

**Czech University of Life Sciences Prague**

**Faculty of Economics and Management**

**Systems Engineering and Informatics**



**Diploma Thesis**

**Wearables for Health and Fitness Enhancement  
A User Experience Study**

**Shailany Vizconde**

# CZECH UNIVERSITY OF LIFE SCIENCES PRAGUE

Faculty of Economics and Management

## DIPLOMA THESIS ASSIGNMENT

B.Sc. Shailany Vizconde, BSc

Informatics

Thesis title

**Wearables for Health and Fitness Enhancement: A user experience study**

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### Objectives of thesis

The main aim of the thesis is to evaluate the use of smartphones and wearable devices for health and fitness purposes from the user's perspective.

The partial goals is:

- To make a literature review of the current state of the art in wearables and smartphone applications for health and fitness;
- To make a survey of user experience among health and fitness applications and wearables target users;
- To make a case study of the use of health and fitness applications and wearables.

### Methodology

Methodology of the thesis is based on study and analysis of information resources. The practical part is focused on a qualitative survey among target users by selected empirical methods. The case study will synthesize results of the literature review and survey. Based on the theoretical knowledge, empirical evaluation and case study, practical recommendations and conclusions will be formulated.

**The proposed extent of the thesis**

60 – 80 pages

**Keywords**

wearable technology, wearable devices, wearable fitness device, fitness trackers, mobile wearable devices

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**Recommended information sources**

- Direito, A., Pfaeffli Dale, L., Shields, E., Dobson, R., Whittaker, R., & Maddison, R. (2014). Do physical activity and dietary smartphone applications incorporate evidence-based behaviour change techniques?. *BMC Public Health*, 14(1), 646. doi:10.1186/1471-2458-14-646
- Jon G. (2013) "Meet The Tech Duo That's Revitalizing the Medical Device Industry," *Fast Company*,
- Kamel Boulos, M., Brewer, A., Karimkhani, C., Buller, D., & Dellavalle, R. (2014). Mobile medical and health apps: state of the art, concerns, regulatory control and certification. *OJPHI*, 5(3). doi:10.5210/ojphi.v5i3.4814
- Lee, J. (2013). Validity Of Consumer-Based Physical Activity Monitors And Calibration Of Smartphone For Prediction Of Physical Activity Energy Expenditure, 1-148.
- Mobiquity inc,. (2014). The Future " at Least the Near Future " of Wearables May Just be Health and Fitness Tracking | Mobiquity. Retrieved 12 April 2015, from <http://www.mobiquityinc.com/future-%E2%80%93-least-near-future-%E2%80%93-wearables-may-just-be-health-and-fitness-tracking>
- Ramsey, R. (2013). The Impact of Wearable Technology in Healthcare. *Wearabletechworld.com*. Retrieved 12 April 2015, from <http://www.wearabletechworld.com/topics/wearable-tech/articles/353619-impact-wearable-technology-healthcare.htm>
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### **Declaration**

I declare that I have worked on my diploma thesis titled “Wearables for Health and Fitness Enhancement: A User Experience Study” by myself and I have used only the sources mentioned at the end of the thesis.

In Prague on date \_\_\_\_\_

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**Nositelná zařízení pro zlepšení zdraví a životního stylu**  
**Studie uživatelských zkušeností**

**Wearables for Health and Fitness Enhancement**  
**A User Experience Study**

## **Summary**

In today's world where time is precious, many people tend to neglect their health that they cannot even find time to visit the doctor for a regular health checkup, they also skip meals and become physically inactive.

For these reasons, people are looking for an alternative which can be worn on their body to monitor their well-being and get insights on various health parameters.

This is when wearable devices come into the picture. Wearable devices became immensely popular to both working professionals and students who want to stay physically active.

Several wearables brands are currently out in the market offering different features such as tracking eating habit, calories burned, sleep quality tracker, pedometer and a lot more. The aim of this study is to dig deeper on the effectiveness of wearables in not just monitoring various health parameters but also its implication to people's daily lives that concerns their health.

## **Keywords**

Wearable technology, wearable devices, wearable fitness device, fitness trackers, mobile wearable device

## **Souhrn**

V dnešním uspěchaném světě je čas natolik drahocenný, že stále více lidí zanedbává svoje zdraví. Kvůli úspoře času nechodí na běžné zdravotní prohlídky k svému doktorovi, či vynechávají pravidelné stravování a stávají se fyzicky neaktivními.

Z těchto důvodů mnoho lidí hledá alternativu v podobě zařízení, které může být nošeno na jejich těle. Zařízení monitoruje jejich pocit pohody a vytváří přehled o nejrůznějších zdravotních parametrech.

Nositelná zařízení se stávají běžnou realitou. Tato zařízení jsou nesmírně populární jak pro pracující, tak i pro studenty, kteří chtějí zůstat fyzicky aktivní, a tedy i zdraví.

Několik značek na trhu aktuálně nabízí nositelná zařízení s různými funkcemi, jako například sledování stravovacích návyků, kvality spánku, množství spálených kalorií, krokoměr a další. Cílem této studie je jít hlouběji a zaměřit se na efektivitu nositelných zařízení, nejenom co se týče monitorování různých zdravotních parametrů, ale také na jejich vliv na každodenní život lidí a jejich zdraví.

## **Keywords**

Wearable technology, wearable devices, wearable fitness device, fitness trackers, mobile wearable devices.



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# 1. Introduction

## 1.1. Background of the study

The use of mobile and wearable devices for health and fitness enhancement has increased substantially in the past few years globally. A survey conducted by PwC (2014) showed that one in ten Americans owns a health and physical fitness wearable devices.

Mobile health monitoring has the potential to revolutionize the quality of healthcare and minimize the overall cost of healthcare by eliminating late detection of some health conditions and making sure that people who need urgent medical attention get it early. As the wearable health devices become a part of our daily lives, it has enabled users to manage their biological and physical fitness thus reducing their health care cost. Together with the existing cost-effective medical technologies, wearable devices and mobile and health monitoring can significantly contribute to the increased effectiveness in disease prevention, disease management, early diagnosis, intervention and home rehabilitation.

Mobile and Wearable technology have greatly evolved in the 21st century (Giuliano, 2015). Mobile and Wearable devices are part of the trending and most sought smart gadgets. Based on current tech statistics, about one out of six consumers who have learned about smartphone and wearable devices have already purchased either or both of them, and among this population, most of them are wearing the fitness bands. However, the demand or appeal of mobile and wearable is not limited to fashion or trending accessories. Most consumers opt to use this technology to facilitate their health and fitness needs, utilizing both smartphone and wearable apps to achieve their health goals. Particularly, consumers are using their wearable and mobile applications to keep track of heart rates and calorie loss. This technology has great potential to make rapid improvement in the field of medicine. Mobile medical devices are usually worn on the head, waist, neck, torso, feet, and the wrist. While these gadgets present great benefits to the consumers, most people

have raised concern over the security and other disadvantages linked to most of the technological devices (Kamel Boulos et al., 2014).

In addition, although the majority of wearable devices users are teenagers and young adults, most of the consumers utilizing the fitness and health apps are estimated to be over the age of thirty-five years. Based on the current success of smartphone and wearable technologies in the healthcare environment, the gadgets are likely to have higher perceived quality in the fitness and health areas.

The main purpose of the research study is to determine the extent to which the mobile and wearable gadgets or technologies are effective as tools to monitor different health parameters and the extent of their usability. The study will be based mainly on researchers own review and analysis of information including journal articles and business reports, among sources of necessary literature and survey result. The thesis is divided into theoretical and practical parts. The theoretical part will involve the literature review of the existing studies concerning the use of mobile and wearable technologies in health and fitness. The practical part focuses on determining how the mobile and wearable devices are applied to monitor or track health and determine its effectiveness.

## **2. Objective and methodology**

The main aim of the thesis is to evaluate the use of smartphones and wearable devices for health and fitness purposes from the user experience perspective. This includes monitoring fitness and health conditions such as heartbeat rate, distance covered, calories burnt, weight loss, among others to improve health condition and stay fit.

The partial goals of this research study are to make a literature review of the current state of the art in wearable and smartphone applications for health and fitness. Conduct a survey of user experience among health and fitness applications and wearable target users to determine if the user of health and fitness wearable devices can replace seeking treatment from medical practitioners. It will also enable to identify the key factors that affect the user experience of using wearable and mobile devices and propose a feature that meets the needs of the users based on their experience of using such device.

To achieve these objectives, the main method was based on chi-square statistics using SPSS. There were 100 respondents who participated in the survey. The result of the survey was analyzed using descriptive method and chi-square method to verify whether the hypotheses were true or false.

