



SMART WEARABLE HEALTHCARE DEVICES: PERSONAL HEALTH CARE COMPANION, CURRENT AND FUTURE CONSUMER ADOPTION STATUS

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ABSTRACT

Healthcare wearable devices are gaining momentum in this era of digitalization as these devices enable an individual to monitor their health on a regular basis with the inbuilt capability of tracking the individual's health and the allied fitness activities. When the adoption of wearable devices is considered it came into light that the adoption of wearable devices is quite less as compared to other smart devices as smart and trending phones. Now a days, manufacturers and designers are depicting increased interest to understand the factors influencing in adopting of these technologies which in turn will help them improve the features and desirability of wearable devices in order to create sensation among consumers and win them over. Due to the privacy issues and concerns involved with these devices the users are facing a trade-off between the perceived risk and the perceived benefit associated with it. The goal of this chapter is to review and synthesize the literature of consumer's adoption of healthcare wearable technologies and associated factors along with it.

KEYWORDS: wearable technology, healthcare wearable devices, technology acceptance theories, privacy risks

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1. INTRODUCTION

Self-tracking has recently surfaced as a big market trend with respect to lifestyle and personal optimization which can be labelled as life-monitoring, calculated-self, individual analytics, self-monitoring and individual informatics. Through self-tracking people can monitor and track some activities of their day to day life with the help of digital technology willingly and with self-interest (Lupton, 2014a). In this recent trend different individuals track the data about their health pertaining to their daily activities – on regular basis post which that data is analyzed to generate different statistical chart and image. (Choe et al., 2014; Sjöklint et al., 2015). Different Technology and devices can be used to do so like smart watches, Blood pressure monitors, computers, tablets, smart phones wearable devices. Wearables refer to smartwatches, wristbands, patches, clip-on devices and jewellery or textiles with embedded sensors which measure bodily functions or physical activity (e.g., Nike Fuel, Jawbone or FitBit) (Lupton, 2013a; Swan, 2012b). Wearables are to be worn 24 /7 by anybody and it records the daily readings of the body movements like heart rate, blood pressure, pulse body temperature, calories burn and number of steps (Lupton, 2013b). The collected data can be analyzed to have a better track of the daily activities to enhance the quality of life. The recent advancements in sensors and communications have made it possible for individuals to monitor their various physiological conditions using the wearable healthcare devices. Human health and fitness are areas in which wearables can offer insights and it is also quite evident with the popularity of the fitness trackers. Smart healthcare has become especially important in this ever-increasing world population, the conventional patient-doctor appointment has lost its effectiveness. Smart healthcare can be implemented at all levels starting right from the temperature monitoring to tracking vital signs in the elderly. The technology of wearable device can be used to encourage the individuals to be more active and in turn make good lifestyle choices.

The domain of internet of things is extending itself into healthcare both the medical and social care (Mittelstadt, 2017). Internet of things is defined as an innovation that is radical and disruptive in nature which transforms the way the consumers lead their live through creating products which are connected and smart (Sivathanu, 2018). Devices which are enabled using internet for the monitoring the health of users outside the traditional medical institutions are becoming greatly common in the healthcare sector (Mittelstadt, 2017). The healthcare wearable technologies are playing a important role in the management of health of an individual by doing the functions of prevention of disease, real time monitoring of health of an



individual, medication dispensation, fitness and well-being monitoring and also helps in the collection of data for health related research work (Mittelstadt, 2017).

Wearable technology in healthcare includes the healthcare wearable devices and the fitness trackers like the Samsung gear, Fitbit, apple watch which ensures that this emergence is one of the most prominent fields in the areas under the internet of things (IoT) (Marakhimov & Joo, 2017). These devices also do not limit the user's normal activities and still monitor the health of the individual involved (Sivathanu, 2018). They allow the consumers to monitor their health on a personal level and in turn the health data generated is accessed by the physicians in order to provide a personalized health and medical care (Marakhimov & Joo, 2017). They monitor the various activities of the individual ranging from the quality of sleep of the individual, body temperature, blood pressure to blood oxygen levels (Sivathanu, 2018).

These devices also prove to be of immense value for the older people. With the increasing aging population in countries like India displays a potential market for these healthcare devices (Sivathanu, 2018). They are in certain cases life savers to the older people as it records and guards the health of the individual. This has led many corporate giants to like the Infosys, Intel, IBM and Wipro into making these IoT enabled wearable devices to monitor health (Sivathanu, 2018).

