glasses	Survey	Online Questionnaire	Conceptual Framework	Partial-Least-Squares approach-SmartPLS	Actual System Use	General
S67	Claus-Peter H. Ernst, Florian Rheingans, and Burhan Cikit (2016)	This study assessed the significant relationship between perceived health increase and the use of activity tracker.	Quantitative	Germany	115 activity tracker potential users	Activity tracker	Survey	Online Questionnaire	–	SmartPLS	Intention to Use	Healthcare
S68	Gao et al. (2016)	This study investigated the users' adoption of smart wearables to help the healthcare industry in China.	Quantitative	China	145 General Public	Wearable device	Survey	Questionnaire	Extended TAM & DOI	SmartPLS	Intention to Adopt	Healthcare
S69	Choi and Kim (2016)	This study examined the impacts of determinants that are associated with the features of fashion products on the intention of using the smartwatches.	Quantitative	South Korea	562 individuals	Smart Watches	Survey	Questionnaire	Extended TAM	SPSS	Intention to Use	Fashion
S70	Wu et al. (2016b)	This research investigated the intention of using smartwatches from user perspective by integrating IDT, TAM, and UTAUT.	Quantitative	Taiwan	212 smartwatches users	Smart Watches	Survey	Questionnaire	Extended TAM, DOI, & UTAUT	SPSS & SmartPLS	Intention to Use	General
S77	Park et al. (2016)	The objective of this study is to investigate significant factors of using healthcare wearables among users.	Quantitative	South Korea	877 health wearables' users	Healthcare wearable devices	Survey	Questionnaire	Extended TAM	AMOS	Intention to Use	Healthcare

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Table 5 (*continued*).

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S78	Syakirah Mohamad Taib et al. (2016)	This paper investigated the technology adoption factor of wearables through Tam and DOI theories and the relative factors of pervasive computing and mobility.	Quantitative	Malaysia	272 students and staffs of universities	Wearable devices	Survey	Questionnaire	Extended TAM and DOI	SPSS	Intention to Use	General
S84	Marakhimov and Joo (2017)	This study examined the individuals' health and perceived privacy of the extended use of healthcare wearables.	Quantitative	United States	260 users of healthcare wearables	Healthcare wearable devices	Survey	Online Questionnaire	Coping Theory and CMUA	AMOS	Extended Use	Healthcare
S85	Pantea Keikhosrokia-nia, Norlia Mustaffa, & Nasriah Zakaria (2017)	This study proposed an iHeart system and explored the success factors of implementing the proposed system from the perspectives of healthcare professionals.	Quantitative	Iran and Malaysia	323 healthcare professionals	Healthcare wearable devices	Survey	Questionnaire	Extended Delone and McLean success Model	AMOS-SPSS	Influential Factors of Adoption	Healthcare
S89	Cheng and Mitomo (2017)	This study identified the main factors of general publics' perceived usefulness of using wearables for disaster applications.	Quantitative	Japan	647 respondents	Smart Watches	Survey	Questionnaire	Extended TAM	SPSS and AMOS	Influential Factors of Adoption	Disaster
S91	Dawei Liu, Xiaohong Guo (2016)	This paper empirically examined the influences of crucial factors on purchase intentions for wearables through the concept of social benefit and trust.	Quantitative	China	356 wearable devices buyers	Wearable Devices	Survey	Questionnaire	Extended TAM, DOI and TTF	LISREL	Purchase Intention	General
S92	Jon-Chao Hong, Pei-Hsin Lib, Pei-Chi Hsieh (2017)	This study identified how users' innovativeness influence their purchase and intention to use smartwatches.	Quantitative	Taiwan	276 smartwatches users	Smart Watches	Survey	Questionnaire	DOI, TAM, expectation–confirmation theory, and flow theory	AMOS	Intention to Use	General
S94	Potnis et al. (2017)	This study proposed a model to identify the substantial factors that influence the intention of using a personal safety wearable namely POM by students.	Mixed Method	USA	405 undergraduate students	A personal safety wearable device (POM)	Survey and Grounded Theory	Questionnaire and Interview	Extended UTAUT	AMOS	Intention to Use	Higher Education

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S95	Jeong et al. (2017)	This study examined the potential factors influence the usage and adoption of smart wearables by innovators.	Quantitative	Republic of Korea	312 college students	Wearable Devices	Survey	Questionnaire	DOI and Domain-specific innovativeness (DSI)	AMOS	Purchase Intention	General
S97	Tussyadiah et al. (2017)	This study proposed a framework for the embodiment relationship in technical mediation and evaluated the embodiment of wearables that equipped with the AR technology in the tourism industry.	Quantitative	England	211 museum visitors	Smart Glasses	Survey	Questionnaire	Conceptual Framework	covariance-based structural equation modeling-Mplus	User Experiences	Tourism
S100	Adapa et al. (2017)	This study investigated the contributing and inhibiting factors affected the adoption of smart wearables.	Qualitative	–	15 students and 10 university staffs	Smart Watches and Smart Glasses	Experiment	In-depth Interview	–	–	Influential Factors of Adoption	General
S102	Rajanen and Weng (2017)	This research investigated the factors that affect behavioral intention to use wearables for individuals' personal healthcare.	Quantitative	China	156 respondents	Smart Band	Survey	Questionnaire	Extended TAM	SmartPLS	Intention to Use	Healthcare
S104	Moritz Becker, Andreas Kolbeck, Christian Matt, & Tomas Hess (2017)	This study investigated the influential factors of continuous use of activity trackers and to identify the specified role of privacy concerns in intention to use these devices.	Qualitative	–	16 fitness tracker users	Fitness Trackers	Unclear	Semi-structured interview	Extended UTAUT2 & HITAM & HIPC model	Thematic analysis-ATLAS.ti	Intention to Use	Healthcare
S105	Hayeon Jeong et al. (2017)	This experimental research identified how students wear smart watches and to investigate the factors influence wearing behaviors through a longitudinal analysis.	Mixed Method	South Korea	1–50 smartwatch users- 2–6 smartwatch users	Smart Watches	Experiment	Dataset of smartwatches-Interview-Survey- Ground Truth Data Collection	–	Content analysis	User Experiences	General

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S107	Kuo-Lun Hsiao (2017)	This study identified factors that affect smart watches adoption by integrating task-technology fit model and DOI.	Quantitative	Taiwan	341 smartphone users who are the potential adopters of smartwatches	Smart Watches	Survey	Online Questionnaire	TTF, DOI, & New Product Adoption model (NPA model)	SmartPLS	Intention to Adopt	General
S114	Zhang et al. (2017)	This paper explored the potential factors affecting the healthcare wearables intention to adopt from consumers' perspectives attributes, technical attributes and health attribute.	Quantitative	China	436 potential users of healthcare wearable	Healthcare wearable devices	Survey	Questionnaire	Snob effect theory, Health Belief Model, TAM, Conformity and reference group	SmartPLS	Intention to Adopt	Healthcare
S116	Rawan Alharbi et al. (2017)	This research examined eating related wearables for fine-grained eating detection.	Mixed Method	–	13 participants	Neck and wrist worn sensors, and wearable video camera	Experiment	Observation, Questionnaire, Interview	–	–	Influential Factors of Adoption	Healthcare
S122	Arjun Puri et al. (2017)	This study assessed acceptance and usage of wearable activity trackers in Canadian community of older adult housing.	Mixed Method	Canada	20 older adults	Wrist-worn activity trackers	Experiment	Questionnaire and Semi-structured interviews	Extended TAM and Sensor Acceptance Model	–	Technology Adoption	Fitness and Physical Activity
S129	Ksenia Sergueeva and Norman Shaw (2017)	This research examined the intention of individuals toward using wearables for monitoring their health situation.	Quantitative	USA	141 individuals	Wearable Devices	Survey	Questionnaire	Integrating Protection Motivation Theory (PMT) & UTAUT	Smart PLS	Intention to Use	Healthcare
S137	Shin (2017)	This study examined the relation of consumer experiences and the quality perception of the Internet of Things then developed a framework for Quality of Experience (QoE) in personal informatics.	Mixed Method	South Korea	Qualitative (95 participants), Quantitative (490 participants)	Smart watches	Ethnography and Survey	Observation, ethnographic interviews, questionnaire, data extracted from wearables	Conceptual Model	NVivo and partial least squares (PLS)	User Experiences	Telecommu-nications
S138	Nga H. Nguyen et al. (2017)	This study identified the feasibility and acceptability of activity trackers among postmenopausal breast cancer survivors.	Qualitative	Australia	14 postmenopausal women with breast cancer	Fitbit One, Jawbone Up, Garmin Vivofit, Garmin Vivosmart, Garmin Vivoactive and Polar	Experiment	Focus groups interview (semi-structured interview)	–	NVivo (Thematic analysis approach)	User Experiences	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S141	Wiegard and Breitner (2017)	This research examined the users' readiness for adopting Pay-As-You-Live services with wearables through comparing perceived benefits and perceived privacy risks.	Quantitative	Germany	353 user and non-user of wearables	Wearable Devices	Survey	Questionnaire	Privacy calculus theory (PCT), UTAUT2	SmartPLS	Intention to Use	Healthcare
S142	Choi et al. (2017)	This paper examined the potential factors that affect the intention of construction workers to adopt smart vest and wristband in their workplace.	Quantitative	USA (Indiana, Michigan, Ohio)	120 construction workers	Smart vest and wristband	Survey	Questionnaire	Extended TAM	LISREL	Intention to Adopt	Occupational safety in construction
S145	Canhoto and Arp (2017)	This research examined how the characteristics of health and fitness wearables will confirm the acceptance and sustained use of these devices.	Qualitative	Germany	20 sport enthusiastic adults	Health and fitness wearables	Case Study	Interview-focus group	Conceptual Framework	–	Technology Adoption	Sport and Healthcare
S147	Dehghani (2018)	This study extracted the motivational factors of smartwatches users' continuous intention to use their devices.	Qualitative	–	Reviews of Amazon consumers	Smart watches	Ethnography	Extracting online reviews from Amazon	Conceptual Framework	–	Technology Adoption	General
S148	Milad Dehghani, Ki Joon Kim, Rosa Maria Dangelico (2018b)	This study examined the key factors that influence on smartwatches users' intention to continue usage by developing and validating a new conceptual model.	Quantitative	All over the world	385 actual users of smartwatches	Smart watches	Survey	Questionnaire	Conceptual Framework	Smart PLS	Continuous Usage	General
S150	Debajyoti Pal, Suree Funilkul, Vajirasak Vanijja (2018)	This study examined the key determinants of continuous usage of smart watches users by proposing a new conceptual framework.	Quantitative	Thailand, India, Singapore, Malaysia	312 smartwatch consumers	Smart watches	Survey	Questionnaire	Expectation–confirmation model (ECM)	SPSS and Smart PLS	Continuous Usage	General
S158	Koo (2018)	This empirical study examined the effect of design factors on individuals' perception and their behavioral intention to use wearable soft robots.	Quantitative	USA	425 individuals with movement disabilities	Wearable soft robot	Survey	Questionnaire	Extended TAM	Welch's t-test	Intention to Use	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S159	Jenna Blumenthal et al. (2018)	This paper explored physiotherapists' attitudes toward mHealth applying a modified TAM questionnaire.	Quantitative	On-tario/Canada	76 physiotherapists	Wearable tracking device	Survey	Questionnaire	Extended TAM	PLS-PM technique	Intention to Use	Healthcare
S167	Martin Wiesner et al. (2018)	This study explored the privacy and motivational aspects of wearables utilized by active and healthy citizens.	Quantitative	Berlin, Frank-furt/Main, and Hamburg/ Germany	845 runners	Wearable Devices	Survey	Questionnaire	–	R version 3.3.3	Technology Adoption	Healthcare
S172	Kwok Ng and Tatiana Ryba (2018)	This research investigated the relationship between smart wearable devices and developing athletes in professional sports among student-athletes in high schools.	Quantitative	Finland	437 adolescents athletes	Fitness trackers and fitness applications	Survey	Questionnaire	–	Descriptive statistics (ANOVA tests)	Technology Adoption	Fitness and Physical Activity
S176	Nicola D Ridgers et al. (2018)	This study examined the acceptability and usability of Fitbit Flex among teenagers in Australia.	Qualitative	Burwood/ Australia	60 teenager aged 13 and 14 years	Fitbit Flex	Experiment	Interview, Focus Group	–	A manual protocol (pen profiles, verbatim transcripts)	Technology Adoption	Fitness and Physical Activity
S189	Shayarath Srizongkhram et al. (2018)	This research examined the determined factors of adopting smart wearables among the elderly and their caregivers in Thailand.	Quantitative	Thailand	143 elderly or their caregivers, nurses, physical therapist or their family members	Wearable Devices	Survey	Questionnaire	Conceptual Model	SPSS Statistics 22 and SPSS Amos 22	Actual System Use	Healthcare
S202	Nunes and Arruda Filho (2018)	This qualitative study analyzed users' behavior toward Google Glass through users' online comments on a social network, Reddit.	Qualitative	–	Consumers review in social network Reddit	Google Glass	Ethnography	Online reviews of wearables consumers on Reddit	–	–	User behavior	General
S213	Lidynia et al. (2018)	This study identified the determinants of using wearable technologies.	Quantitative	Germany	166 individuals	Activity tracker	Survey	Questionnaire	Conceptual Model	Parametric and non-parametric method	Technology adoption	Fitness and Physical Activity