### **2.1. Research questions**

User's experience of using health and fitness wearable devices is influenced by different factors such as consumer demographics, usability, application feature to motivate the user, wearability as well as the assessment as to whether these devices can replace seeking of medical attention by the users and whether they are sufficient enough to monitor the user's health improvement.

From the main question, we can conceptualize into four statements;

S1: The use of health and fitness wearable devices has an impact on the usage of treatment

services from medical practitioners.

S2: Having a wearable and mobile device for health fitness motivates people to engage in physical activity.

S3: Using wearable and mobile devices improve the health of the user.

S4: The usability and wearability of wearable and mobile devices to a large extent affects their use.

### **3. Literature Review**

The literature relevant to this area will be divided into sections. The first part of the review documentation will look at the progression of research with the digital health and fitness monitoring. The other section discusses the existing technology within digital wearable and smartphone, which would enable them to track fitness activity, together with the perceived future of these technologies. Physical fitness presents huge health benefits and is an essential factor in the prevention of lifestyle diseases.

#### **3.1. Overview of mobile and wearable technologies for health and fitness**

Mobile and wearable technology are products that can be worn on a user's body and are integrated with computing devices to monitor the user's daily activities. It includes a wide range of devices and applications that enable the users to collect and display real-time sensory data, fitness, health, and motion. The concept of mobile and wearable technology has certainly been around for decades and currently is the most trending in the digital market which has been propelled to its heights as a result of technological advancement especially. The improved communication infrastructure globally has also assisted the exponential rise on the use of these mobile and wearable technologies. Moreover, accessibility and the user demographics have made these devices even more popular in the global market. Virtually, most individuals with smartphones have installed health and fitness applications in their phones. The calculator watch was the earliest pieces of wearable technology which was introduced in the 1980 (Patel et al 2015). This was followed by the eruption of portable computing in the early 1990s which led to more experimentation in the technology with increased degrees of success. The invention of a head mounted display called the "Private Eye" was an important step in the development of wearable technologies;

the device used a vibrating mirror to generate display directly in the user's field of vision. Gradually, an increased trend towards miniaturization coupled with the lower cost of electronic components such as sensors, storage, displays, computing and connectivity, driven by smartphones, helped to improve the functionality and accessibility of mobile and wearable technologies. The cost of manufacturing was also lowered which subsequently made mobile and wearable technologies more feasible for consumer applications.

### 3.2. Usability and User Experience of Wearable devices

According to Capegemini (2014) the numerous wearable devices introduced over the decade are used to track health and measure physical activity as described. The firm based its research on building conceptual working framework where it measured the user experience related to the use of wearable devices. The study was based on providing knowledge about the applicability of wearable devices in the life insurance companies to learn how they helped people to improve.

Data was collected through using the health care technology self-efficacy (HTSE) method. In case of other researchers, Stewart and Steven (2016) have measured that the health care technology self-efficacy has increased the profits of the manufacturer as well as the technology industries for keeping huge amount of data set. It has helped in storing, maintaining and running data easily. Data stored and obtained from wearables has also helped insurance companies to track biometric information. The challenges faced by the insurance companies are the risk to data security, privacy and distill of strategic data set. Despite all these, Takei (2014) in his research made a comparison between the human behavior and human interaction with the use of wearable devices and its application in artificial electronic skin provided as smart bandages. These devices helped humans in monitoring performance. Humans were truly compatible with the devices and showed flexibility in fabricating the sensors and transistor components. Joinson *et al.*, (2016)

explained that the wearable devices were useful for personalization, confidentiality of information and the reliability needed according to the circumstances. These devices also enhanced human computer interaction.

Another theory developed and the effects are studied by Kreutel, Ilona and Agathe (2015) where they mainly established the conceptual framework regarding the architect about the fitness MOOC. Conceptual framework is based on the technology, health and learning where technology is related to the knowledge and information provision tool to healthy resources. Afterwards, Smither *et al*, (2016) in their research on user's experience with the wearable devices using product reviews online, related description of the wearable devices and the fitness technology to fitness solutions but at increased cost. The study suggests that the cost-effective solution should be provided to regulate the product acceptance. They explained that wearable devices have three higher level workouts; usage, trust and motivation through increased user experience.

### 3.3. Body Area Network, A Traditional Antenna

In information technology, huge data sets are maintained reliably through connectivity. Energy harvesting (2014) presented the need of the study according to the firm. It has provided research related to the biological process through innovative technological system. According to this paper body area networking requires the potential sampling rates, distance operations and wireless technology to develop and harvest powerful energy from human body. The paper further explains that these devices generate power passively through personal objects, are cost effective, economic and have improved mobility through fighting against depression and isolation.

Along with this estimation (Zafar and Javed 2014) also conducted research based on the wireless technology and its use in the body area networking. Technology has been growing in every field of life, especially in the medical field where the wireless devices are used to



monitor health activities. These activities are monitored through the wireless devices that transmit signals to medical professionals who are then able to control health of patients more easily because of the accurate health profiling. Daily activities of the patient are monitored and controlled by using wireless devices in remote areas. These wearable devices have significant effects on the medication and monitoring through accurate information gathered by these devices. A twist in the research design made it possible to turn fiction into reality due to the developments observed in the study made by Leijedekkers, Valerie and Val (2010). They developed a research model where the body sensor networks were related to the monitoring of the health through wearable devices. The research study covered Europe and Australian regions. The wearable devices were used to measure the bio signals in human body through the use of a wireless communication link. The signals were then transmitted to remote locations attached to the health professionals. Cardiac monitors were attached to the mobile and to the health professional monitoring systems. It was expensive but with lower risk since approximate accuracy of the body was monitored in actual environment. Body area networking was attached and controlled thoroughly. The technology has made life easier and healthy.

### 3.4. The Health, Fitness and Wellness Technology devices

Health and fitness technology are a sunshade phrase that covers areas of wearable innovations and the mobile applications. Fitness and health innovations have improved quickly due to the current improvement in innovations and technology. Health and fitness applications were predicted to extend from 154 million downloads in 2010 to 908 million by the year of 2016 and also a prediction of an increased number of wearable machinery from 35 million since the year of 2013 to 134 million by 2018 (Statista 2017). The creation of manageable devices gives the health and fitness companies a great chance to prosper in the wearable technology sales.

Wearable innovations are changing and transforming the health and fitness sector. In 2008, Fitbit Inc. discharged one of the main activity trackers, remote empowered wearable innovation (Fitbit, 2014). Made by James Park and Eric Friedman, the item known as Fitbit Classic adds to the consistent combination of fitness into a consumer's day to day schedule, no more restricted to the repression of the exercise center (Fitbit, 2014). Furthermore, the Nike Company created a fitness wristband referred as a Fuelband wristband in the year 2012 (Giuliano, 2015). This idea was first started by the pioneers of Fitbit, and it modified the technology, which was referred as the fitness and health technology, which transformed the manner in which the customers evaluate their fitness levels, lay down their goals, and eventually follow their physical activity.

In the year of 2005, a company known as MyFitnessPal launched a mobile application that enables the users to track and follow their calories and also to share the information with acquaintances or close friends (Taylor, 2015). The integration of wearable technology with mobile phones gave MyFitnessPal a platform to operate in both wearable technology and mobile applications. One of the companies that are associated to MyFitnessPal is the Fitbit Tracker, which enables the users to record and keep all the data tracked by Fitbit Company and eventually synchronized to MyFitnessPal. The incorporation of the social media into health and fitness innovations plays a major role in the development of the fitness innovations within the communities and societies.

In addition, there are some companies, for instance, the Misfit Wearable's which are offering the wearable health and fitness technology that are suitable and convenient. The company is not only tracking but also encourages the day to day activities that are best for the body, and it comes in various wearable innovations such as the sports band, necklaces, clasp and the leather band (Miller,2013). There are also various companies that are coming up with fitness clothes such as T-shirts and bras that track the level of the calories and also

the rate of respiration (OMsignal, 2013).

Social media plays a major role in the development of these health and fitness innovation or rather technology. The users of these innovations desire to share almost everything with their friends, and these demands have enabled the social media accounts to grow and expand to a greater level. Mobile phones are seen as the primary source since many users are on Twitter, Facebook and others on Instagram (Horizon Media, 2013). These trends show that the mobile applications market is growing and that social media plays a significant role in the transformation of health and fitness technology industry since it enables the users to track and monitor how they should exercise and record their day to day activities.