Mostly the fitness wearable devices attracts the young users as they help them in monitoring their day to day fitness conditions and the wearable devices used in the medical field for monitoring the health is preferred mostly by the middle age to old age people (Luo, 2015).

The usage of the healthcare wearable devices and the research prospect of it can be divided into two main sub sections which includes the adoption intention of the consumers on the first place and the privacy aspects therein through the health data collected in order to monitor the health of the individuals. The articles reviewed mainly focuses on the models used to evaluate the acceptance of technology and the adoption intention factors involved. The future challenges mainly involve the implementation factors and the privacy risks associated with it.

2. TECHNOLOGY ACCEPTANCE THEORIES

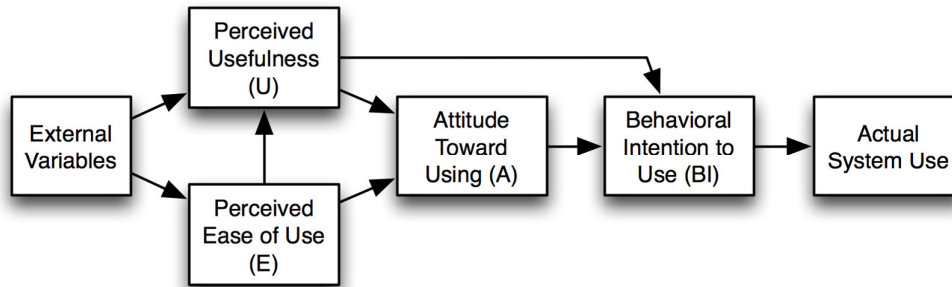
Technology acceptance model: The technology acceptance model (TAM) that was proposed by (Davis, 1989) is one of the most important and highly valued models among the researchers and scholars who have investigated the consumer's acceptance of various innovative technologies in various contexts. TAM is one of the models which has been used the most in order to evaluate and understand the technology adoption depending upon the varying contexts (Mercado, 2018). Accordingly, the factors that are considered are perceived usefulness, Perceived ease of use, Attitude towards using and behavioural intention to use, Compatibility and Perceived risk (Nasir & Yurder, 2015).

TAM additionally identifies the lack of instructions as a barrier to a person adopting, because it is a barrier to actual system use and can imply to the user that they should be able to use the device and that difficulties are personal failing. The TAM model also provides with two main factors and elements which are considered to influence the consumers or the users to adopt a particular technology, those elements are perceived usefulness and perceived ease of use (Jusob, George, & Mapp, 2016). Perceived ease of use depends on the consumer or the user



considering whether using that particular device or technology would improve the work efficiency. Perceived ease of use on the other hand depends on the consumers attitude and belief that using certain system would enhance the efficiency of work.

Figure 1: Technology acceptance model



Source: Davis et al. (1989)

3. UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY

The unified theory of acceptance and use of technology (UTAUT) model is an extension of the TAM. This model integrated the TAM with other decision making theories such as the theory of reasoned action, theory of planned behaviour, social cognitive theory, and innovation diffusion theory (Mercado, Adoption of fitness wearables : Insights from partial least squares and qualitative comparative analysis, 2018). This model also includes the performance-expectancy theory, facilitating conditions and the social influence to explain the use and behavioural intention. Other main reason for the researchers to use this particular model is mainly due to the growing and increasingly huge market for the healthcare wearable devices along with the proliferation of the brands makes an interesting case in order to study the technology adoption in the enabling technologies category.

The unified theory of acceptance and use of technology compared to the technology acceptance model is a more recent approach in the field of technology acceptance (Venkatesh, Thong, & Xu, 2012). This model understands the use of information systems and the intention to use to use them from various theories like the expectancy theory which focusses on effort expectancy, social cognitive theory which focusses on social influence and personal computing utilisation which focusses on facilitating conditions.

4. UNIFIED THEORY OF ACCEPTANCE AND USE OF TECHNOLOGY 2

The extended version of UTAUT is the UTAUT2 which was meant to be a more integrative model. The hedonic motivation was added to the model due to its key predictor in the earlier researches and the importance therein (Talukder, Chiong, Bao, & Malik, 2018). The factor of price value was also added because in the consumer context, the users must bear the costs associated with the service use.