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S215	Pradeep Yammiyavar and Deepshikha (2018)	This study developed a smart handcrafted scarf named Aster and examined the significance and acceptance of shifting to interactive communication assistance in the social environment.	Quantitative	India	60 young students	A smart handcrafted scarf named as Aster	Survey	Questionnaire	Extended TAM	SPSS	Actual System Use	Textiles
S219	Dehghani and Kim (2019)	This study proposed three key factors (screen size, uniqueness, and design) for aesthetic appeal and examined the effect of these factors on purchase intention and users behavior.	Quantitative	All over the world	377 smartwatches actual users and 361 potential users of smartwatches	Smart watches	Survey	Questionnaire	Conceptual Framework	Smart PLS	Purchase Intention	General
S227	Li et al. (2019)	This study examined the key factors of smart wearables adoption among older adults above 60 years old based on the technology acceptance model.	Quantitative	Shen-zhen/China	149 adults above 60 years	Wearable Devices	Survey	Close-ended questions (Questionnaire)	Extended TAM	AMOS	Intention to use	Healthcare

Table 6
Primary studies in design theme.

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S3	Eimei Oyama et al. (2010)	This study proposed a porotype of wearable behavior navigation system and evaluate it.	Quantitative	Japan	8 participants	Head-mounted camera	Experiment	Data extracted from the wearables	–	–	Prototype Development	Healthcare
S4	Shuhei Terada, Yusuke Enomoto, & Hisayoshi Endo (2010)	This research examined an estimation system equipped with a self-location sensor for an indoor environment.	Quantitative	–	6 healthy male	Three-axis acceleration sensor (Hitachi wireless-T)	Experiment	Data extracted from the wearables	–	–	Prototype Development	Fitness and Physical Activity
S6	Louis Atallah, Benny Lo, Rachel King, and Guang-Zhong Yang (2011)	This study examined the placement of wearables sensors on different part of the body.	Quantitative	–	Eleven individuals	3-D accelerometers and a body sensor network platform	Experiment	Data extracted from wearables	–	–	Features	Fitness and Physical Activity
S7	M. Smoleń et al. (2011)	This paper proposed a novel health monitoring system by integrating wearable ECG and ACC sensors.	Quantitative	–	7 volunteers without history of cardiovascular diseases	Revitus ECG	Experiment	Data extracted from wearables	–	–	Prototype Development	Healthcare
S9	Maria Paula Saba, Denise Filippo, et al. (2011)	This study proposed a wearable interaction system for haptic interaction.	Qualitative	–	5 people	Smart Belt	Experiment	Interview	–	–	Prototype Development	Healthcare
S10	Jeroen H. M. Bergmann et al. (2012)	This study identified the patients' preferences toward using wearables.	Quantitative	UK	299 patients	Wearable Devices	Survey	Questionnaire	–	–	User preferences	Healthcare
S11	Gilles Bailly et al. (2012)	This study developed a shoe-mounted wearable in three gesture sets, Triangle, Radial, and Finger-Count, and evaluate it based on the users' preferences.	Quantitative	–	12 participants	Shoe-mounted	Experiment	Questionnaire and Observation	–	Kruskal–Wallis (KW) test	Prototype Development	General
S12	William Burns et al. (2012)	This study evaluated the usability of the wearables.	Quantitative	–	6 elderly	Textronics chest straps and Adidas base layer	Experiment	Questionnaire and data extracted from wearables	–	–	Prototype Development	Fitness and Physical Activity
S16	Muaremi et al. (2013)	This research assessed the stress experience of staffs applying features of smartphones and wearable chest belts and presented a solution for assessing the stress.	Quantitative	–	35 employees in three IT companies	Wahoo chest belts	Experiment	Questionnaire and data extracted from wearables	–	Cross-correlation analysis	Features	Healthcare

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Table 6 (*continued*).

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S17	Akane Sano and Rosalind W. Picard (2013)	This study discovered physiological and behavioral signs of stress among individuals.	Quantitative	USA	18 healthy participants	Wrist-worn sensor	Experiment	Questionnaire and data extracted from wearables	–	Linear correlation analysis	Features	Healthcare
S20	E. Kańtoch et al. (2014)	This study implemented and examined a prototype of health tracking system.	Quantitative	–	Fifteen healthy participants, 12 males and 3 females	Health monitoring devices	Experiment	Observation, Data extracted from wearables	–	–	Prototype Development	Healthcare
S24	Enrico Tanuwidjaja et al. (2014)	This study developed a wearable system based on smart Google Glass to assist color blindness people to see a filtered image of the present location in real time.	Qualitative	California/ USA	23 color-blind individuals	Smart Glasses	Grounded Theory	Interview	–	–	Prototype Development	Healthcare
S25	Julia van Heek et al. (2014)	This study investigated the generic characteristics of smart textiles by comparing users' requirements in medical and sports settings.	Quantitative	Germany	172 participants	Smart wearable textiles	Survey	Questionnaire	–	Descriptive analysis, Spearman's correlation, and ANOVA tests	User Requirements	Healthcare and Sports
S34	Yubo Zhang and Pei-Luen Patrick Rau (2015)	This research examined the effect of gender, motion, and display on the use experience and enjoyments of the individuals in interaction with wearables.	Quantitative	China	36 smart watch and bracelet users	Smart watch and smart bracelet	Experiment	Paper-based questionnaire	–	ANOVA test	User Requirements	Fitness and Physical Activity
S37	Enrica Papi, Athina Belsi, Alison H McGregor (2015a)	This study identified the patients' perspective about osteoarthritis, especially, design specifications and needs as well as the method of using wearables to assist the rehabilitation direction.	Qualitative	England	21 Osteoarthritis patients	Health wearable devices	Case Study	Focus group Interview	–	A thematic analysis	User Preferences	Healthcare
S42	Jochen Kuhn et al. (2016)	This paper proposed a new approach to employ Smart Glasses for sensor-based experiments and hands-free presentation in the educational sector.	Quantitative	Germany	46 high-school students	Wearable Devices	Experiment	Questionnaire and Observation	Cognitive Load Theory and Cognitive Theory of Multimedia Learning	SPSS	Prototype Development	Education

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S53	Liuxing Tsao, Lukas Haferkamp, Liang Ma (2016)	This study found out the specific consumers' needs and preferences of wearables for physical activity monitoring among Chinese and Germans. Also, this study compared the results to highlight the impact of cultural difference.	Quantitative	Germany–China	158 college students and staffs	Wearable Devices	Survey	Questionnaire-Interview	–	–	User Requirements	Fitness and Physical Activity
S60	M. Claudia tom Dieck, Timothy Jung and Dai-In Han (2016)	This paper examined the requirements of visitors to develop Smart Glasses applications in the art gallery and museum domain.	Qualitative	Manch-ester/England	28 art gallery visitors	Smart Glasses	Experiment	Interview	–	Affinity diagram technique	User Requirements	Museum
S65	Enrica Papi, Ged M Murtagh, Alison H McGregor (2016)	This study investigated clinicians' perception of health wearables in supporting osteoarthritis (OA).	Qualitative	England	13 health professionals	Health wearable devices	Case Study	Semi-structured interviews	–	Inductive thematic analysis,	User preferences	Healthcare
S66	Athina Belsi, Enrica Papi, Alison H McGregor (2016)	This study clarified the effect of using wearables on patients with osteoarthritis to manage their condition.	Qualitative	London/ England	21 patients with osteoarthritis	Smart wearable sensors — knee monitoring device	Case Study	Focus groups interview	–	Framework Methodology	User Preferences	Healthcare
S71	Yoonhyuk Jung, Seongcheol Kim, & Boreum Choi (2016)	This study identified how much consumers evaluate different smart watch attributes by testing their preference structure of the wearables.	Quantitative	South Korea	123 participates	Smart Watches	Survey	Questionnaire	–	SPSS 19 Conjoint	User preferences	General
S75	Frode Eika Sandnes (2016)	This study tried to find out the functionalities that visually impaired individuals need in various circumstances to decrease the limitations and barriers.	Qualitative	Norway	3 visually impaired academics	Smart Glasses	Case Study	Interview	–	–	User Requirements	Healthcare
S87	Juan C. Torrado, Javier Gomez, & Germán Montoro (2017)	This experimental study analyzed the needs of autism spectrum disorders' individuals to ease certain behavioral issues that undermine their mental well-being during their life.	Quantitative	Spain	2 individuals with Autism Spectrum Disorders	LG Watch Urbane smartwatches	Experiment	Observation and data extracted from the wearables	–	–	User Requirements	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S90	Anna Perry, Laura Malinin, Eulanda Sanders, Yan Li, Katherine Leigh (2017)	This study considered the designer and user perspectives to examine: designer-user needs, design purposes, and the relationships between the above requirements and design purposes.	Qualitative	USA	15 smart clothing designers and users	Smart Clothing	Case Study	In-depth interview	–	Interpretative phenomenological analysis	User Requirements	Textiles
S131	LouAnne E. Boyd, Xinlong Jiang, & Gillian R. Hayes (2017)	This study explored the awareness, understanding, and the usage of interpersonal space for individuals who have Autism by creating and assessing a new wearable system.	Mixed Method	–	10 children with autism	A wearable sensor	Experiment	Interview, Questionnaire and Observation	–	–	Prototype Development	Healthcare
S134	Peter Washington et al. (2017)	This research developed and evaluated a system for automatic recognition of facial expressions by smart Google Glass which passes real-time social signs to children who have Autism Spectrum Disorder.	Qualitative	–	14 children who have Autism Spectrum Disorder and their families	Smart Glasses	Experiment	Interview, Extracting log data from wearables, observation	–	–	Prototype Development	Healthcare
S136	Dimitris Chatzopoulos et al. (2017)	This paper developed and evaluated a system based on smart Google Glass to reach text information in the encompassing environment.	Quantitative	Hong Kong	6 students	Smart Glasses	Experiment	Observation, Questionnaire	–	–	Prototype Development	General
S140	Guillermo Bernal et al. (2017)	This study developed and examined a wearable protective device for energy firms.	Qualitative	Italy	3 ICT workers, 2 site supervisors, five plant operators, and 4 workers	Personal Protective Equipment	Case Study	Semi-structured interviews, simulation	–	–	Prototype Development	Energy Industry
S152	Anya S. Evmenova, Heidi J. Graff, Vivian Genaro Motti, Kudirat Giwa-Lawal, and Hui Zheng (2018)	This study described the process of designing a prototype, a smartwatch application, to support students with disability to improve their learning, independence, and participation.	Mixed Method	–	Study1(5 staff and 6 disabled adults)-Study2 (10 staff, and 11 students with IDD) -Study3 (32 staff)	Smart watch	Experiment	Focus group and individual interviews, data extracted from the wearables	–	Constant comparative analysis – thematic coding – Descriptive statistics	Prototype Development	Healthcare