It is evident that the society is beginning to adopt health and fitness technology, and this adoption is growing each and every day due to the introduction of smartphones which enable users or the consumers to download applications that help track and monitor their health and fitness. The users of social media accounts are rapidly increasing, and it is based on the lifestyle-related health risks. This number contributes to the development and requirement of health and fitness innovations or technology. The recognition of health and fitness innovations in the United States regarding to the epidemic of obesity plays a major role, and it provides a platform for the development of mobile applications that deals with the health and fitness sector. Various Mobile tech consultancy companies such as the Research2Guidance project showed that in the year of 2014 there was an increase in data relating to doctor's offices, and also the commercialization of the smart clothes (Black, 2013). The study shows that health and fitness innovations have a positive impact on the users of these applications since they provide and offer great solutions towards the health and fitness sector using cheap and readily available resources. These health and fitness applications have faced several obstacles, and one of the major challenges is widespread

adoption of these apps by customers, health-care systems and the patients (Rutherford, 2010).

However, these innovations have the capability of offering solutions by stipulating preventative measures and health care to the world population. Additionally, over time, there has been an observable growth in the demographic attributes of individuals who use innovation based items and administrations. The biggest demographic client in the 1970s and 1980s were individuals between the ages of 18-34 years of age; notwithstanding, now the demographic client has widened up to include children, young people, and grown-ups beyond 50 years old (Marshall and Norman, 2001). This change in demographic qualities of individuals who utilize and buy health and fitness items and administrations has tremendous ramifications on the development of fitness and health innovation.

This expansion of the client base has led to development of wearable devices that are particular to specific demographic. Diversion plan principals and fitness support/ checking apparatuses are two primary illustrations of various client-centered items. Diversion plan principals target youngsters with quick input, compensates and certain levels of authority, while health support and checking devices target more established grown-ups with apparatuses to screen pulse and sugar levels (Marshall and Norman, 2001). A wide study that investigated the implications of mobile health and fitness applications on the age limit of the working class citizens revealed a positive feedback among the users (Ahtinen, 2009). This case study involved the working class employed in Southern Finland, and the age bracket ranging from 31- 45 years. The study took duration of one year starting from the year of 2008 up to the year of 2009 and it observed that 79 percent of the involved customers or parties sought to boost exercise activities beneficial to health and fitness levels, and each of the involved parties had two or more health risks. Ahtinen found that usefulness, and easy-of-use.

Motivating factors, for instance, variety of fitness parameters, flexible exercise programs, and graphs are of great importance to mobile applications. These mobile applications have been facing various obstacles one being the monotonous data entry which does not support the cyclic use, for example, holidays, applications being too complicated and users being in a hurry to use the provided applications in the mobile. The study shows that when starting, users try to test various applications in matters of functionalities and also to learn about all the available applications, and eventually developing the usage habits and personalized goals in the direction of a more integrated usage of the applications within user's day to day life (Gerber 2009). There are various applications found in the smartphone's, for instance, SMS reminders which greatly promote the health behaviors especially weight loss maintenance.

The main trend seen in the health and fitness innovations is the enhancement of geo-location, metabolic and physiologic and the indicators of energy force. Marshall and Norman (2001) demonstrated that amid monetary subsidence, users tend to work out outside so as to curtail exercise center enrollment charges and hardware costs. This pattern has prompted buyer interest for self-following devices and applications. Gupta (2011) looked at the main two hundred portable fitness applications and observed further that clients favored applications that transform inadequately arranged undertakings into simple assignments. Self-following is an essential part of fitness and health innovation that permits the client to track running, biking courses, workout information and exhaustive workout history, control music, geo-label courses and photographs, and share execution levels through online networking applications.

Another key finding for versatile fitness and health applications recommended that clients support highlights that make a consistent, portable client experience. Lui (2011) investigated the main two hundred portable fitness and health applications from an

engineer's point of view and arranged them as indicated by reason, capacity, and client fulfillment. The fundamental discoveries recommended that customers support portable health and fitness applications with setting mindfulness, visuals, and following devices. Connection mindfulness incorporates one of a kind versatile element, for example, area mindfulness, inclination mindfulness, and system mindfulness. The information representation that is observed to be most ideal in versatile health and fitness applications incorporates 2D outlines and 3D sees. Also, following instruments, for example, the Calorie Tracker, which is a portable application that tracks a client's eating routine, weight change, and workout recurrence, are favored by users due to convenience and also because of the ease of using the calorie tracker.

Despite the fact that there has been much study and discussion that surrounds mobile fitness and health applications and also the implications to the user, there has been limited scientific study that explores the wearable fitness innovations. This is debatably due to the virtual early stages of wearable fitness. Specifically, there is merely single research and study that examines the value of wearable fitness tracking policy (Burns et al., 2012). According to Burns et al. devices such as the Fitbit and Jawbone UP involves high-complexity, which entails the presentation of large amount of data to the user and high-engagement interfaces which requires the users regular monitoring. The above two illustrations are a great challenge to those health and fitness applications users who are less active. The challenges faced by the less active users of the health and fitness applications, are more likely to make them quit the use of such applications and derive them back to the old habits of checking and monitoring their health and fitness status.

Burns et al. 2012 created a wearable innovation known as the ActivMON. He designed the ActivMON in such a way that it was of low-complexity and low-engagement interface. ActivMON is a wristband that has an accelerometer and LED light. The accelerometer in

the ActivMON is to enable the user to watch and monitor their level of physical activity, whereas the LED light is designed to alert the user when they are required to increase their level of physical activity.

Individuals are now involved in one way or another in this health and fitness innovations and technology. These technologies and innovations enables them to monitor their energy levels reducing, waistlines growing and they tend to seek ways and to find the spirit and morale to work on their health and fitness status by doing exercise and living a healthy way of life. It is evident by studies that majority of the individuals are seeing potential in this innovations of various health and fitness applications. The study reveals that one in ten Americans above 18 years possessed a health and fitness tracking device. The study also indicated that by the year 2018, a large number of such wearable health and fitness tracking devices would be incorporated into worker's fitness programs, based on the estimates from ABI Research (Wooldridge, 2014).

These health and fitness devices are fast gaining recognition and human beings wants to be associated with devises that are visible and tangible, especially in day to day life and immediate satisfaction. Companies that are involved in the development of these gadgets are adapting to these demands and are seeking and finding ways that will enable them meet the demands of the customers and also keep up with societal trends. The health and fitness technology providers have established steadiness by integrating social media and also by giving solid data concerning the individual exercise schedule. The real-time generation of this data, and in some cases allowing of users to share their exercises routines via social media, they do more than just providing information but also, they strengthen and inspire the rest on the benefits of health and fitness gadgets. All the above situations came into reality by making the exercise routine a game (Beckham 2012).

The turning of exercises into game by one individual or groups acted as a game changer in

health and fitness since it provided a healthy competition among the members in the group. This atmosphere makes individual or group members to have positive inspiration for bearing attestation of commitment and hard work Beckham (2012).

According to physicist (Duggan 2015) an individual cannot improve if he cannot measure and for this to occur data is required. Once the data is received, one requires setting definite goals or principles to provide the sense of achievement that will make one work smart for the benefit of his/her health. Once individuals have their goals in mind and start working on them, the help of data provided will not only encourage them to improve by following the data but also the fitness progress in their bodies.

A research by Wake Forest University worked with a number of overweight individuals for a period of ten months; a certain number of the individuals were determined to lose weight. A few number of the group used the health and fitness tracking device while the rest did not. The research revealed that, the individuals who used the gadget lost more weight than those who did not use the health and fitness tracking gadgets. The study also indicated that health and fitness tracking devices provides instructions that are of great importance to the users and they helped them in monitoring and alerting on areas that required improvement, for instance in weight loss (Brownstein 2014).

Past researches observed several shortcomings of health and fitness technologies. These health and fitness gadgets, and their website counterparts encompass the ability to establish one's input of food and output of energy. This trait can help in getting a representation of probable weight loss, but it is evident that majority of the older people are in a way of deceiving themselves by using such information to indulge in excessive eating (Bee, 2014). Psychologists reveal that, by purely relying on the data collected by use of electronics such as computers one tend to follow what the gadgets instructs but fails to follow what the body requires him/her to do. For instance, if the device directs the user to stop moving, the user



obeys yet he can do more beyond the limit provided by the fitness tracking device.

According to the findings of the psychologists, as an alternative of considering the gain of a higher output and losing weight, individuals are consuming more just because they are instructed to do so by the health and fitness trackers hence maintaining the body weight instead of reducing it. These demerits rely on the method of data collection and also the place where the tracking device is worn on (Bee, 2014).