UTUAT2 provides seven direct factors that affect the intention of the consumers to adopt a new technology (Gao, Li, & Luo, 2015). Hedonic motivation involves the pleasure which is derived from the adoption and usage of technology (Venkatesh, Thong, & Xu, 2012). As the consumers have to bear the costs involved in adopting a technology, in UTUAT2 they usually face a trade-off between the perceived benefits and the monetary value involved. As the monetary cost is involved with the adoption of a technology, this particular factor also measures the quality factor involved along with the wearable technology (Venkatesh, Thong, & Xu, 2012). UTUAT2 differentiates itself from the UTUAT by theoretically hypothesizing and in turn testing the positive impacts of facilitating the conditions involved in the consumers intention to adopt (Venkatesh, Thong, & Xu, 2012).

5. BEHAVIOUR REASONING THEORY

Behaviour reasoning theory provides a common platform which enables the researcher to study the relative influence of the “reasons for” and “reasons against” adoption (Sivathanu, 2018). The behavioural reasoning theory enables the study of adoption and the resistance factors in a single framework (Sivathanu, 2018). “Reasons for” basically elaborates about the intention to adopt and the factors involves and the “reasons against” the adoption are the reasons for the resistance for the adoption of the wearable device.

DIFFUSION OF INNOVATION:

The diffusion of innovation theory is useful for examining innovation and success of their dissemination through a more precise indicator of consumer behavior (Talukder, Chiong, Bao, & Malik, 2018). This model is used to determine their influence on the adoption of fitness wearable technology. This theory suggests that through a process called innovation-decision, individuals pass from obtaining knowledge about an innovation to forming an attitude about it (Demir, 2006). Innovation diffusion related researches show that innovation is a an important element and that personal innovativeness is also a important variable in determining the outcomes related to the outcomes of technology adoption (Talukder, Chiong, Bao, & Malik, 2018).

This attitude will then impact the individual’s decision to accept or reject the innovation. The influence of certain variables like the effort expectancy from expectancy, social influence from social cognitive theory and facilitating conditions from personal computing utilization on the use and the intention to use are segregated according to the gender, age and experience in using the particular system and the voluntariness to use the system (Mercado, 2018).

6. WEARABLE TECHNOLOGY ACCEPTANCE IN HEALTHCARE

The results from a research show that technology acceptance, health behavior and privacy context perspectives has a significant effect on the consumers intention whether or not to adopt the wearable device (Luo, 2015). The findings also suggest that consumers pay more attention to social influence, perceived privacy risk and perceived vulnerability in their acceptance of wearable technology in healthcare, since they focus more on the enjoyment, their comfort level and price of the particular wearable device.



By the wearer using the technology is able to become aware of the daily distance walked and monitor his health in order to lead a healthy life (Haghi, Thurow, Habil, Stoll, & Habil, 2017). Many wearable devices have been implemented to measure critical elements in the monitoring of healthcare.

Attitudes have also been used to predict and explain the individual's intentions to adopt various technologies and devices. An individuals' innovativeness is also connected with their personal traits (Lee & Lee, 2018). Consumers who are innovative tend to adopt early. The results of this study also revealed that there is not much difference between people who are aware of the fitness trackers and those who are not aware of these devices. An individuals' intention to adopt the fitness tracker is positively correlated with the variables representing interpersonal influence, technology self-efficacy, information technology related innovativeness.

Most of the users who adopt the wearable tend to stop using the wearables within 6 months (Canhoto & Arp, 2016). Sometimes the users may not reap the necessary benefits as promised while buying. The usage of a technical product is largely influenced by technical and social contexts. The technical context involves what the technology can actually do and the social context what is acceptable in a particular social context.

The managers and the social planners involved in marketing these wearable devices should implement strategies which should not only focus on the usefulness and the ease of use but it should also focus on the consumer's healthcare behaviours and protect the privacy of the users (Luo, 2015).

7. FUTURE CHALLENGES IN IMPLEMENTATION OF HEALTHCARE WEARABLE TECHNOLOGIES

There are certain challenges for both the healthcare system and the wearable technologies industry for the implementation of these devices in healthcare (Lewy, 2014). In the aspect of the healthcare system the main challenge is to enable the use of these technologies by changing the model of care and sharing information. Implementation of these technologies requires the collaboration of the healthcare professionals and patients, not just in adoption, but also according to process of development and implementation in best practice and care pathways.