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S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S177	Yuxi Jia, Wei Wang, Dong Wen, Lizhong Liang, Li Gao and Jianbo Lei (2018)	This study evaluated the perception of consumers' usability and preferences of activity trackers.	Quantitative	China, USA, Singapore, Italy, and Canada	388 individuals	Activity Trackers	Survey	Questionnaire	–	–	User Preferences	Fitness and Physical Activity
S188	Jesús Morenas Martín et al. (2018)	This study designed and developed an eye tracker for collecting the quality fixation measurements in the sports environment.	Quantitative	–	30 university students without visual impairments	Mask-type eye tracker	Experiment	Data extracted from wearables and observation	–	SPSS version 21.0	Prototype Development	Healthcare
S196	Marín-Morales et al. (2018)	This study developed a new emotion detection system for efficient situations evoked by Immersive Virtual Environments using wearables.	Quantitative	Spain	60 healthy individuals	Head-mounted wearables (B-Alert x10 and Samsung Gear VR)	Experiment	Data extracted from wearables and observation	–	Matlab	Prototype Development	Healthcare
S197	Hachisu et al. (2018)	This study developed a new smart head-mounted wearable to assess the time of the face-to-face mode with the identity of the teammate.	Quantitative	Tokyo/Japan	First study (6 students and 4 teachers)- Second study (7 students and 4 teachers)	Smart headband	Experiment	Data extracted from wearables, video recording, observation	–	–	Prototype Development	Healthcare
S243	Wanqing Wu, Sandeep Pirbhulal, Heye Zhang, and Subhas Chandra Mukhopad-hyay (2019)	This study developed a model to combine data from salivary cortisol, physiological and psychological stress response inventory applying a wearable device to obtain high consistency and reliability in measuring stress.	Quantitative	–	30 college students	Textile Electrodes-Based Wearables	Experiment	Data extracted from wearables, questionnaire, and observation	–	Stepwise regression analysis	Prototype Development	Healthcare
S244	Friederike J.S. Thilo et al. (2019)	This paper examined the usability and acceptance of a new fall detection wearable device among elders in their daily life.	Qualitative	Switzerland	15 older individuals	Fall detection wearables	Case Study	Focus group interview	–	f4® and MAXQDA® software	Prototype Development	Fitness and Physical Activity

Table 7
Primary studies in security and privacy theme.

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S8	Andrew Raij et al. (2011)	This study evaluated the concerns of people about disclosure of data that collected from the wearables.	Quantitative	USA	66 students	AutoSense sensor system	Experiment	Questionnaire and data extracted from wearables	–	–	Privacy	Healthcare
S22	Seyedmostafa Safavi, Zarina Shukur (2014)	This study formulated a new improved conceptual framework for wearable healthcare systems.	Qualitative	Malaysia	A heart surgery patient	Smart Wearables	Case Study	Observation	Conceptual privacy framework	–	Privacy	Healthcare
S27	Roberto Hoyle et al. (2014)	This study investigated the people perspective on managing privacy when they are using wearable cameras and to find out which type of first-person pictures they consider sensitive.	Mixed Method	India	36 Participants	Wearable Cameras	Experiment	Interview and Questionnaire	–	–	Privacy	General
S38	Vivian Genaro Motti & Kelly Caine (2015)	This study investigated users' privacy concerns of wearables through a qualitative content analysis of online comments.	Qualitative	–	Users' comments on 59 online sources	Head-mounted and wrist-mounted devices	Ethnography	Extracting online comments and observation	–	Content analysis	Privacy	General
S41	Micah T. Prochaska, Valerie G. Press, et al. (2016)	This study specified the perception of patients about their concerns of privacy while their doctors use Smart Glasses in the process of treatment.	Quantitative	Chicago/USA	86 hospitalized patients	Smart Glasses	Survey	Questionnaire	–	–	Privacy	Healthcare
S52	Emmanuel Sebastian Udoh & Abdulwahab Alkharashi (2016)	This study assessed the privacy awareness of students toward using smart watches in American College in India.	Qualitative	India	10 students	Smart watches	Case Study	Interview	–	–	Privacy	Higher Education
S55	Kwee-Meier et al. (2016a,b)	This study investigated the relationship between demographic data and privacy and security perceptions among cruise ships passengers.	Quantitative	Germany	2085 cruise ships passengers	Safety-enhancing wearables	Survey	Questionnaire	Conceptual framework	MANOVA test	Privacy and Security	Marine

(*continued on next page*)

Table 7 (*continued*).

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S80	Wieneke et al. (2016)	This study discovered why individuals use wearable devices despite privacy concerns through examining the perceived values of wearable devices.	Qualitative	Switzerland	22 wearable users	Bracelets and watches	Case Study	Laddering interview technique & semi-structured interview technique	Privacy Calculus Theory	Means-end chain analysis (MECA)-content analysis	Privacy	General
S83	Segura Anaya et al. (2018)	This study determined users' ethical perceptions toward using wearables in healthcare industry.	Quantitative	Sydney/Australia	60 wearables' users	Health Wearable Devices	Survey	Questionnaire	Conceptual Framework an ethical framework	SPSS	Ethical Implications	Healthcare
S113	Lidynia et al. (2018)	This study examined sensitivity and privacy concerns regarding data collected with wearable devices.	Quantitative	Germany	82 users	Fitness Trackers	Survey	Questionnaire	–	ANOVA	Privacy	Fitness and Physical Activity
S206	Becker (2018)	This study empirically examined factors affecting the users' health information privacy concerns by conducting 7 focus group interviews.	Qualitative	–	42 health wearable users	Health wearable devices	Grounded Theory	Focus group interviews	Health information privacy concerns model	Thematic analysis	Privacy concerns	Healthcare

Table 8
Primary studies in social acceptability theme.

S-ID	Author(s)/ Year	Objective	Methodology	Country	Subject/Sample	Wearables Type	Research Strategy	Data Collection Methods	Theory/ Framework	Analyzing Tool/Technique/ Test	Theme	Industry
S74	Profita et al. (2016)	This study examined how information about the consumers' disability impact on the judgments of the social acceptability of a smart Google Glass in a public environment.	Mixed Method	USA	1200 participants from Mechanical Turk	Head-mounted devices — Smart glasses	Survey and Grounded Theory	Questionnaire (Likert-scale responses) and Open-ended responses	–	SPSS- Open and axial coding	Social Acceptability	Healthcare
S101	Ouverson et al. (2017)	This paper explored the relation of aesthetics considerations with the social acceptability of wearables that are mostly identified as fashionable devices.	Quantitative	USA	Survey 1 (221students)- Survey 2 (306 students)	Smart Glasses, Smart Watches	Survey	Questionnaire	–	–	Social acceptability	Fashion

example, Muaremi et al. (2013) evaluated a solution for measuring the stress experience of users by applying features of smart wearables and smartphones through an experimental study. In a study, Hachisu et al. (2018) designed a new head-mounted wearable device equipped with an infrared emitter and receiver for assessing the time of face to face state with the partner's identity. This device can be used in the healthcare industry by providing awareness via visual feedback within the parent's device for the developmental disorders' children who faced behavior difficulties. In another study, Marín-Morales et al. (2018) developed an emotion detection wearable system for automatic recognition of affective states evoking by Immersive Virtual Environments (IVM). The outcomes validated the value of using IVM to obtain and automatic recognition of various emotional states from cardiac and neural dynamics. Table 6 presents a brief summary of studies in the design theme.

5.1.4. Security and privacy theme

The fourth addressed theme in the primary studies was security and privacy concerns that cover 4% of the SLR studies (11 papers). This theme involves studies that explained and examined the ethical, security and privacy implications. For example, Segura Anaya et al. (2018) examined wearables consumers' ethical perceptions in the health industry by conducting a survey among patients who are using wellness wearable devices. Their findings showed that patients had high concerns about privacy issues regarding the information shared by wearable devices with the third parties. In another study, Becker (2018) examined health information privacy concerns through conducting semi-structured interviews among health wearables' actual users. The results of the thematic map reveal three principal factors, namely, state-trait data sensitivity, dilemma of forced acceptance, and transparency. In the same trend, Lidynia et al. (2018) examined data sensitivity and privacy concerns among 82 smart wearables users. Results revealed that the users of the smart wearables preferred not to disclose data to the public through online forums. Kwee-Meier et al. (2016a,b) examined the relationship of demographic information and personal attitudes with security and privacy perceptions of 2085 passengers regarding using smart wearables in a cruise company. The findings indicated that security risk perception and privacy concerns decline by rising age and need for protection and safety. Table 7 presents the primary studies that were in security and privacy theme.

5.1.5. Social acceptability theme

The last identified theme in the primary studies was social acceptability. The studies in this theme evaluated the social acceptability of smart wearable devices. Two studies that are summarized in Table 8, involved by social acceptability issues. In the first study, Profita et al. (2016) surveyed 1200 people about the usage of Google Glasses in a public environment. They explored how the information about the consumers' disability influenced judgments of the social acceptability. The results of their study determined that people assumed the head-mounted displays as a socially acceptable device if the smart head-mounted devices were being used as an assistant tool for individuals with disabilities. In the second study, Ouverson et al. (2017) inspected the relationship between fashion and social acceptability of the wearable devices. They emphasized that fashion and social acceptability are indeed two separate constructs.

In continuance, the research mind map of smart wearables themes is revealed in Fig. 10. This figure also presents the number of studies distributed in each research methodology. Most studies applied quantitative methodology. In general, 24 studies adopted the mixed method methodology. In technology-focused theme, 89 studies used the quantitative methodology and 27 papers employed qualitative methodology. Whereas, 15 papers employed the mixed method methodology. In user behavior theme, 52 out of the total of 65 papers applied quantitative methodology while 8 papers applied qualitative methodology. Out of 11 papers in security and privacy theme, 5 papers applied quantitative methodology, 5 papers used the qualitative, and one paper adopted the mixed method methodology. In design theme 22 papers adopted the quantitative methodology, 11 papers used the qualitative and two papers applied the mixed method methodology. Two studies were reported in social acceptability theme, one used quantitative and the other employed the mixed method methodology.

5.2. Second research question

In the domain of smart wearables, several different theories and frameworks have been employed by academics. Accordingly, this study seeks to answer the second research question: "What are the theoretical adoption models and frameworks that applied in the previous smart wearables researches?"

The results of SLR show that the most commonly used theory in smart wearable studies was the Technology Acceptance Model (TAM). TAM is the most commonly and extensively used IS theory for investigating the individuals' acceptance of Information and Communications Technology (ICT). According to the TAM, user acceptance can be described based on two dimensions, namely, perceived ease of use and perceived usefulness (Davis, 1993). As presented in Fig. 11, TAM has the majority number of studies with 25 papers. Among these papers, a quantitative study was conducted by Kim and Shin (2015) to examine the main psychological factors of smartwatches adoption in South Korea by extending the original TAM. In a similar study, Chuah et al. (2016) investigated the essential factors of behavioral intention to adopt smartwatches based on TAM in Malaysia. In the other study, Gao et al. (2015) explored the potential factors of users' intention to adopt wearables in healthcare. Cheng and Mitomo (2017) examined the significant factors of users' perceived usefulness of using smart wearables for disaster applications based on TAM in Japan.