According to (Bee, 2014), the bracelet, smart-pedometer can be tricked into believing that the user is moving the lower part of the body more than expected, thus giving wrong results. When an individual starts estimating how much they consume based on to their output, things can go wrong speedily if the data provided has been misconfigured. For instance, the track on living a healthy lifestyle to reduce excess weight, can get users depressed or even disturbed if they start seeing the contrary occurring.

Another predicament that researchers have come across, is that majority of the adults seize using their health and fitness trackers for various reasons. This is widely explained by (Kosir 2015) whereby the author indicates that more than half of the U.S. consumers who possess an activity tracker have seized using it. The study indicated that for younger adults, health and fitness trackers are as more of fashion devices than helpful tools and that the devices can wear off. A different article on this subject matter explained a few causes why this may occur. Among the number of factors why customers loss interest include; wearability, mobile application challenges, device look and feel, informational challenges, and other motivational challenges (Obesity, Fitness & Wellness Week, 2014). The study also revealed that for many young adults the health and fitness devices may be just the current fashion.

This mindset without an individual setting goals and target for their health and fitness tracking and monitoring tends to lose interest. However, the author of this article

maintained that, older Americans who are anxious about their health and fitness and may also require extra motivation, the health and fitness trackers could be of use to them (Wooldridge 2014).

The main rationale of this research is to enhance and improve the development of research based on developing market, which involves the development and creation of wearable technology which will be of great benefits to the users concerning their health and fitness status. This can only be achieved by understanding the day to day user's fitness and health habits through today's innovations and technologies such as mobile applications. The health and fitness research can propose important key to the debate surrounding technologies and innovations that can enhance the quality life for humans.

There is also the concept of monitoring patients remotely which is currently not new but recently has a lot of attention (Nielsen 2014). This application is placed on smart wearable body sensors. Whereas other articles have focused primarily on devices which have been used for research or have needed a physician's prescription, it expands to the opportunities and benefits through which these devices provide because of their availability to a wide range of users. There is now more evidence to support the reliability of these devices, and the technology is more easily accessed. These devices contain an assortment of diverse sensors which can be used to monitor variables and transmit the status and data either to a personal device or an online storage site, normally through an application.

The different kinds of the sensors use different types of stimuli that respond to physical body movements, vital signs, and other organic substances and their placements including clothing, subcutaneous implant, body part accessory, etc. These devices have the capacity to meet the patients' needs by sending information in real-time to the patient's smartphone, computer or other wireless devices and have the potential to influence their behaviors. Sensors allow patients to monitor themselves, track and assess human physiological data

while also providing interfaces and a dashboard for healthcare providers. These sensors can be easily managed and are becoming increasingly accurate and reliable for patient care. The wearable and mobile health devices can also be utilized as a diagnostic device to aid in identifying and managing of diverse diseases.

Current medical technological applications and devices enable monitoring for vital-sign and hence promises great benefits for prevention, prediction, and management of diseases. Despite the significant development of the monitoring device industry, the widespread integration of this technology into medical practice remains limited.

### 3.5. Progression of research on health and fitness activity monitors

According to the recent studies and research by (Patel et al 2015) information supporting the benefits of health technology and mobile applications in physical health and fitness monitoring has become increasingly common to patients, medical practitioners, and the caregivers. According to (Direito et al 2014), physical exercise goes a long way in preventing several common health conditions, including diabetes, chronic kidney disease, cardiovascular disease, dyslipidemia and hypertension. This is supported by other scholars including (Koetsier 2013) in which he argued that cardiovascular fitness reduces mortality and improved health care. For instance, there are various types of consumer-oriented physical exercise monitors and mobile applications that are based on built-in technology which is geared towards helping people to become more physically active. Public health studies have sought to create behavioral interventions and devices to promote or facilitate physical activity in various demographics. While various developments have been made in this field, a promising growth is the increased accessibility of consumer-oriented devices and resources that may aid individuals to monitor their behaviors.

According to the findings by Jung-Min Lee (2013), one of the benefits of smartphones and

health wearable devices is that they are readily available and actively marketed by many companies in the consumer marketplace. Lee's findings proposed that there are several factors that have led to the use of wearable health and mobile health technologies. This includes the increased use of wireless data technology, the existence of low-priced medical devices and the increased use of social network which has acted as a marketing platform for these medical applications and wearable health technological devices. These factors have provided an exciting ground to develop public health and individual fitness, but Lee also proposed that it is important to evaluate and analyze the effectiveness and the quality of these health devices. In doing so, it will ensure the development of efficient devices which will be more beneficial to the users.

Another study conducted in the US in 2012 about the utility of some Smart health technologies through representative data gathered by the National Cancer Center found no significant evidence of the use of these gadgets by ethnicity or race, but there were significant variances for age, gender, and socio-economic status. According to findings of this study, women participants were more likely to utilize mobile and digital wearable devices for health and fitness-related needs, same with the younger adults and those of higher economic status. Individuals of socioeconomic status were less likely to purchase these gadgets or download health-related apps aimed to monitor their health individual health conditions, diet or physical exercises. While few academic studies exist on how various social groups utilize applications, consumer market research reports continue to present some insights into the area (Ramsey 2013).

A report by Koetsier (2013) revealed that females use about 40 percent more health-related technologies than males and even purchase 17 percent more of the highly-priced devices. The report also argued that men utilize fitness or weight-related gadgets and mobile applications 10 percent more than females. This is consistent with Nielsen (2014) findings

concerning the use of wearable gadgets. Based on a survey, Nielsen argued that while both women and men utilized fitness exercise bands almost in equal rates, females have a more probability of using calorie and diet monitoring mobile applications.

### 3.6. Types and the future of mobile and wearable technologies and the perceived benefits

According to Jung-Min Lee (2013), the growing competition in the modern technology market presents the users with choices, but competition has also rendered it hard to determine the utility or the relative worth of different mobile and wearable devices because of the growing availability of the technical gadgets regarding health monitoring devices. This, therefore, has enabled personalized monitoring of health though there is limited data that enables the utility and the effectiveness of this technical devices.

Another recent study by Mobiquity firm involving 1000 consumers of mobile health and fitness software or application revealed that over 50 percent planned to purchase wearable tools to monitor and enhance their health. The study commissioned by Mobiquity Company was aimed at encouraging use of mobile devices to boost health situations and discovered that the effect of wearable devices and mobile applications on user's personal health. The study found that half of those who plan to purchase wearable devices to track their fitness and health want to prefer pedometers, with more than 45 percent interested in having wristbands and over around 40 percent preferring smart watches. In addition, 63 percent expected to use their wearable gadgets each day. The study also argued that smartphone users are more likely to start using a wearable in the coming days compared to those using regular cellphones.

Also according to the Mobiquity study, 65 percent of males anticipate using health and fitness wearable routinely compared to about 60 percent of females.

In another study, Kamel, Boulous and Yang (2014) conducted a survey on dozens of

various mobile, location-oriented apps, which support the power of sharing, especially through social media and other online sites. The survey found that most of the applications found in these mobile devices were related to weight loss and exercise category. The author explains that in-built cameras, especially in smart phones, enable individuals to capture their diary of the drinks and foods they took on daily basis. The images of this food and drinks were then transferred to platform that analyzed and detected the quantity of food portions together with the calories contained in these foods. It also provided a platform through which calorie intake is measured, prospective body weight, and a goal oriented physical activity required.

Wearable technology exists in various sizes and forms. Ramsey (2013), depicted that there was a dynamic modification, improvement, and development of watch technology and thus even today's regular watch has the capabilities of performing complex functions and calculations with regards to the medical and health status of an individual. This includes in-built GSM based systems that enable the transfer and notifications of health and physical status of the individual wearing the watch. (Ramsey 2013).

More sophisticated ones even operate like minimized computers; carrying their operating systems and capable of supporting various applications. Such wearable today has in-built sensors that allow them to operate as activity monitors and customized digital supports, in order to meet their tracking activities.

The potentials of using wearable technology further in the future of healthcare are limitless. This is supported by the FDA's validation of the use of sensor pill which is a wearable health device that monitors and tracks the status of the body to ensure that medications and prescribed drugs are working properly and are utilized effectively (Ramsey, 2013).

Other wearable devices that can exist inside the human body have also been created to monitor what is happening inside the body, enabling the device to send back biological

information to the nurses or doctors. Researchers argued that there was likelihood that these wearable sensors can be effectively integrated into healthcare bracelets. Smartphone technology has had a great impact on the advancement of remote tracking systems grounded in wearable sensors. Tracking applications dependent on mobile phones are increasingly being used. Smartphone and related gadgets are readily accessible today. More and more people are opting for traditional information loggers since they present a virtually ready to operate ground to log information and transfer information to a remote area.