Giving a user centric approach in which the ability to control the data access and issue permissions is given to the user itself (Liang, et al., 2018). By this way they get the ownership of their data and whether or not to make their data available public or private. This would lead to decentralized permission management through which a permission should be needed to access the personal health data. Wearable devices does the work of conversion of transforming the original health of an individual into a readable format and that on the other hand is synced on with the account of the patient or individual online (Liang, et al., 2018). To enable the device to store the data online for any further investigation during times of data leakage the user should create an account with a cloud database server. When the data related to the individual's health is generated through the healthcare wearable devices, in order for a better protection it is uploaded to the blockchain network. In this way a confidence for the user



of these wearable devices for healthcare is created since there is a trusted security along with it (Liang, et al., 2018).

The immaturity of the solutions existing today pose as an important barrier to the implementation of wearable technologies in healthcare (Lewy, 2014). The time required by the physician to use the data compared with the added value provided by it poses as an important challenge for the implementation of healthcare wearable technologies.

8. PRIVACY RISKS AND ISSUES ASSOCIATED WITH THE ADOPTION OF HEALTHCARE WEARABLE DEVICE

With the invention of smartphones, security measures and protocol has changed as the technology becomes more advanced (Chalif, 2016). The future of wearables is in the augmented reality and virtual reality. Wearable devices are often open to security breaches at many different places due to the complexity of the device. There is the device itself which transfers the data to a phone or a web app and then transfer the data to a cloud or device server. During the connection of Bluetooth from the device to the web or phone app there are many areas for security breaches.

As the data which is collected from the wearables can be related to the user, privacy is one of the major concerns in the utilization of these devices (Perez & Zeadally, 2017). These wearables can collect data about events that a user might not want to share with cloud service providers. Some wearables have sensors that not only capture data about the wearer, but allow the collection of data about the user's surroundings.

Integrating the block chain technology with healthcare industry would reduce the privacy concerns due to the enhanced security because of it (Liang, et al., 2018).

The data generated by these healthcare wearable devices in a way create ample opportunity in order to cultivate healthy habits among the users (Mittelstadt, 2017). Privacy is a very important aspect involved as health-related data is generated in real time they provide with greater scope (Mittelstadt, 2017). Once the data is generated, they must be transferred, curated, labelled, stored and finally analysed which would be of an immense benefit for the user especially, service provider and other stakeholders involved. Informational privacy involves the control of data about an individual and at its narrowest part the informational privacy is directly involves with hiding the personal data from the unauthorised parties (Mittelstadt, 2017). The ownership regarding the redistribution of the health-related data collected through the wearable devices is quite vague (Mittelstadt, 2017). The factor of law comes in this case when the rights are guaranteed through the privacy and protection law.

With the development of the health care industry into a smart healthcare industry brings along with it the need for collecting the personal health data of individuals in order to improve their services (Kim, Jang, & Yoo, 2018). The smart watches and smart bands like apple health and google fit are wearable devices which collect and accumulate personal health data in a large scale. Since the data collected through the wearable devices is stored in a cloud environment, the privacy there in is questioned as the cloud servers are often beyond the trusted domain (Kim, Jang, & Yoo, 2018).



9. CONCLUSION

This paper provides a review of the literature of the various research papers related to the adoption of wearable technologies by consumer's and the privacy risks associated with it. By doing that, this paper brings together the overall approach of the research works involving the wearable technology adoption. Technology adoption theories related papers were also reviewed. Since healthcare wearable devices are a currently growing market, the other aspects related to it like the adoption of those devices by the consumers and the underlying factors associated with it including the challenges and privacy issues related to it are also an important element to be discussed and reviewed in research.

The companies involved with the manufacturing and selling of healthcare wearable devices should focus more on protecting the privacy of its users and create more trust in certain ways as to how they protect the privacy and overcome all the challenges which inhibits a particular consumer from actually adopting the device. If the concentration is done on that basis the rate of adoption might as well increase. Apart from these the various technology adoption theories also display various components depending on that particular theory using which they evaluate the adoption intention of consumers is also useful during the course of the research.

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