Following TAM, Diffusion of Innovation Theory (DOI) was used in seven papers. DOI (Rogers, 1983) is one of the most widely used theories to examine the Information Technology adoption (Wu et al., 2016a). Compatibility, relative advantage, complexity, observability, and triability are the five constituent constructs of DOI theory. Most researchers have used DOI with other theories and frameworks. For example, a study conducted by Gao et al. (2016), extended the original TAM by adding compatibility construct of DOI to examine users' behavior of adopting smartwatches. In a similar study, Wu et al. (2016b) examined relative advantage and compatibility in an integrated model of DOI and TAM. However, some IS academics claimed that only one-fifth of the researches which applied the DOI theory have a clear theoretical basis, and most studies have used the DOI conceptions more than a separated and independent model (Greenhalgh et al., 2005; Wu et al., 2016a).

The next most commonly used theories in the primary studies were the Unified Theory of Acceptance and Use of Technology (UTAUT) and UTAUT2. The basic UTAUT demonstrates that user acceptance can be defined by four indicators: effort expectancy, performance expectancy, facilitating conditions, and social influence. Since IT products and services are applied in both personal life and organizational setting, Venkatesh et al. (2012) and Kim et al. (2007) recommended that original TAM and UTAUT theories may be more useful for investigating the adoption and intentional behavior of employees in organizations. Thus, Venkatesh et al. (2012) developed UTAUT2 with three extra factors of hedonic motivation, habit, and price value to analyze users' behavioral adoption in the personal life setting. As depicted in Fig. 11, three studies applied the original UTAUT and three studies used UTAUT2. For example, Potnis et al. (2017) developed a UTAUT based model for examining the influential factors of users' intention to adopt personal safety wearable devices. In another study, Wiegard and Breitner (2017) investigated the readiness of users to adopt Pay-As-You-Live services using smart wearable devices based on UTAUT2.

The fourth commonly used theory among the primary studies of this SLR is Privacy Calculus Theory (PCT). This theory postulates that a

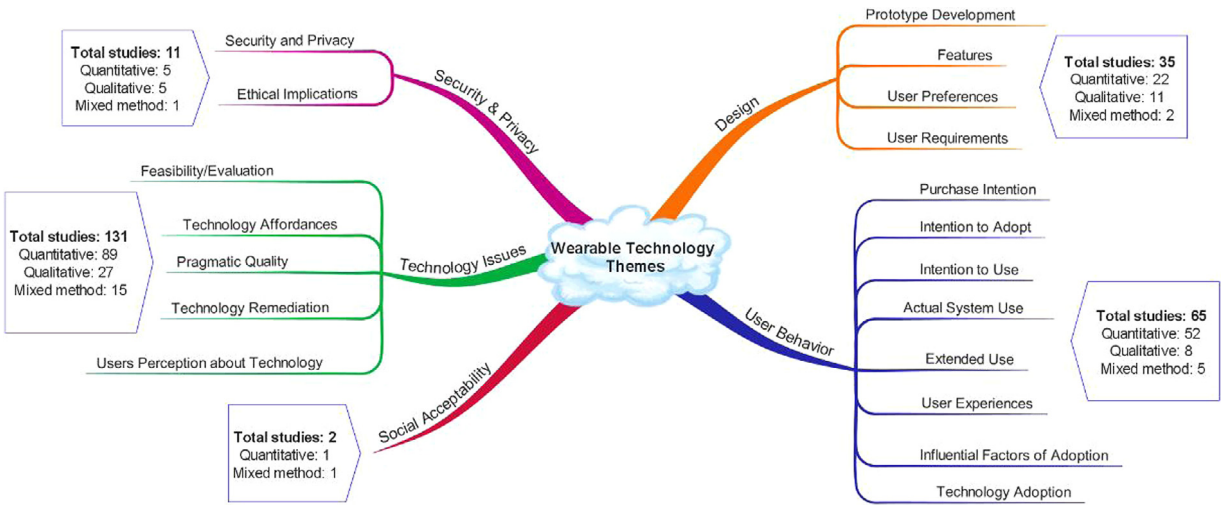

Fig. 10. Mind map of smart wearables research themes and research methodologies.

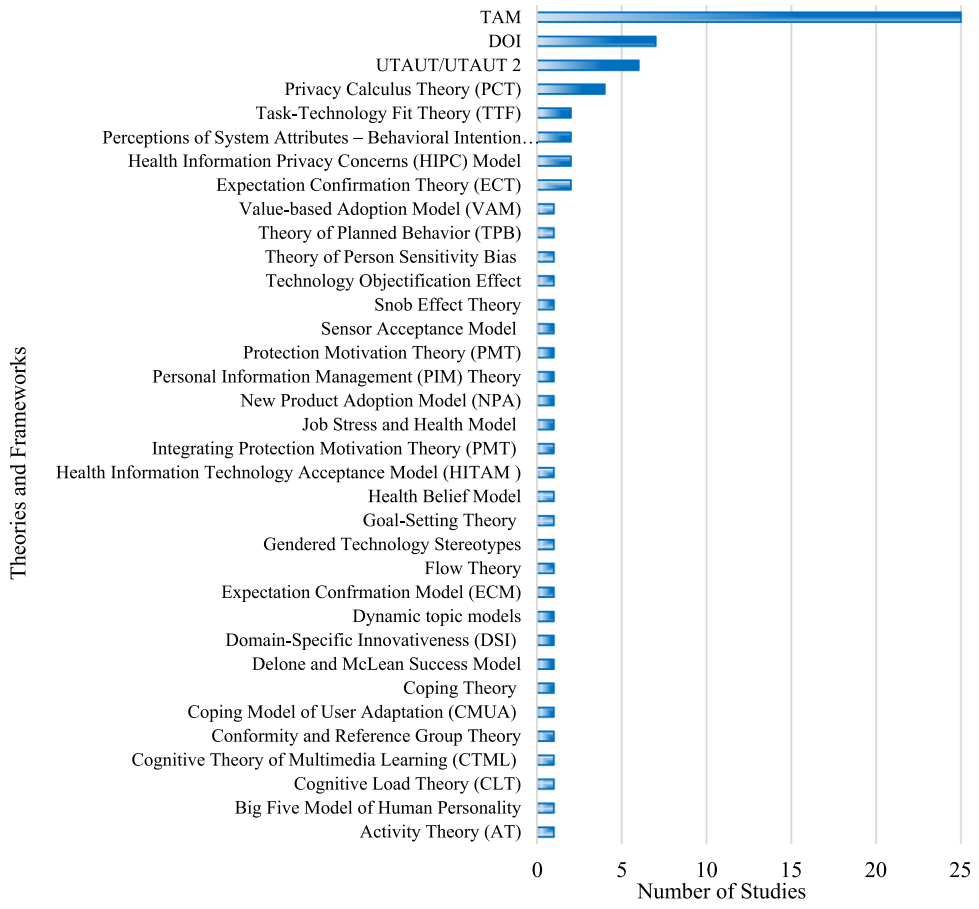

Fig. 11. Distribution of theories and models.

user behavioral intention to reveal personal information is based on his/her analysis of risks and social benefits (Laufer and Wolfe, 1997). PCT has been extensively applied to describe users' intention to reveal their personal information in different domains, such as location-based service (Xu et al., 2011, 2009), electronic commerce (Li et al., 2011), and healthcare (Anderson and Agarwal, 2011; Li et al., 2016). As shown in Fig. 11, four studies adopted PCT to examine the privacy concerns in the context of smart wearables. For example, Li et al. (2016) have examined the importance of users' privacy perceptions in adopting healthcare wearables based on PCT theory. In another study, Wieneke et al. (2016) examined the reasons of using smart wearable devices despite privacy risks based on the perceived value of the wearables and the PCT theory.

5.3. Third research question

The last research question was "What are the most potent factors that affect smart wearables behavioral intention and adoption?"

To answer this question, the most influential factors were derived from the primary studies (58 papers) which investigated the factors

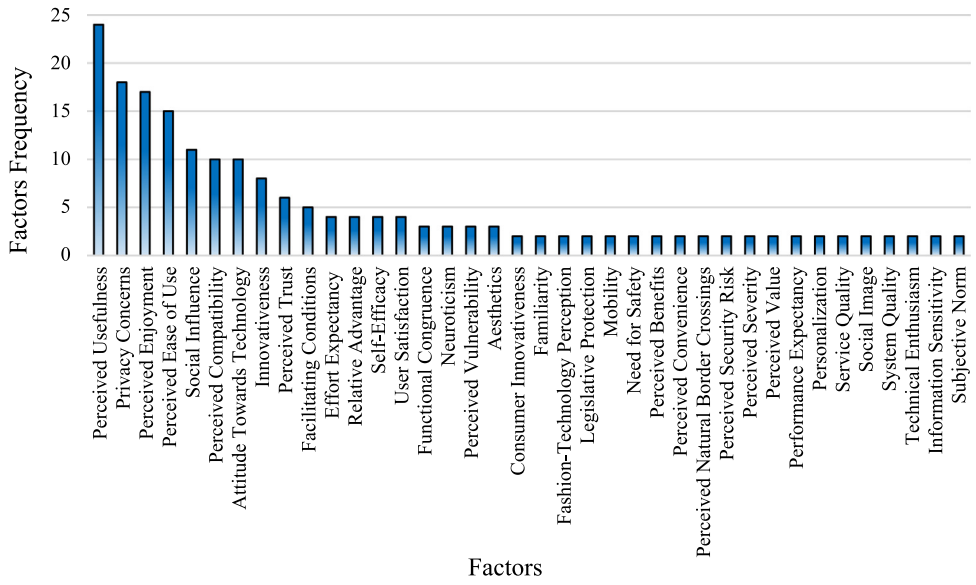

Fig. 12. Predictors of adopting smart wearables.

Table 9
Result of weight analysis.

Independent variable	Dependent variable	TR[a]	SIG[b]	NS[c]	Weight
Perceived usefulness	Behavior intention	18	15	3	0.83
Perceived enjoyment		9	7	2	0.78
Attitude toward technology		9	9	0	1
Social influence		10	8	2	0.8
Trust		4	2	2	0.5
Perceived ease of use		7	2	5	0.28
Privacy concerns		7	6	1	0.86
Relative advantage		3	2	1	0.67
Effort expectancy		3	3	0	1
Compatibility		4	4	0	1
Self-efficacy		3	2	1	0.67
Facilitating conditions		5	4	1	0.8
Perceived usefulness	Attitude toward	9	9	0	1
Perceived ease of use		10	5	5	0.5
Perceived enjoyment		2	2	0	1
Perceived ease of use	Perceived usefulness	8	8	0	1
Compatibility		5	5	0	1
Trust		2	2	0	1

[a]Total Relationships.
[b]Significant Relationships.
[c]Non-significant Relationships.

based on quantitative methodology, hypotheses, and theories. Fig. 12 represents 38 factors mentioned more than one time in the primary studies. As shown in Fig. 12, the most controversial factors among researchers were perceived usefulness and privacy concerns that are mentioned in 24 and 18 studies, respectively. The next disputable factors among smart wearables researchers were perceived enjoyment with 17 studies, perceived ease of use with 15 studies, and social influence with 11 studies. According to Venkatesh et al. (2003), perceived enjoyment is equivalent to hedonic motivation; so in the remaining parts of this study, perceived enjoyment is chosen to refer to both terms. Moreover, attitude toward technology and perceived compatibility were mentioned in 10 studies. As depicted in Fig. 12, innovativeness, perceived trust, and facilitating conditions were declared as potential factors in eight, six, and five studies, respectively. In the same vein, effort expectancy, relative advantages, self-efficacy, and user satisfaction were mentioned in four studies. The rest of the factors were cited two or three times in the primary studies.