Apart from being applied as information gateways, smart wearable, and mobile health gadgets can also play a vital role in processing data. As the demand for wearable continues to increase rapidly, visual plea will grow in importance. Smart gadgets already appear futuristic but firms such as Martian and Cuff are striving to make them better and trendy. Considering the growing demand, the cost of these devices is likely to go down, making them even more accessible to more people (Direito et al., 2014). Early buyers always pay higher prices for emerging technological products, particularly for technological products such as mobile phones. Based on the current forecasts, the cost of wearable's is likely to drop, thus, the new manufacturers entering into the wearable and mobile business should guarantee a variety and at lower cost.

Health and fitness gadgets consist of electronics-infused clothing such as the bracelets and body devices that improves our sensitivity and enable us to operate in manner that we cannot usually do. Some of these are actually understand our normal heartbeat rate, glucose level and many more. Digital health and fitness is an essential subject matter of smart wearables and it is of expectation that over 90 million smart wearables would be sold by the year 2017.

According to Duck, et al (2012), wearable devices and smartphones is becoming an industry that is looking to be a big and profitable in the global market. It is one of the

greatest milestones in technological innovations in the century and therefore is currently something that will be the key to the optimal operation of our future society, especially when it comes to healthcare.

### 3.7. Latest trends and brands of wearable technology in the market

Fitness and wellness technology is an umbrella term that covers areas of wearable technology e.g. Fitbit, Xiaomi Band, Garmin and mobile apps too.

#### *Fitbit*

The Fitbit wearable device is an activity tracker that is designed to measure the user's exercise, diet and sleep. It is a wireless-enabled wearable technology device which is used to measure data such as the heart rate, number of steps walked, quality of sleep, steps climbed, and other personal metrics.

Currently, Fitbit is the leading fitness tracker in terms of shipments. Currently, it has a little over 43% market share globally, while the Chinese vendor Xiaomi has 24%. But Xiaomi is expected to overtake Fitbit over the next few years thus the position of Fitbit in the market is slowly slipping. However, fitness trackers are expected to grow at a 25% CAGR, and total fitness tracker shipments is expected to hit 187 million 2021.

The picture below is a Fitbit Flex with accompanying wristband.

*Figure 1: Fitbit*





Source: Fitbit (2017)

### *Apple watch*

Apple Watch is a line of smartwatches which was developed by Apple Inc. Apple watch incorporates fitness monitoring and health-oriented capabilities which has been integration with iOS and other Apple products and services. The apple watch device is available in four different variants which are: Apple Watch, Apple Watch Hermès, Apple Watch Sport, and Apple Watch Edition. It relies on a wirelessly connected iPhone for its functionality such as calling and texting and is compatible with the iPhone 8 or later models running iOS 11 or later, through the use of bluetooth.

*Figure 2: Apple Watch*



Source: Express.co.uk (2016)

### *Garmin*

The Garmin Vivofit 3 is a wearable device worn on a wrist and is used to measure the user's steps, sleep, body movement, heart rate and the number of stairs that the user has climbed. It is a classic watch with an activity tracking capabilities. It has a built-in accelerometer which calculates distance for indoor workouts, without need for a foot pod, step counter, learns the user's activity level and assigns a daily step goal, move bar, and sleep-monitoring capabilities.

*Figure 3: Garmin*



Source: Wearable (2016)

### *Misfit*

The Misfit Flash is an activity and sleep tracker that is worn on the wrist of the user, clip onto the belt or dangle from keychain. It is used to measure the number of steps the user takes in a day, as well as the distance traveled and the calories burned. It also tracks how long the user sleep at night.

Misfit comes in seven different colors to choose from and currently the device has appealed to a wide range of users because of its sleekness and affordability which retails between \$34 and \$50. This has made the misfit device particularly appealing to a number of users.

*Figure 4: Misfit*



Source: Misfit (2017)

In the healthcare industry, wearable and smart devices have seen major innovations in the recent past especially the Intelligent Asthma Management by Health Care Originals. This device presents the consumer with an Automated Device For Asthma Monitoring And Management or ADAMM (Spela, 2015). The device has also been integrated with the smartphones through the use of smart applications which enables consumers and users to be able to get real-time data when monitoring a patient's asthmatic condition. Both the device and the application alert a user when one is experiencing asthmatic condition, treatment plans, and tracking information on the treatment of the symptoms. The device and the app will be able to alert the user when whether they are experiencing an asthma situation, journaling, treatment plans, displays, and the tracking and information on the treating of symptoms.

Another wearable device for healthcare purposes in the market is the Valedo Back Therapy. It is currently one that will be mostly embraced in the health care industry especially those who love to be gamers. Valedo is engineered for those who have problems with lower back health. It has video game like user interface that give the user exercises to do. It is very similar to like the games that user would see on a home video gaming system such as the Wii and Wii Fit.

The wearable device is attached to the user's back and the smart sensors are able to store data which can then be accessed through the companion app. It is run on BlueTooth Smart technology. On the other hand, it is also run on any iOS device such as an iPad or iPhone. It is being known that a lot of healthcare facilities are starting to embrace the Valedo and their course of action when it comes to lower back pain and treatment.

The research predicts that these health and fitness gadgets will play a major role in ensuring that the public lives a healthy lifestyle by alerting the consumers on various activities they

are required to perform, for instance an easy change in diet, exercise or sleep patterns. Here are some of the health and fitness gadgets that enable the consumer to exercise various habits that can be of great impact towards their personal health;

1. Integrated health and fitness display software platforms
2. Smart watches and bracelets
3. Health and fitness apps

#### 3.7.1. Fitness Wearable and Tracking Devices

These health and fitness gadgets gives rough but useful steady real-time dimensions of steps that should be considered, intensity of exercise that should be done by the consumer, flights of stairs that the users have climbed and the amount of calories burned. These health and fitness gadgets alerts the consumer via Bluetooth integrated with smart phones and this enables the consumer to note the changes during the day time and night, and can make a comparison of daily routine and eventually share their personal information with friends, thus motivating others.

These health and fitness gadgets, for instance, wristbands, Apple watches and earphones, among others can be of great impact towards health but it comes with cost for those individuals who are less active and they require motivation in order to control the healthy lifestyle. Due to the development of technology there are certain health and fitness gadgets that are free and easy to operate via the smart phones for instance iPhone and the Android phones also by using the computers that are at home. These free applications play a major role in assisting the consumers to improve in various habits that are not useful towards their health.

These health and fitness gadgets available in the smart phones can improve the habits of the users in various ways explained below;

### *Weight loss*

Lose it! is an application that has more than thirty million users. This application has enabled millions of individuals achieve their goals in reducing their excess weight. The app analyses the weight, age and health goals of the user and create a personalized weight loss plan with the required calorie that the user needs daily.

### *Quit smoking*

Smoke free is an app that enables the consumers to quit smoking since provides all the required information on how to quit. The app also has a platform that enables the consumer share the information concerning the cravings and how hard it is in researching scientifically the essential ways of quitting.

### *Reduce drinking*

The Alcohol unit calculator is an app that calculates the amount of alcohol the consumer has taken and also the number of calories reduced. Both men and women are advised to stop drinking alcohol on regular bases but the recommended amount that is less than 14 units per week.

### *Monitor diet*

One You Easy Meals is a free application that enables consumers to eat yummy healthier food. Use it to search for easy calorie-counted recipes for breakfast, lunch, and evening diet including the puddings. It also helps the user to keep track using a shopping list, which comes with an organized recipes required.

### *Calorie checker*

Calorie checker is platform that enables the consumer to understand and know different foods and drinks in a simple and quick manner. The page lists the calories and fat content

available in different foods such as the generic foods, meals available in the world, branded products, alcoholic drinks and also the list of restaurant food not forgetting the fast food chains.

#### *Stay motivated and habit formation*

With the gamification features of wearables, users feel motivated to reach their goals. These features enable users to form a habit and challenge their self and compete with their friends and family on social media or through the application.

#### *Sleep tracker*

Sleep problems has become a growing concern today which has resulted to numerous road accidents, etc. Sleep tracker enables people to understand their sleeping habits and know whether they are actually getting enough sleep that their body needs. The sleep tracking uses actigraph that measures movement through a measuring device called accelerometer. For people who have sleep disorder or sleep disruptions, this is very useful to understand their sleep pattern.

#### *Track heart rate*

One popular feature of wearable is the heart rate monitoring. As the heart beats, it transmits the electrical signal through the heart muscle. This transmitter of the heart rate monitoring is placed on the skin where the heart beats and then picks up the signal which then sends the electromagnetic signal that contains the heart rate data to wrist receiver that displays the heart rate data. The heart rate feature has the heart rate zone alarm where you set the zone and it will alarm when you are high or low.