On the other hand, many IS researchers have used the weight analysis technique (Jeyaraj et al., 2006) to identify the most effective predictors from a pool of factors in various context, such as e-participation (Naranjo Zolotov et al., 2018), mobile banking (Baptista and Oliveira, 2016), and e-government (Rana et al., 2015). According to Jeyaraj et al. (2006), weight analysis is defined as a method of examining the strength of independent variables in the relationship with a specific dependent variable. Independent variables are categorized in two different groups, namely: (a) "well-utilized" factors that are examined more than 5 times in the previous quantitative studies and (b) "experimental" factors that are examined less than 5 times in the literature (Jeyaraj et al., 2006). According to Jeyaraj et al. (2006), the weight of each independent variable can be derived by applying the subsequent formula:

$$(a) \quad W = \frac{SIG}{TR}$$

where W refers to the total weight of an independent variable, TR refers to the number of times the independent variable was examined (frequency), and SIG refers to the number of times the relationship of the independent and dependent variables was found to be significant. For example, the relationship between perceived usefulness and intention was examined 18 times and their relationship was observed as a significant relationship 15 times in the primary studies. The weight of the relationship between these two variables is obtained by [15/18] = 0.83. The outcomes of the weight analysis are exhibited in Table 9.

Jeyaraj et al. (2006) considered two other definitions, namely: "best predictor" and "promising predictor". Best predictor refers to the well-utilized relationships with a weight higher than 0.80. Promising predictor refers to the experimental relationships with a weight equal to 1 which means further examinations are needed to reach the desired criteria for being the best predictor. In other words, if more studies examined the relationships of promising factors, they may be recognized as the best predictors in the future. As shown in Table 9, six well-utilized relationships were categorized as best predictors of smart wearables adoption, namely: (a) perceived usefulness on intention, (b) attitude toward technology on intention, (c) social influence on intention, (d) privacy concerns on intention, (e) perceived usefulness on attitude toward, and (f) perceived ease of use on perceived usefulness. Among the remaining relationships, five relationships are classified as promising predictors of wearables adoption. The

subsequent relationships of dependent and independent variables are identified as promising predictors: (a) effort expectancy on intention, (b) compatibility on intention, (c) perceived enjoyment on attitude toward technology, (d) compatibility on perceived usefulness, and (e) trust on perceived usefulness.

According to Fig. 12 and Table 9, perceived usefulness is the most examined factor and one of the best predictors of behavioral intention in the smart wearables domain. IS academics emphasized that perceived usefulness positively influence the behavioral intention of users toward adopting and using smart wearables (Rajanen and Weng, 2017; Zhang et al., 2017). In line with the findings of this SLR, Li et al. (2019) accentuated that perceived usefulness is the major predictor of the behavioral intention of using smart wearables. Moreover, the results of the weight analysis technique revealed that perceived ease of use holds a strong direct influence on perceived usefulness. In this regard, Li et al. (2019) confirmed the positive and direct effect of perceived ease and perceived usefulness of health wearables among older adults.

Attitude toward using technology is another best predictor of smart wearables identified in this study. Academics believe that individuals with a more positive attitude toward using technology will have more intention to use it (Chuah et al., 2016; Wu et al., 2016a). In this regard, Sumin Helen Koo (2018) ascertained that attitude toward using smart wearables derives adoption intention significantly. Besides, the direct and positive effect of perceived usefulness on attitude toward using smart wearables has investigated and verified in various studies (Choi and Kim, 2016; Chuah et al., 2016; Koo, 2018).

Social influence is ranked as one of the most significant, direct, and positive predictors of smart wearables adoption (Rajanen and Weng, 2017), while privacy concerns factor is identified as a strong, direct, and negative predictor in the literature Kwee-Meier et al. (2016a,b). Choi et al. (2017) examined the impact of social influence on construction workers toward adopting smart wearables and demonstrated that social influence has a strong positive relationship with intention behavior. Furthermore, they confirmed there is a strong negative relationship between privacy concerns and workers' adoption intention of smart wearables.

6. Discussion

This systematic study reviewed a large scale of literature to determine the current state of smart wearables studies which has appeared as substantial interest among researchers and practitioners. Nonetheless, the existing body of knowledge about smart wearables still has some gaps and limitations.

The outcomes of this study indicate that more than 58% of the studies explored smart wearables in the healthcare sector while almost 11% of the papers examined the physical activity of different age categories of people in daily life. A limited number of papers had performed in other industries such as Textile (Yammiyavar and Deepshikha, 2019), Museum (Dieck et al., 2016), Tourism (Tussyadiah et al., 2017), Military (Wouwe et al., 2011), Marine (Kwee-Meier et al., 2016a,b), Fashion (Ouverson et al., 2017), Construction (Choi et al., 2017), Airline (Neis and Blackstun, 2016), and education (Garcia et al., 2018; Yu et al., 2017).

In a study administered by Cheng and Mitomo (2017), the fundamental determinants of individuals' perceived usefulness of smart wearables usage had examined for disaster applications. Since natural disasters threaten the lives of many people annually all over the world, more explorations are needed to examine the applicability of smart wearables in this field.

Some studies reported that smart wearables are affected by considerable errors in people's daily lives (Gorny et al., 2017). In contrast to the user behavior studies in smart wearables domain which have started to extend the user interaction research beyond the laboratory setting, investigations in the technology-focused theme predominantly concentrate on the lab-based and short-term research design. These could fail to cover all the complicated processes in which the technical functionality of smart wearables records and reflects the individuals' information in the actual life setting and over time. Hence, there is a lack of longitudinal studies in this growing experimental theme.

On the other hand, many smart wearables provide updates for their firmware which may change the assessment features of the devices over time, and therefore decrease the validity and reliability of the data collection and analysis technique. Hence, technology-focused studies could serve from the value of longitudinal research of smart wearables in the actual life setting, with a more comprehensive perception of how technological properties may emerge over time.

The other challenge of the studies in the technology-focused theme is the limited attention toward users' perception regarding the accuracy of data versus the factual accuracy of data collection and analysis in the smart wearables. More precisely, smart wearables may not satisfactorily reflect individuals certain activities. The existing studies in the technology-focused theme are deal with evaluating the accuracy and validity of smart wearable devices. Consequently, a fruitful path for future investigation can arise at a confluence of the adoption research along with the technological focus.

Based on the results of factor weight analysis, it could be deduced that limited empirical research studies have been examined the impact of potential factors on users' behavioral intention toward adopting and using smart wearables. Although reports express the increased demand for smart wearables in the coming years, the current adoption and usage of smart wearables are still quite low and half of the users would abandon their wearable devices in the first six months (Canhoto and Arp, 2017; Dehghani, 2018; Levy, 2014). Therefore, more research studies are needed to examine the reasons why individuals refuse to adopt or continue the usage of smart wearables.

Moreover, future research may examine the relationships of the "promising predictors" to discover whether they can be considered as the "best predictors" or not. Furthermore, the non-significant factors found in this study should not be rejected directly in the future works, essentially based on the low and limited number of researches that have examined them in the past. For example, the relationships of performance expectancy and trust on behavioral intention were examined in many contexts and found as the best predictors of technology adoption (Naranjo Zolotov et al., 2018; Rana et al., 2015, 2014). While these factors are detected as non-significant factors in this study. Therefore, it is recommended to examine the possibility of confirming or refusing the current tendency of the non-significant factors as the future work.

Essentially, smart wearables adoption may be affected by cultural dissimilarities in various nations (Choi et al., 2005; Im et al., 2011; Niknejad et al., 2019). The findings of this review showed that most research studies were handled in Europe and the Americas. Only a few studies have been accomplished in the Middle East, Oceania, Africa, and Asia. Thus, there is a need for examining the acceptance and usability of smart wearables and performing experimental research in the regions which few or no study has been undertaken so far.

On the other hand, overusing smart fitness trackers may cause an unhealthy and damaging obsession for personal health of people and even their family members (Van den Bulck, 2015). According to the results of this SLR, the unhealthy obsession has not been adequately addressed in the smart wearables literature so far. Furthermore, most smart wearables are not identified as medical devices (Peake et al., 2018).

Additionally, the theoretical foundation of smart wearables research is still in the very infancy stage of development (Dehghani, 2018; Gao et al., 2015). As stated by Choi and Kim (2016) and Dehghani (2018), most academic studies on smart wearables have been examining the technological perspective more than user behavioral perspective and there is a dearth of studies to understand actual users' perception and their personal preferences. Similarly, the findings of this review revealed that out of the 244 primary studies, 49 papers examined the influential factors of wearables acceptance based on the existing

models and theories while twenty papers tested a limited number of critical factors in a conceptual model. In this regard, this review along with other academics emphasize that there is a need to examine smart wearables users' perception and behavioral intention through a unified and comprehensive model (Claes et al., 2015; Dehghani, 2018; Gao et al., 2015; Steele et al., 2009).

Research on how smart wearables should be designed and what are the essential features that should be considered in the process of designing smart wearables is hardly ever reflected in the literature. Ki Joon Kim (2016) stated that smart watches are considered as fashion items rather than time-telling and smart tools among the general public. Thus, features and design-factors of smart wearables have more influence on the acceptance of these devices by individuals. Kim (2016) also examined the effect of smart watches screens' forms and found that the round screens for smartwatches are a useless solution for adequately controlling the device, but users are still preferring round screens over the square screens.

Notwithstanding that Information Technology promotes home-based rehabilitation programs by connecting disabled people and rehabilitation professionals remotely (Telerehabilitation), the slow adoption of emerging technologies makes some limitations for rehabilitation programs (Rawstorn et al., 2018). Smart wearables can overwhelm the accessibility difficulties of Telerehabilitation by empowering professionals to render real-time support and treatment to patients in almost any place (rural/remote areas). Although smart health wearables are extremely useful and valuable in Telerehabilitation domain, they have not been examined sufficiently in the literature. Besides, the elderly and disabled individuals could be the major users of smart wearables. Hence, more feasibility studies are needed for examining smart wearables as the technology-assisted tools for elderly and people with disabilities to identify their preferences and requirements. It is important to involve these groups as the co-designers for developing more practical and effective solutions through a collaborative process (Warraich et al., 2018).

According to Ernst et al. (2016), individuals may have more intention to use smart fitness wearables, on condition that they perceive these devices will improve their current health status. Relying on the outcomes of this review, more studies are needed to determine how using smart fitness wearables could influence individuals' attitude and knowledge about their health status.

On the other hand, from the methodological perspective, few studies have used the mixed method while no article has applied the design science methodology. Possibly additional research studies using mixed method and design science methodology propose more value to the body of knowledge in this research field. Additionally, the use of moderator variables such as age, gender, education, and cultural dimension, was scarce in the quantitative studies. Therefore, it is recommended to examine the effect of this demographic information in the future studies.

7. Conclusions

This review provides an outline of recently published smart wearables research studies. A systematic approach was adopted for answering three research questions. This review includes studies that were published between 2010 and 2019. After applying multiple systematic processes, the total number of 244 papers were selected as the primary studies. The remaining articles were eliminated from this SLR since they could not meet the adequate inclusion criteria and quality assessment of this study. However, this systematic review has some limitations. Since this study was conducted in March 2019, it may not cover all papers published then. Furthermore, more studies may be attained by modifying or adding other relevant keywords to the search string such as "quantified-self technology".

After analyzing the extracted data, the primary studies are classified into five research themes, namely: security and privacy, user behavior, social acceptability, technology-focused, and design. The majority of studies belong to technology-focused theme with 131 studies followed by user behavior research theme with 65 studies and design theme with 35 studies. The other research themes had less attention such as security and privacy and social acceptability research themes. Although the bulk of the papers is devoted to the technology-focused theme, there is still a need for more technological investigations on wearables users' requirement and preferences under free-living conditions.

The findings of this review are in line with the results of similar studies, in other contexts, that indicate the majority of investigations have used the theory of TAM to examine the users' behavioral intention regarding smart wearables. However, more study is needed to examine other renowned IS theories and models in the context of smart wearables. Furthermore, perceived usefulness has identified as the most prominent and influential factor of smart wearables adoption followed by privacy concerns, perceived enjoyment, and perceived ease of use.

Using smart wearable devices are applicable in various industries such as healthcare, fashion, education, military, and disaster events. The findings revealed that the majority of the reviewed papers conveyed in the healthcare industry. Only a limited number of studies explored the entertainment and personal safety perspectives of smart wearables that can be an inspiring research area in the future.

Furthermore, the results indicated that the majority of papers accomplished in the United States followed by Germany and the United Kingdom. Since cultural dissimilarities may influence smart wearables adoption, empirical investigations should be conducted in the regions where limited studies or no research has performed so far.

Based on the results, the majority of primary studies applied quantitative research method (69%). Qualitative methodology was used in 21% of the primary studies and the remaining 10% studies used mixed method methodology. Nevertheless, more exploration is needed to qualitatively investigate the different impact of smart wearables usage on individuals' daily life.

In conclusion, since smart wearables is one of the most popular technologies in the market, this systematic review could be valuable for both academic researchers and wearables developers. Based on the findings, this study concluded that smart wearables is a relatively new research area and there is a great need for more exploration within this field. Furthermore, this study comes up with a research mind map of smart wearables themes, theories, and methodologies for those academic researchers who are looking for a research area where more investigation is needed. Moreover, the results of this review would help academics, among particular novice researchers, to realize the existing limitations and gaps as well as the future works for smart wearables researches.

CRediT authorship contribution statement

Naghmeh Niknejad: Conceptualization, Methodology, Data curation, Writing - original draft. **Waidah Binti Ismail:** Conceptualization, Methodology. **Abbas Mardani:** Conceptualization, Methodology, Writing - original draft, Visualization. **Huchang Liao:** Supervision, Writing - review & editing. **Imran Ghani:** Writing - review & editing.

Appendix A. Full name of the journals and conferences

See Table A.1.

Table A.1

Journals/Conference name	Impact factor (2018)	References	Journals/Conference name	Impact factor (2018)	References
Learning and Technology Conference	–	S36	BMJ Open	2.376	S37, S65, S66, S155
European Conference of the International Federation for Medical and Biological Engineering	–	S7	British Journal of Sports Medicine	11.645	S178
World Congress of Biomechanics (WCB 2010)	–	S4	Conference on Human Factors in Computing Systems	–	S208, S133, S131, S11, S74, S135, S98, S109, S40, S8
ACM Transactions on Interactive Intelligent Systems	–	S171	Children	–	S236
Acta Neurologica Scandinavica	2.852	S165	Chronobiology international	2.562	S127
Advances in Human–Computer Interaction	–	S172	Clinical Neurophysiology	3.675	S239
American Journal of Alzheimer's Disease & Other Dementias®	–	S1	Clinical Rheumatology	2.293	S231
Americas Conference on Information Systems (AMCIS)	–	S63	Clinical Simulation in Nursing	2.286	S88
Annual International Conference of Engineering in Medicine and Biology Society (EMBC)	–	S20	Clothing and Textiles Research Journal	0.897	S48
Appetite	3.501	S238	Computers & Education	5.627	S31
Applied Clinical Informatics	1.306	S41	Computers in Human Behavior	4.306	S32, S34, S47, S57, S69, S70, S71, S84, S92
Applied Computing and Informatics	–	S149	Computers in Industry	4.769	S130
Applied Ergonomics	2.61	S227	Conference on e-Business, e-Services and e-Society	–	S68
Arthritis Care & Research	4.53	S230	Congress of the International Ergonomics Association	–	S212
Asia-Pacific Conference on Wearable Computing Systems (APWCS)	–	S2	Cyberpsychology, Behavior, and Social Networking	2.65	S51
Aslib Journal of Information Management	1.702	S225	Digital Avionics Systems Conference (DASC)	–	S81
Automation in Construction	4.313	S79, S142, S143, S144	Digital Health	–	S234
Behavior & Information Technology	1.429	S56, S147, S219	Disability and Rehabilitation	2.054	S183
BioMed Research International	2.197	S118	Electronic Markets	3.553	S141
BioNanoScience	–	S16	European Journal of Cardiovascular Nursing	2.497	S179
BLED 2018 Proceedings	–	S214	European Journal of Dental Education	1.531	S45
BMC Neurology	2.233	S168	European Journal of Information Systems	2.603	S153
BMC Pregnancy and Childbirth	2.413	S241	International ACM SIGACCESS Conference on Computers and Accessibility	–	S132
Evidence-Based Mental Health	–	S111	International Conference on Applied Human Factors and Ergonomics	–	S113
First Monday	–	S94	International Conference on Applied Human Factors and Ergonomics	–	S213, S216, S217, S218
Frontiers in Neurology	2.635	S108	International Conference on Collaboration and Technology	–	S9
Frontiers in Psychology	2.129	S233	International Conference on Computers Helping People with Special Needs	–	S75
Future Technologies Conference (FTC)	–	S52	International Conference on Cross-Cultural Design	–	S53

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Table A.1 (*continued*).

Journals/Conference name	Impact factor (2018)	References	Journals/Conference name	Impact factor (2018)	References
Gait & Posture	2.414	S224	International Conference on Digital Health Conference	–	S76
Gynecologic Oncology	4.393	S160	International Conference on Financial Cryptography and Data Security	–	S38
Health and Technology	–	S14	International Conference on HCI in Business, Government, and Organizations	–	S129
Humaine Association Conference on Affective Computing and Intelligent Interaction	–	S17	International Conference on Human-Computer Interaction	–	S101
IEEE Journal of Biomedical and Health Informatics	4.217	S243	International Conference on Information Science and Applications	–	S211
IEEE Technology and Society Magazine	1.022	S15, S18	International Conference on Information Society (i-Society)	–	S78
IEEE Transactions on Biomedical Circuits and Systems	4.252	S6	International Conference on Management of Engineering and Technology (PICMET)	–	S43
IEEE Transactions on Biomedical Engineering	4.491	S205	International Conference on Pervasive Computing and Communications (PerCom)	–	S207, S116
IEEE Transactions on Learning Technologies	2.315	S42	International Conference on PErvasive Technologies Related to Assistive Environments	–	S140
IEEE Transactions on Neural Systems and Rehabilitation Engineering	3.478	S198	International Conference on Smart Homes and Health Telematics	–	S12
IFIP International Conference on Human Choice and Computers	–	S55	International Joint Conference on Ambient Intelligence	–	S19
IFIP Working Conference on Human Work Interaction Design	–	S215	International Joint Conference on Pervasive and Ubiquitous Computing	–	S24, S27
Industrial Management & Data Systems	3.727	S39	Journal of Construction Engineering and Management	2.734	S201
Information & Management	4.12	S137	Journal of Emergency Nursing	1.489	S154
Information Development	1.265	S91	Journal of Geography in Higher Education	1.533	S35
Information Systems Journal	3.286	S166	Journal of Healthcare Engineering	1.295	S204
Information Technology & People	1.263	S77	Journal of Hospitality and Tourism Technology	–	S60
Innovation & Management Review	–	S202	Journal of intensive care	–	S117
Intensive and Critical Care Nursing	1.652	S146	Journal of Marketing Management	2.392	S145
International Academic Mindtrek Conference	–	S102	Journal of Medical Internet Research	4.945	S115, S190
International Journal of Cardiology	3.471	S151	Journal of Neuroscience Methods	2.785	S161
International Journal of Clothing Science and Technology	0.752	S158	Journal of Personalized Medicine	–	S123
International journal of environmental research and public health	2.468	S180	Journal of Science and Medicine in Sport	3.623	S181
International Journal of Fashion Design, Technology and Education	–	S90	Journal of sleep research	3.432	S195
International Journal of Hospitality Management	4.465	S30	Journal of Special Education Technology	–	S152

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Table A.1 (*continued*).

Journals/Conference name	Impact factor (2018)	References	Journals/Conference name	Impact factor (2018)	References
International Journal of Human–Computer Interaction	1.354	S99, S100	Journal of Sports Sciences	2.811	S125
International Journal of Medical Informatics	2.731	S49, S114, S128	Journal of Travel Research	5.338	S97
International Journal of Surgery	3.158	S21, S44	Journal of Visualized Experiments	–	S170
Internet Journal of Allied Health Sciences and Practice	–	S96	Knowledge-Based Systems	5.101	S192
Internet Research	4.109	S29	Library Hi Tech	1.256	S107
JMIR mHealth and uHealth	4.301	S106, S121, S122, S124, S126, S164, S167, S174, S175, S176, S184, S187, S191, S200, S203, S228, S232	Measurement in Physical Education and Exercise Science	–	S119
Journal of Ambient Intelligence and Humanized Computing	1.91	S169, S229	Medical Engineering & Physics	1.785	S33, S185
Journal of Asthma	2.081	S156	Medicina	–	S237
Journal of Biomechanics	2.576	S240	Medicine and science in sports and exercise	4.478	S110
Journal of clinical nursing	1.757	S244	Military Medicine	0.853	S5
Journal of Computer-Mediated Communication	4.896	S93	Orthopedics	1.608	S23
Multikonferenz Wirtschaftsinformatik, MKWI	–	S67	Proceedings of the Human Factors and Ergonomics Society Annual Meeting	–	S26
Pacifc Asia Conference on Information Systems (PACIS)	–	S104, S80	Journal of Sports Engineering and Technology	–	S188
Parkinsonism & Related Disorders	4.36	S157, S222, S221	Psychiatry Research	2.208	S72
Pediatric blood & cancer	2.486	S54	Robotics and Computer-Integrated Manufacturing	4.392	S82
PeerJ	2.353	S177	International Symposium in Robot and Human Interactive Communication	–	S3
Personal and Ubiquitous Computing	1.735	S163	Schizophrenia Research	4.569	S112
Physiotherapy Canada	0.895	S159	Science and Engineering Ethics	2.275	S83
Portland International Conference on Management of Engineering and Technology (PICMET)	–	S189	Scientific Reports	4.011	S120, S196
Plos One	2.776	S22, S194, S242	Seizure: European Journal of Epilepsy	2.765	S226
Preventive Medicine	3.449	S139	Sensors	3.031	S10, S87, S162, S193, S197, S220, S235
Preventive Medicine Reports	–	S182	Sleep Medicine	3.36	S223
Proceedings of the 2018 ACM International Joint Conference and 2018 International Symposium on Pervasive and Ubiquitous Computing and Wearable Computers	–	S209	Sport Sciences for Health	–	S173
Proceedings of the 51st Hawaii International Conference on System Sciences	–	S206	Supportive Care in Cancer	2.754	S138
Proceedings of the 8th ACM on Multimedia Systems Conference	–	S136	Surgical innovation	1.472	S46
Proceedings of the 8th International Conference on Pervasive Computing Technologies for Healthcare	–	S25	Systems, Applications and Technology Conference (LISAT), 2015 IEEE Long Island	–	S28

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Table A.1 (*continued*).