#### *Track progress*

Wearables enable users to track their activities such as steps, distance traveled, floors

climbed, active minutes, specific exercises or activities, workout routes and pace. This helps users know where they are on their goal and gives them a chance to improve day by day.

### 3.8. Wearable and Mobile devices for Health and Fitness Enhancement

Many people in today's world where time is precious tend to neglect their health because they spend most of their time juggling various tasks that they don't even have time to visit a doctor for health assessment to ensure that they are healthy. They only visit when they start suffering from a serious condition. For this reason, many people are looking for an alternative which can be worn on their body to consistently track their health and get insights on various health parameters Haghi M. et al., (2017).

A regular exercise provides many health benefits which are why doctors and fitness experts recommend doing an exercise daily. Many people opted to go to the gym, do yoga or do home exercises to ensure that they stay fit. However, not all people are motivated enough to exercise which leads to obesity. With the arrival of wearable devices, many people nowadays have started to use these devices to monitor their health and stay active.

According to Patel M.S. et al (2015) using wearable devices to promote behavioral health, change is a complex process. Many of health-related behaviors such as exercising regularly and eating may lead to a meaningful health improvement if it is sustained. Users may need to create persistent new habits by turning external motivation into internal or maintain their external motivation, either way, both are difficult.

A study conducted by Schwarzer (2008) concluded that motivation is one of the key factors that hinder the users from increasing the user's level of physical activity. The study further recommended that users have to be considered during the designing and testing of the product to ensure that technology can help motivate the users.

According to Mesko (2016), stress is considered to be one of the biggest health risks which can result to several health issues such as obesity, health disease, health ache, and diabetes but stress can be fought with the help of the right wearable devices. These devices can help people become healthier and have a better life by having the best sleep quality, staying fit, getting rid of stress, keeping blood pressure on track and exercising in the most efficient way.

With today's health wearable devices, early detection of the medical condition is already possible like for instance, if the users' wearable devices indicate that their usual activity has dropped but their heart rate is higher than usual, this could be a sign that the users could be sick Aharon (2017).

From a doctor's perspective, wearable devices are like a self-help medical help which make health care more efficient, effective to both patients and doctors. Normally, doctors rely on patients to tell what they are feeling but with the help of wearable devices data, doctors can easily know how they're feeling or possibly know the reason behind an ailment before a patient walks into an exam room Duggan (2015).



## 4. Practical part

The practical part of the thesis focused on finding out how mobile and wearable are effective tools for health and fitness enhancement. Partial goals assessed mobile and wearable devices usability, wearability, user's motivation to use such devices and accessibility in identifying the health benefits that these devices offer.

Several methods were employed to gather and analyze data.

Based on the theoretical knowledge, practical recommendations and conclusions were formulated.

The health and fitness technology is growing in a speedy manner, thus giving a positive boost to an individual and the public at large concerning their health status. The health and fitness revolution have its own merits but also a number of unpredicted consequence, for instance the surfacing of influential individual electronic health trackers which are till now unavailable and also the high cost of the tracker. These health and fitness gadgets are greatly contributing towards the change in our health standard by enabling the users to file and safe their daily health-related behavior guide.

The research gave a brief illustration of how the health technology is speedily transforming the way the users of these health and fitness applications, such as the smart watches, and the materialization of online and mobile software policies or platforms that are integrated together to help the consumers to monitor and share their personal health information with others, thus acting as a motivating factor

To achieve the thesis aim, a systematic, theoretical analysis of the methods was applied to a field study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses concepts such as paradigm theoretical model, phases and quantitative or qualitative techniques, and therefore this research described the methodology used, designed target population, sample

design, data collection/procedures, instruments used, reliability, validity and data analysis method.

#### 4.1. Significance of the study

The study will be significant to several stakeholders.

First, it is valuable to the stakeholders who manufacture mobile and wearable devices for health and fitness enhancement. On the other hand, it is significant to the professionals in the health and fitness sector as it gives them relevant insight on the usability and relevance of these devices. It is also of great value to other researchers and academicians since it provides literature for the future research.

Moreover, it also provides recommendations on other areas for further studies where future knowledge can be drawn and at the same time act as a reference material.

#### 4.2. Research design

This study adopted a descriptive research design which according to Trochim (2005) is used to show how all the components of a research study work hand in hand and also it provides the structure that is used to address the core research questions. It enabled the study to generalize the findings on the use of wearable devices for fitness and health enhancement to a large population due to its ability to ensure minimization of bias and maximization of reliability of the evidence collected.

#### 4.3. Data collection

This research used various methods in order to obtain the most accurate and relevant data. Mobile and wearable gadget users were recruited through email lists and through social media including Twitter, Facebook, and many others.

The study was grounded on individual researcher's survey and analysis of the information collected. The overall research utilized both primary and secondary sources of data. The primary method involved interview questions administered via questionnaires and the

online survey. The survey consisted of 21 structured questions. The survey questions covered information in areas such as general background including gender, age, current mobile or wearable technology use such as smartphone, frequency of use, the reason for use, and attitude towards the devices such as usability and benefits. This research targeted consumer ages from 20-60+ years old working professionals within the Czech Republic. A sample population of 100 was used to formulate the analysis.

#### 4.4. Data analysis and presentation

The data collected through the questionnaires survey were transcribed for analysis. The data collected was investigated, analyzed and compared to the secondary data from the literature in order to assess the level of motivation of the mobile and wearable consumers. From this analyzed data, a design of methodology of use for mobile and wearable devices was formulated.

#### 4.5. Limitation and assumptions

This research study limited its target in one country only; therefore, future study should reach out to other users of mobile and wearable for health and fitness enhancement from other countries. Moreover, the participants have different gender and age distributions, and this is likely to bring bias toward technology consumers.

#### 4.6. Hypothesis

In order to address the research questions. The following hypotheses were formulated.

##### **Hypothesis 1**

H<sub>0</sub>: The use of health and fitness wearable devices has no significant impact on the usage of treatment services from medical practitioners

*Against*

H<sub>1</sub>: The use of health and fitness wearable devices has a significant impact on the usage of treatment services from medical practitioners.

## **Hypothesis 2**

H<sub>0</sub>: Having a wearable and mobile device for health fitness does not motivate people to engage in physical activity.

*Against*

H<sub>1</sub>: Having a wearable and mobile device for health fitness motivates people to engage in physical activity.

## **Hypothesis 3**

H<sub>0</sub>: Using wearable and mobile devices does not improve the health of the user.

*Against*

H<sub>1</sub>: Using wearable and mobile devices improve the health of the user.

## **Hypothesis 4**

H<sub>0</sub>: There is no statistical significant evidence that the usability and wearability of wearable and mobile devices to a large extent affects their use

*Against*

H<sub>1</sub>: There is statistical significant evidence that the usability and wearability of wearable and mobile devices to a large extent affects their use.

All the hypotheses were tested under the significance alpha level 0.05. If the p value obtained from the chi square test statistic was below the alpha level 0.05, the null hypothesis was rejected at 95% confidence interval.

## **4.7. Data Analysis**

### **4.7.1. Descriptive Statistics**

From the descriptive statistics results in the appendix, it is clear that the most popular wearable device among the male respondents was the Apple watch, 25 %, while most of the females preferred Garmin, 12 %. Majority of the wearable devices, 46 % did not use

the device for more than two years, while 44 % have used the wearable device between two to four years. This showed an increasing popularity over time for the use of the wearable devices. The most popular feature of the wearable device was the glucose monitoring feature, 23 % of the respondents preferred to have the feature included, followed by the heart rate variability, 23 % and stress mood monitoring, 21 %. Majority of the respondents who took part in this study was between 20 - 29 years, 44 % while only 20 % were from the 30 – 39 age bracket. The main reason for wearing the health and wearable device according to the descriptive statistics on the appendix is that the majority of the respondents, 17 % wear such device so as to stay fit and energetic. Majority of the respondents 42 % considered the functionality of the health and wearable device when purchasing the device, while the least factor they considered when buying the device was what they family or friends said about a certain brand, the design of the device came in second as the most important factor to consider when buying a device and third most ranked factor was the comfortability of the health and wearable device (Appendix Table 8.1.1e).

#### 4.7.2. Results of the survey

### Hypothesis 1

Table 4.7.2.1

**Does the usage of health and wearable devices have an impact on the usage of treatment services from medical practitioners?**

	Observed N	Expected N	Residual
Definitely would	29	25.0	4.0
Not sure	23	25.0	-2.0
Probably would	47	25.0	22.0
Probably wouldn't	1	25.0	-24.0
Total	100		

Table 4.7.2.2

**Test Statistics**

	<b>Does the usage of health and wearable devices have an impact on the usage of treatment services from medical practitioners?</b>
Chi-Square	43.200 <sup>a</sup>
df	3
Asymp. Sig.	<.000001

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 25.0.

Results from table 4.7.2.2 show that the p value obtained from the Chi-Square test is less than alpha level 0.05, therefore the null hypothesis was rejected. Usage of health and wearable devices has a statistically significant impact on the usage of treatment services from medical practitioners.

## Hypothesis 2

Table 4.7.2.3

**Having a wearable and mobile device for health fitness motivates people to engage in physical activity.**

	Observed N	Expected N	Residual
Neither agree nor disagree	15	20.0	-5.0
Somewhat agree	53	20.0	33.0
Somewhat disagree	4	20.0	-16.0
Strongly agree	25	20.0	5.0
Strongly disagree	3	20.0	-17.0
Total	100		

Table 4.7.2.4

**Test Statistics**

	<b>Having a wearable and mobile device for health fitness motivates people to engage in physical activity.</b>
Chi-Square	84.200 <sup>a</sup>
df	4
Asymp. Sig.	<.000001

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

Results from table 4.7.2.4 show that the p value obtained from running the Chi-Square analysis is less than alpha level 0.05; hence the null hypothesis was rejected. There is a statistically significant relationship between having a wearable and mobile device for health and fitness and engaging in physical activity.

### Hypothesis 3

Table 4.7.2.5

**Using wearable and mobile devices improve the health of the user.**

	Observed N	Expected N	Residual
Neither agree or disagree	18	20.0	-2.0
Somewhat agree	54	20.0	34.0
Somewhat disagree	5	20.0	-15.0
Strongly agree	18	20.0	-2.0
Strongly disagree	5	20.0	-15.0
Total	100		

Table 4.7.2.6

**Test Statistics**

	Using wearable and mobile devices improve the health of the user
Chi-Square	80.700 <sup>a</sup>
df	4
Asymp. Sig.	<.000001

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

The p value obtained from running the Chi-Square test was less than alpha level 0.05 hence the null hypothesis was rejected. A statistically significant relationship was observed between using wearable and mobile devices, and improving the health of the user.

### Hypothesis 4

Table 4.7.2.7

**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
Usability of the health and Wearable device	100	1	5	3.03	.853
Effectiveness of the Health and Wearable Device	100	1	5	3.39	1.007
Valid N (listwise)	100				

Table 4.7.2.8

**Correlations**

		Usability of the health and Wearable device	Effectiveness of the Health and Wearable Device
Spearman's rho Usability of the health and Wearable device	Correlation Coefficient	1.000	.326**
	Sig. (2-tailed)	.	.001
	N	100	100
Effectiveness of the Health and Wearable Device	Correlation Coefficient	.326**	1.000
	Sig. (2-tailed)	.001	.
	N	100	100

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Since the effectiveness and the usability of the health and wearable devices was measured in a ranked scale, non-parametric method, Spearman correlation, was used to test the null hypothesis that there is no statistically significant evidence that the usability and wearability of wearable and mobile devices to a large extent affects their use. Results from table 4.7.2.8 show that the p value obtained from the analysis, 0.01 was less than alpha level 0.05 hence the null hypothesis was rejected at 95% confidence interval. The correlation coefficient obtained from the test, 0.326 shows that there is a positive correlation between usability and effectiveness, that is when a device's effectiveness reduces its usability.

#### 4.7.3. Generated model

To answer the research questions, this paper used the Pearson Chi-Square test of



associations and the Spearman rank correlation test, so as to ascertain whether the responses given by the respondents were merely by chance. The Pearson Chi-square tests compares the observed value and the expected value under the following formula;

$$X^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i}$$

Where;  $O_i$  represents the observed values and  $E_i$  represents the expected values.

While the Spearman rank correlation uses the following formula to calculate the rank;

$$r = 1 - \frac{6 \sum d^2}{n^3 - n}$$

Where;  $n$  is the number of samples and  $d$  the difference in rank (Hauke & Kossowski 2011).

#### 4.8. Verification of statements

Pearson Chi-square test of association is used to do analysis on categorical data only. The data collected from the survey used categories to collect information from the users. Some of the data categories used in the study used a Likert scale. That is the respondents had only the chance to express how strongly they agreed or how strongly they disagreed with the asked question. For the categorical variables that were ranked from most relevant to least relevant the Spearman correlation coefficient, a non-parametric method, was used.

## 5. Results and discussions

### 5.1. Summary and recommendations

Based on the result of the survey study, the health and wearable device is an important device that provides important data of the user to a medical practitioner, secondly the device is seen as a motivator of engaging in physical activities, thirdly users of the health and wearable device reported increase in health fitness whereas in a study done by Patel, et al (2015), they have emphasized that wearable devices are facilitators and not drivers on health behavioral change. The result of the study shows that gamification, usability, wearability and functionality of wearable devices affect user experience to a large extent which shows similar result to a study done by Smither et al (2016) where they narrowed down the factors that affect user experience into usability, trust in technology, motivation and wearability. Users of the health and wearable devices did not note any reduction in performance after using the health and wearable devices for a longer period of time. However, further research is necessary in order to determine which device manufacturer provides the most efficient and long lasting performance. This research should include both the users and the medical practitioners. This will help users to use only the gadgets that are highly efficient and accurate and also provide a well-researched rank of gadgets. Ranking of the gadgets will increase the competition among the companies to manufacture more efficient and advanced health and wearable devices.

According to 36% of the health and wearable device, users agreed that their devices had syncing issues, this in combination with 31% that complained that their devices got damaged easily. However, a majority of the users 77 % agreed that the data collected from the wearable devices was accurate. Considering that functionality of the health and wearable device came first as the first priority for buying a health and wearable device, followed by the design, comfortability, ease of use, durability, price and brand in that order.

Companies should improve the functionality of these devices to ensure they handle syncing issues so that users and medical practitioners can receive uniform data without any hitches; this is because the data obtained from these devices is very accurate, and the only problem is in the ease of transferring the correct data to other gadgets for visualization and analysis. In addition, 24 % of wearable users would like to have glucose monitoring functionality feature on their wearable device followed by heart rate variability with 23 %.

## 5.2.Future trends

From the descriptive statistics, 44% of the users of the health and wearable device were between 20 – 29 years while those under 20 years were 12 %. This shows that in the next 10 years, the health and wearable devices will be used by more people across the generations as more people become aware of the health devices. Given the importance of health and wearable device in improving the health of the users and the recent growth in health awareness in the world the market for health and wearable devices will continue to grow exponentially.

## **6. Conclusion**

This paper evaluated the use of smartphones and wearable devices for health and fitness purposes from the user experience perspective by first making an extensive literature review of the current state of users experience with the health and wearable devices when monitoring health and fitness and then through a survey that collected information about how the health and wearable devices monitored fitness and health conditions such as heartbeat rate, distance covered, calories burnt and weight loss. The survey was conducted evaluated whether the use of health and fitness wearable device had an impact on the usage of treatment services from medical practitioners, whether the devices motivated people to engage in physical activities, whether these devices had a role in improving health of the users and lastly whether the usability and wearability of wearable and mobile devices to a large extent affected the devices usability.

Using the Pearson Chi-square tests of association Spearman rank correlation tests on the data obtained from the survey, this paper was able to fulfill the aim of the study; to evaluate the use of smartphones and wearable devices for health and fitness purposes from the user's perspective. The data analysis from this study has agreed with past researches done on the health and wearable devices however this study adds on the usability of the health and wearable devices, how issues such as syncing are affecting the effectiveness of the health devices.

## 7. References

AHARON, Yiftah Ben. Small wearable devices may lead to big health care savings. *STAT*[online]. 21 September 2017. [Accessed 11 October 2017]. Available from: <https://www.statnews.com/2017/06/07/wearable-devices-health-care-savings/>

BUCHEM, Ilona, MERCERON, Agathe, KREUTEL, Joern, HAESNER, Marten and STEINERT, Anika. Gamification designs in Wearable Enhanced Learning for healthy ageing. 2015 International Conference on Interactive Mobile Communication Technologies and Learning (IMCL). 2015. DOI 10.1109/imctl.2015.7359545.