Journals/Conference name	Impact factor (2018)	References	Journals/Conference name	Impact factor (2018)	References
Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies	–	S105, S134	Telematics and Informatics	3.714	S50, S85, S89, S95, S103, S148
Annals of Thoracic Surgery	3.919	S13	The Drivers of Wearable Device Usage	–	S58, S59, S62, S64
The Journal of Arthroplasty	3.524	S186	Universal Access in the Information Society	0.92	S86, S150
JAMA — Journal of the American Medical Association	51.273	S73	World Neurosurgery	1.723	S199
Twenty-fourth Americas Conference on Information Systems	–	S61, S210			

Table B.1

ID	Study title
S1	Acceptance of wearable technology by people with Alzheimer's disease: Issues and accommodations
S2	The determinants for adoption of wearable computer systems in traditional Chinese hospital
S3	A study on wearable behavior navigation system (II) - A comparative study on remote behavior navigation systems for first-aid treatment
S4	User Localization Using a Wearable Sensor
S5	Sleep Monitoring: A Comparison Between Three Wearable Instruments
S6	Sensor Positioning for Activity Recognition Using Wearable Accelerometers
S7	Wearable Patient Home Monitoring Based on ECG and ACC Sensors
S8	Privacy Risks Emerging from the Adoption of Innocuous Wearable Sensors in the Mobile Environment
S9	Hey yaa — A Haptic Warning Wearable to Support Deaf People Communication
S10	Wearable and Implantable Sensors: The Patient's Perspective
S11	ShoeSense: A New Perspective on Hand Gestures and Wearable Applications
S12	A Smart Garment for Older Walkers
S13	Functional Recovery in the Elderly After Major Surgery: Assessment of Mobility Recovery Using Wireless Technology
S14	Wearable technology to improve education and patient outcomes in a cardiology fellowship program - a feasibility study
S15	Comparing British and Japanese Perceptions of a Wearable Ubiquitous Monitoring Device
S16	Toward Measuring Stress with Smartphones and Wearable Devices During Workday and Sleep
S17	Stress Recognition using Wearable Sensors and Mobile Phones
S18	Perceptions of a wearable ubiquitous monitoring device
S19	Visibility of Wearable Sensors as Measured Using Eye Tracking Glasses
S20	Monitoring activities of daily living based on wearable wireless body sensor network
S21	Google Glass in pediatric surgery: An exploratory study
S22	Conceptual Privacy Framework for Health Information on Wearable Device
S23	Emerging technology in surgical education: combining real-time augmented reality and wearable computing devices
S24	Chroma: a wearable augmented-reality solution for color blindness
S25	User requirements for wearable smart textiles: does the usage context matter
S26	Texting while driving using Google Glass: Investigating the combined effect of heads-up display and hands-free input on driving safety and performance
S27	Privacy behaviors of lifeloggers using wearable cameras
S28	Activity Tracker Technologies for Older Adults: Successful Adoption via Intergenerational Telehealth
S29	An acceptance model for smart watches: Implications for the adoption of future wearable technology
S30	Wearable technology in service delivery processes: The gender-moderated technology objectification effect
S31	What are the educational affordances of wearable technologies?
S32	Who will buy smart glasses? Empirical results of two pre-market-entry studies on the role of personality in individual awareness and intended adoption of Google Glass wearables
S33	Use of wearable technology for performance assessment: A validation study
S34	Playing with multiple wearable devices: Exploring the influence of display, motion and gender
S35	The world through glass: developing novel methods with wearable computing for urban videographic research
S36	Wearable learning technology: A smart way to teach elementary school students
S37	A knee monitoring device and the preferences of patients living with osteoarthritis: A qualitative study
S38	Users' privacy concerns about wearables: Impact of Form Factor, Sensors and Type of Data Collected
S39	An empirical study of wearable technology acceptance in healthcare
S40	Eye-wearable technology for machine maintenance: Effects of display position and hands-free operation
S41	Patient perceptions of wearable face-mounted computing technology and the effect on the doctor-patient relationship
S42	gPhysics — Using Smart Glasses for Head-Centered, Context-Aware Learning in Physics Experiments
S43	Exploring adoption of Smart Glasses: Applications in medical industry
S44	The effectiveness of Google GLASS as a vital signs monitor in surgery: A simulation study
S45	Student perspectives on using egocentric video recorded by smart glasses to assess communicative and clinical skills with standardized patients
S46	Does Wearable Medical Technology With Video Recording Capability Add Value to On-Call Surgical Evaluations?
S47	Wearable fitness technology: A structural investigation into acceptance and perceived fitness outcomes
S48	Attitudes and Purchase Intentions for Smart Clothing: Examining U.S. Consumers' Functional, Expressive, and Aesthetic Needs for Solar-Powered Clothing
S49	Examining individuals' adoption of healthcare wearable devices: An empirical study from privacy calculus perspective
S50	User acceptance of wearable devices: An extended perspective of perceived value
S51	Round or Square? How Screen Shape Affects Utilitarian and Hedonic Motivations for Smartwatch Adoption
S52	Privacy Risk Awareness and the Behavior of Smartwatch Users: A Case Study of Indiana University Students
S53	User Requirements of Wearable Technology for Activity Tracking
S54	Use of a Fitness Tracker to Promote Physical Activity in Children With Acute Lymphoblastic Leukemia

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Table B.1 (*continued*).

ID	Study title
S55	Safety-Enhancing Locating Wearables on Passenger Ships: Privacy and Security Perceptions by the Elderly
S56	Development and validation of a technology acceptance model for safety-enhancing, wearable locating systems
S57	Wearable technologies: The role of usefulness and visibility in smartwatch adoption
S58	Success Comes to Those Who Are Successful: The Influence of Past Product Expectation–Confirmation on Smartwatch Usage
S59	Does Perceived Health Risk Influence Smartglasses Usage?
S60	Mapping requirements for the wearable smart glasses augmented reality museum application
S61	The Influence of Privacy Risk on Smartwatch Usage
S62	The Potential Influence of Privacy Risk on Activity Tracker Usage: A Study
S63	The Usage of Augmented Reality Smartglasses: The Role of Perceived Substitutability
S64	The Influence of Subjective Norm on the Usage of Smartglasses
S65	Wearable technologies in osteoarthritis: a qualitative study of clinicians' preferences
S66	Impact of wearable technology on psychosocial factors of osteoarthritis management: a qualitative study
S67	The Influence of Perceived Health Increase on Activity Tracker Usage
S68	Understanding the Adoption of Smart Wearable Devices to Assist Healthcare in China
S69	Is the smartwatch an IT product or a fashion product? A study on factors affecting the intention to use smartwatches
S70	Exploring consumers' intention to accept smartwatch
S71	Consumer valuation of the wearables: The case of smartwatches
S72	Wearable devices and mobile technologies for supporting behavioral weight loss among people with serious mental illness
S73	Effect of wearable technology combined with a lifestyle intervention on long-term weight loss: the IDEA randomized clinical trial
S74	The AT effect: how disability affects the perceived social acceptability of head-mounted display use
S75	What do low-vision users really want from smart glasses? Faces, text and perhaps no glasses at all
S76	Impact of a Digital Activity Tracker-Based Workplace Activity Program on Health and Wellbeing
S77	Understanding the emergence of wearable devices as next-generation tools for health communication
S78	Innovation diffusion of wearable mobile computing: Pervasive computing perspective
S79	Feasibility analysis of heart rate monitoring of construction workers using a photoplethysmography (PPG) sensor embedded in a wristband-type activity tracker
S80	Privacy-Related Decision-Making in the Context of Wearable Use
S81	Feasibility analysis of wearables for use by airline crew
S82	The role of wearable devices in meeting the needs of cloud manufacturing: A case study
S83	Ethical Implications of User Perceptions of Wearable Devices
S84	Consumer adaptation and infusion of wearable devices for healthcare
S85	Success factors in developing iHeart as a patient-centric healthcare system: A multi-group analysis
S86	Effect of AR-based online wearable guides on university students' situational interest and learning performance
S87	Emotional Self-Regulation of Individuals with Autism Spectrum Disorders: Smartwatches for Monitoring and Interaction
S88	Using Simulation to Conduct a Usability Study of Wearable Technology
S89	The underlying factors of the perceived usefulness of using smart wearable devices for disaster applications
S90	Explore consumer needs and design purposes of smart clothing from designers' perspectives
S91	Can trust and social benefit really help? Empirical examination of purchase intentions for wearable devices
S92	The effect of consumer innovativeness on perceived value and continuance intention to use smartwatch
S93	Shape and Size Matter for Smartwatches: Effects of Screen Shape, Screen Size, and Presentation Mode in Wearable Communication
S94	Students' intention to adopt Internet-based personal safety wearable devices: Extending UTAUT with trusting belief
S95	Domain-specific innovativeness and new product adoption: A case of wearable devices
S96	Effectiveness of a Wearable Fitness Tracker: Practice Implications in Allied Health – a Single Case Study
S97	Embodiment of Wearable Augmented Reality Technology in Tourism Experiences
S98	Supporting Everyday Function in Chronic Pain Using Wearable Technology
S99	Adapting the Navigation Interface of Smart Watches to User Movements
S100	Factors influencing the adoption of smart wearable devices
S101	Fashion and technology: Implications for the social acceptability of a wearable device
S102	Digitization for fun or reward?: a study of acceptance of wearable devices for personal healthcare
S103	Examining user perceptions of smartwatch through dynamic topic modeling
S104	Understanding the Continuous Use of Fitness Trackers: A Thematic Analysis
S105	Smartwatch Wearing Behavior Analysis: A Longitudinal Study
S106	Detecting Smoking Events Using Accelerometer Data Collected Via Smartwatch Technology: Validation Study
S107	What drives smartwatch adoption intention? Comparing Apple and non-Apple watches
S108	Improved Mental acuity Forecasting with an individualized Quantitative sleep Model
S109	Quantifying Sources and Types of Smartwatch Usage Sessions
S110	Variable Accuracy of Wearable Heart Rate Monitors during Aerobic Exercise
S111	Acceptability of the Fitbit in behavioral activation therapy for depression: a qualitative study
S112	Using wearable technology to detect the autonomic signature of illness severity in schizophrenia
S113	A Step in the Right Direction — Understanding Privacy Concerns and Perceived Sensitivity of Fitness Trackers
S114	Technical attributes, health attribute, consumer attributes and their roles in adoption intention of healthcare wearable technology
S115	Prescribing of Electronic Activity Monitors in Cardiometabolic Diseases: Qualitative Interview-Based Study
S116	Investigating barriers and facilitators to wearable adherence in fine-grained eating detection
S117	Use of wearable devices for post-discharge monitoring of ICU patients: a feasibility study
S118	Using Novel Technology within a School-Based Setting to Increase Physical Activity: A Pilot Study in School-Age Children from a Low-Income, Urban Community
S119	Comparative Accuracy of a Wrist-Worn Activity Tracker and a Smart Shirt for Physical Activity Assessment
S120	The calming effect of a new wearable device during the anticipation of public speech
S121	Feasibility and acceptability of a wearable technology physical activity intervention with telephone counseling for mid-aged and older adults
S122	User Acceptance of Wrist-Worn Activity Trackers Among Community-Dwelling Older Adults: Mixed Method Study
S123	Accuracy in wrist-worn, sensor-based measurements of heart rate and energy expenditure in a diverse cohort
S124	Fitbit Charge HR Wireless Heart Rate Monitor — Validation Study Conducted Under Free-Living Conditions
S125	Comparative evaluation of heart rate-based monitors: Apple Watch vs Fitbit Charge HR
S126	Ownership and use of commercial physical activity trackers among Finnish adolescents: cross-sectional study
S127	A validation study of Fitbit Charge 2™ compared with polysomnography in adults
S128	Using consumer-grade wearables and novel measures of sleep and activity to analyze changes in behavioral health during an 8-month simulated Mars mission
S129	Improving Healthcare with Wearables: Overcoming the Barriers to Adoption
S130	Wearables data integration: Data-driven modeling to adjust for differences in Jawbone and Fitbit estimations of steps, calories, and resting heart-rate

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Table B.1 (*continued*).

ID	Study title
S131	ProCom: Designing and Evaluating a Mobile and Wearable System to Support Proximity Awareness for People with Autism
S132	Technology-Mediated Sight: A Case Study of Early Adopters of a Low Vision Assistive Technology
S133	The Use of Smart Glasses for Lecture Comprehension by Deaf and Hard of Hearing Students
S134	SuperpowerGlass: A Wearable Aid for the At-Home Therapy of Children with Autism
S135	Understanding Low Vision People's Visual Perception on Commercial Augmented Reality Glasses
S136	Hyperion: A Wearable Augmented Reality System for Text Extraction and Manipulation in the Air
S137	Conceptualizing and measuring quality of experience of the internet of things: Exploring how quality is perceived by users
S138	A qualitative evaluation of breast cancer survivors' acceptance of and preferences for consumer wearable technology activity trackers
S139	Impact of a workplace physical activity tracking program on biometric health outcomes
S140	Safety++: Designing IoT and Wearable Systems for Industrial Safety through a User Centered Design Approach
S141	Smart services in healthcare: A risk-benefit-analysis of pay-as-you-live services from customer perspective in Germany
S142	What drives construction workers' acceptance of wearable technologies in the workplace
S143	Wristband-type wearable health devices to measure construction workers' physical demands
S144	Wearable sensors for monitoring on-duty and off-duty worker physiological status and activities in construction
S145	Exploring the factors that support adoption and sustained use of health and fitness wearables
S146	Healthcare professionals' views of smart glasses in intensive care: A qualitative study
S147	Exploring the motivational factors on continuous usage intention of smartwatches among actual users
S148	Will smartwatches last? factors contributing to intention to keep using smart wearable technology
S149	Market-driven management of start-ups: The case of wearable technology
S150	The future of smartwatches: assessing the end-users' continuous usage using an extended expectation–confirmation model
S151	Qualitative and quantitative evaluation of a new wearable device for ECG and respiratory Holter monitoring
S152	Designing a Wearable Technology Intervention to Support Young Adults With Intellectual and Developmental Disabilities in Inclusive Postsecondary Academic Environments
S153	An affordance lens for wearable information systems
S154	Emergency Department Crowding and Time at the Bedside: A Wearable Technology Feasibility Study
S155	Clinician perceptions of a prototype wearable exercise biofeedback system for orthopedic rehabilitation: A qualitative exploration
S156	Validation of fitness tracker for sleep measures in women with asthma
S157	Clinical feasibility of a wearable, conformable sensor patch to monitor motor symptoms in Parkinson's disease
S158	Design factors and preferences in wearable soft robots for movement disabilities
S159	Physiotherapists' and physiotherapy students' perspectives on the use of mobile or wearable technology in their practice
S160	Acceptability and feasibility of a Fitbit physical activity monitor for endometrial cancer survivors
S161	Essential tremor quantification based on the combined use of a smartphone and a smartwatch: The NetMD study
S162	A wearable gait phase detection system based on force myography techniques
S163	Activity trackers, prior motivation, and perceived informational and motivational affordances
S164	Findings of the chronic obstructive pulmonary disease-sitting and exacerbations trial (COPD-SEAT) in reducing sedentary time using wearable and mobile technologies with educational support: Randomized controlled feasibility trial
S165	Wearables in epilepsy and Parkinson's disease—A focus group study
S166	Physiolytics at the workplace: Affordances and constraints of wearables use from an employee's perspective
S167	Technology Adoption, Motivational Aspects, and Privacy Concerns of Wearables in the German Running Community: Field Study
S168	Wearables for gait and balance assessment in the neurological ward — study design and first results of a prospective cross-sectional feasibility study with 384 inpatients
S169	How do you sleep? Using off the shelf wrist wearables to estimate sleep quality, sleepiness level, chronotype and sleep regularity indicators
S170	Evaluation of commercial-off-the-shelf wrist wearables to estimate stress on students
S171	An Active Sleep Monitoring Framework Using Wearables
S172	The Quantified Athlete: Associations of Wearables for High School Athletes
S173	A wearable-enhanced fitness program for older adults, combining fitness trackers and gamification elements: the pilot study fMOOC@ Home
S174	The Accuracy of Smart Devices for Measuring Physical Activity in Daily Life: Validation Study
S175	Accuracy of Wrist-Worn Activity Monitors During Common Daily Physical Activities and Types of Structured Exercise: Evaluation Study
S176	Wearable activity tracker use among Australian adolescents: usability and acceptability study
S177	Perceived user preferences and usability evaluation of mainstream wearable devices for health monitoring
S178	Comparison of four Fitbit and Jawbone activity monitors with a research-grade ActiGraph accelerometer for estimating physical activity and energy expenditure
S179	Feasibility of using the Fitbit® Charge HR in validating self-reported exercise diaries in a community setting in patients with heart failure
S180	Classification accuracy of a wearable activity tracker for assessing sedentary behavior and physical activity in 3–5-year-old children
S181	Comparability of children's sedentary time estimates derived from wrist worn GENEActiv and hip worn ActiGraph accelerometer thresholds
S182	Utilizing wearable technology to increase physical activity in future physicians: A randomized trial
S183	The validity of using activity monitors to detect step count after lumbar fusion surgery
S184	Physical activity assessment using an activity tracker in patients with rheumatoid arthritis and axial spondyloarthritis: prospective observational study
S185	Measurement of physical activity in the pre- and early postoperative period after total knee arthroplasty for osteoarthritis using a Fitbit flex device
S186	Feedback from activity trackers improves daily step count after knee and hip arthroplasty: a randomized controlled trial
S187	Acceptability of Continuous Glucose Monitoring in Free-Living Healthy Individuals: Implications for the Use of Wearable Biosensors in Diet and Physical
S188	Design and development of a low-cost mask-type eye tracker to collect quality fixation measurements in the sport domain
S189	Critical Factors for Adoption of Wearable Technology for the Elderly: Case Study of Thailand
S190	Using a Mobile Social Networking App to Promote Physical Activity: A Qualitative Study of Users' Perspectives
S191	Participants' perceptions on the use of wearable devices to reduce sitting time: Qualitative analysis
S192	Deep learning for freezing of gait detection in Parkinson's disease patients in their homes using a waist-worn inertial measurement unit
S193	Recognition of Sedentary Behavior by Machine Learning Analysis of Wearable Sensors during Activities of Daily Living for Telemedical Assessment of Cardiovascular Risk
S194	Acceptability and utility of, and preference for wearable activity trackers amongst non-metropolitan cancer survivors
S195	Sham sleep feedback delivered via actigraphy biases daytime symptom reports in people with insomnia: Implications for insomnia disorder and wearable devices
S196	Affective computing in virtual reality: emotion recognition from brain and heartbeat dynamics using wearable sensors
S197	FaceLooks: A Smart Headband for Signaling Face-to-Face Behavior
S198	Instrumental Assessment of Stair Ascent in People With Multiple Sclerosis, Stroke, and Parkinson's Disease: A Wearable-Sensor-Based Approach
S199	Clinical Feasibility of a Wearable Mixed-Reality Device in Neurosurgery
S200	Diabetes Educators' Insights Regarding Connecting Mobile Phone- and Wearable Tracker-Collected Self-Monitoring Information to a Nationally-Used Electronic Health Record System for Diabetes Education: Descriptive Qualitative Study

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Table B.1 (*continued*).

ID	Study title
S201	Measuring Workers' Emotional State during Construction Tasks Using Wearable EEG
S202	Consumer behavior regarding wearable technologies: Google Glass
S203	A Wearable Sensor-Based Exercise Biofeedback System: Mixed Methods Evaluation of Formulift
S204	Quantitative Approach Based on Wearable Inertial Sensors to Assess and Identify Motion and Errors in Techniques Used during Training of Transfers of Simulated c-Spine-Injured Patients
S205	Continuous Assessment of Levodopa Response in Parkinson's Disease Using Wearable Motion Sensors
S206	Understanding users' health information privacy concerns for health wearables
S207	Shake-n-Shack: Enabling Secure Data Exchange Between Smart Wearables via Handshakes
S208	Wearables for Learning: Examining the Smartwatch as a Tool for Situated Science Reflection
S209	My Watch Says I am Busy: Inferring Cognitive Load with Low-Cost Wearables
S210	Gamified Wearables in Obesity Therapy for Youth
S211	The Effect of Wearing the Customized Insole on the Coordination of the Right and Left Wrists Measured by Wearables During Golf Swing
S212	Interaction Options for Wearables and Smart-Devices While Walking
S213	What Are You Waiting for? – Perceived Barriers to the Adoption of Fitness-Applications and Wearables
S214	Co-creation Model to Design Wearables for Emotional Wellness of Elderly
S215	Exploring Potential of Traditionally Crafted Textiles to Transform into e-Wearables for Use in Socio-cultural Space
S216	Determining Comfortable Pressure Ranges for Wearable EEG Headsets
S217	Can Personal Activity Trackers Be Used to Provide Insight into Sit-to-Stand Workstation Usage and Benefits?
S218	Using Non-invasive Wearable Sensors to Estimate Perceived Fatigue Level in Manual Material Handling Tasks
S219	The effects of design, size, and uniqueness of smartwatches: perspectives from current versus potential users
S220	Wearable Sensor-Based Exercise Biofeedback for Orthopedic Rehabilitation: A Mixed Methods User Evaluation of a Prototype System
S221	Associations between daily-living physical activity and laboratory-based assessments of motor severity in patients with falls and Parkinson's disease
S222	Effect of using a wearable device on clinical decision-making and motor symptoms in patients with Parkinson's disease starting transdermal rotigotine patch: A pilot study
S223	Objectively measured sleep and body mass index: a prospective bidirectional study in middle-aged and older adults
S224	The transition between turning and sitting in patients with Parkinson's disease: A wearable device detects an unexpected sequence of events
S225	From health to performance: Amateur runners' personal health information management with activity tracking technology
S226	Tonic–clonic seizure detection using accelerometry-based wearable sensors: A prospective, video-EEG controlled study
S227	Health monitoring through wearable technologies for older adults: Smart wearables acceptance model
S228	Impact of Personal Health Records and Wearables on Health Outcomes and Patient Response: Three-Arm Randomized Controlled Trial
S229	Study of stress detection and proposal of stress-related features using commercial-off-the-shelf wrist wearables
S230	Using Physical Activity Trackers in Arthritis Self-Management: A Qualitative Study of Patient and Rehabilitation Professional Perspectives
S231	Detection of Familial Mediterranean Fever attacks by using a connected activity tracker and assessment of impact of attacks to daily physical activities: a pilot study
S232	Evaluating Motivational Interviewing and Habit Formation to Enhance the Effect of Activity Trackers on Healthy Adults' Activity Levels: Randomized Intervention
S233	Acceptability of the Transitional Wearable Companion "plus me" in Typical Children: A Pilot Study
S234	Use of wearable sensors for pregnancy health and environmental monitoring: Descriptive findings from the perspective of patients and providers
S235	Cigarette Smoking Detection with an Inertial Sensor and a Smart Lighter
S236	Can Wearable Cameras Be Used to Validate School-Aged Children's Lifestyle Behaviors?
S237	An Innovative, Unobtrusive Approach to Investigate Smartphone Interaction in Nonaddicted Subjects Based on Wearable Sensors: A Pilot Study
S238	Children's healthy and unhealthy beverage availability, purchase and consumption: A wearable camera study
S239	Changes in event-related potentials during dual task walking in aging and Parkinson's disease
S240	Wearable-based electronics to objectively support diagnosis of motor impairments in school-aged children
S241	Feasibility of smart wristbands for continuous monitoring during pregnancy and one month after birth
S242	Rapid detection of internalizing diagnosis in young children enabled by wearable sensors and machine learning
S243	Quantitative Assessment for Self-Tracking of Acute Stress Based on Triangulation Principle in a Wearable Sensor System
S244	Usability of a wearable fall detection prototype from the perspective of older people — A real field testing approach

Appendix B. Primary studies ID and title

See Table B.1.

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