COLON, Alex. Fitbit Force review: A tiny display makes a huge difference. Alex Colon [online]. 6 December 2013. [Accessed 9 October 2017]. Available from: <https://gigaom.com/2013/12/06/fitbit-force-review/>

COUGHLIN, Steven S and STEWART, Jessica. Use Of Consumer Wearable Devices To Promote Physical Activity: A Review Of Health Intervention Studies. *Journal of Environment and Health Science*. 2016. Vol. 2, no. 6p. 1–6. DOI 10.15436/2378-6841.16.1123.

Direito, A., Pfaeffli Dale, L., Shields, E., Dobson, R., Whittaker, R., & Maddison, R. (2014). Do physical activity and dietary smartphone applications incorporate evidence-based behaviour change techniques?. *BMC Public Health*, 14(1), 646. doi:10.1186/1471-2458-14-646

DOGAR, Javed Ahmad and ZAFAR, Fareeha. Review of Body Area Network Technology & Wireless Medical Monitoring. *Review of Body Area Network Technology & Wireless Medical Monitoring* [online]. 2012. [Accessed 11 October 2017]. Available from: [http://esjournals.org/journaloftechnology/archive/vol2no2/vol2no2\\_14.pdf](http://esjournals.org/journaloftechnology/archive/vol2no2/vol2no2_14.pdf). 2.

Duck Hee Lee, Ahmed Rabbi, Jaesoon Choi and Reza Fazel-Rezai, “Development of a Mobile Phone Based e-Health Monitoring Application” *International Journal of Advanced*

Computer Science and Applications(IJACSA), 3(3), 2012.

<http://dx.doi.org/10.14569/IJACSA.2012.030307>

DUGGAN, Dr. Robert. Wearable Tech Is Your Doctor's Newest Assistant (Op-Ed). *LiveScience*[online]. 18 March 2015. [Accessed 11 October 2017]. Available from: <https://www.livescience.com/50184-wearable-tech-knows-you-are-sick-before-you-do.html>

EL-ATY , Amr Abd . Wireless Wearable Body Area Network (WWBAN) for Elderly People Long-Term Health-Monitoring . *Wireless Wearable Body Area Network (WWBAN) for Elderly People Long-Term Health-Monitoring* [online]. 2015. [Accessed 11 July 2017]. Available from:[http://www.standardsuniversity.org/wp-content/uploads/wireless\\_body\\_area\\_networks\\_for\\_elderly\\_people\\_long\\_term\\_health\\_monitoring.pdf](http://www.standardsuniversity.org/wp-content/uploads/wireless_body_area_networks_for_elderly_people_long_term_health_monitoring.pdf)

Giuliano, Vince. Digital health - health and fitness wearables, apps and platforms - implications for assessing health and longevity interventions - Part 1 Flux in the market. AGINGSCIENCES™ - Anti-Aging Firewalls™ [online]. 3 February 2015. [Accessed 9 October 2017]. Available from: <http://www.anti-agingfirewalls.com/2015/01/11/digital-health-health-and-fitness-wearables-apps-and-platforms-implications-for-assessing-health-and-longevity-interventions-part-1-flux-in-the-market/>

GERTNER, Jon. Meet The Tech Duo That's Revitalizing The Medical Device Industry. *Fast Company* [online]. 10 May 2013. [Accessed 9 October 2017]. Available from: <https://www.fastcompany.com/3007845/meet-tech-duo-thats-revitalizing-medical-device-industry>

HAGHI, Mostafa, THUROW, Kerstin and STOLL, Regina. Wearable Devices in Medical Internet of Things: Scientific Research and Commercially Available Devices. *Healthcare Informatics Research*. 2017. Vol. 23, no. 1p. 4. DOI 10.4258/hir.2017.23.1.4.

JONES, Val, GAY, Valerie and LEIJDEKKERS, Peter. Body Sensor Networks for Mobile Health Monitoring: Experience in Europe and Australia. *2010 Fourth International Conference on Digital Society*. 2010. DOI 10.1109/icds.2010.41.

Kamel Boulos, M., Brewer, A., Karimkhani, C., Buller, D., & Dellavalle, R. (2014). Mobile medical and health apps: state of the art, concerns, regulatory control and certification. *OJPHI*, 5(3). doi:10.5210/ojphi.v5i3.4814

KOSIR, Spela. Wearables in Healthcare. *Wearable Technologies* [online]. 15 April 2015. [Accessed 9 October 2017]. Available from: <https://www.wearable-technologies.com/2015/04/wearables-in-healthcare/>

LEE, Jung-min. Validity of consumer-based physical activity monitors and calibration of smartphone for prediction of physical activity energy expenditure. *Validity of consumer-based physical activity monitors and calibration of smartphone for prediction of physical activity energy expenditure* [online]. 2013. P. 1–148. [Accessed 11 February 2017]. Available from: <http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=4487&context=etd>

LORENZ, Taylor. Under Armour has acquired fitness apps MyFitnessPal and Endomondo for a combined \$560 million. *Business Insider* [online]. 4 February 2015. [Accessed 9 October 2017]. Available from: <http://www.businessinsider.com/under-armour-has-acquired-myfitnesspal-and-endomondo-for-a-combined-435-million-2015-2>

MESKO, Dr. Bertalan. Top 10 Healthcare Wearables For A Healthy Lifestyle. *The Medical Futurist* [online]. 21 July 2016. [Accessed 11 October 2017]. Available from: <http://medicalfuturist.com/top-healthcare-wearables/>

MICHAELIS, Jessica R., RUPP, Michael A., KOZACHUK, James, HO, Bao tran, ZAPATA-OCAMPO, Daniela, MCCONNELL, Daniel S. and SMITHER, Janan A. Describing the User Experience of Wearable Fitness Technology through Online Product Reviews. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*.

2016. Vol. 60, no. 1p. 1073–1077. DOI 10.1177/1541931213601248.

Mobiquity inc,. (2014). *The Future “ at Least the Near Future “ of Wearables May Just be Health and Fitness Tracking | Mobiquity*. Retrieved 12 April 2015, from <http://www.mobiquityinc.com/future-%E2%80%93-least-near-future-%E2%80%93-wearables-may-just-be-health-and-fitness-tracking>

Nielsen,. (2014). *Hacking Health: How Consumers Use Smartphones and Wearable Tech to Track Their Health*. Retrieved 12 April 2015, from <http://www.nielsen.com/us/en/insights/news/2014/hacking-health-how-consumers-use-smartphones-and-wearable-tech-to-track-their-health.html>

Nancy H. (2013), “Patient Safety and Physician Satisfaction,” AirStrip White Paper Series, Patel, S., Park, H., Bonato, P., Chan, L., & Rodgers, M. (2012). A review of wearable sensors and systems with application in rehabilitation. *Journal Of Neuroengineering And Rehabilitation*, 9(1), 21. doi:10.1186/1743-0003-9-21

PATEL, Mitesh S., ASCH, David A. and VOLPP, Kevin G. Wearable Devices as Facilitators, Not Drivers, of Health Behavior Change. *Jama*. March 2015. Vol. 313, no. 5p. 459. DOI 10.1001/jama.2014.14781.

PwC,. (2014). *Wearable Technology Future is Ripe for Growth “ Most Notably among Millennials, Says PwC US*. Retrieved 12 April 2015, from <http://www.pwc.com/us/en/press-releases/2014/wearable-technology-future.jhtml>

Ramsey, R. (2013). *The Impact of Wearable Technology in Healthcare*. *Wearabletechworld.com*. Retrieved 12 April 2015, from <http://www.wearabletechworld.com/topics/wearable-tech/articles/353619-impact-wearable-technology-healthcare.htm>

SOCIETY FOR MATERNAL-FETAL MEDICINE. Electronic fetal heart rate monitoring greatly reduces infant mortality, study finds. ScienceDaily [online]. 14 February 2011.



[Accessed 9 October 2017]. Available from:

<https://www.sciencedaily.com/releases/2011/02/110212094609.htm>

TAKEI, Kuniharu. Human Interactive Wearable Devices: Applications of Artificial Electronic Skins and Smart Bandages. *Design, User Experience, and Usability. User Experience Design for Everyday Life Applications and Services Lecture Notes in Computer Science*. 2014. P. 710–718. DOI 10.1007/978-3-319-07635-5\_67.

Wearable Devices and Their Applicability in the Life Insurance Industry. Capgemini Worldwide [online]. [Accessed 9 October 2017]. Available from: <https://www.capgemini.com/resources/wearable-devices-and-their-applicability-in-the-life-insurance-industry/>

Wearable technology global market volume units 2013-2018 | Statistic. Statista [online].

[Accessed 21 November 2017]. Available from:

<https://www.statista.com/statistics/302500/wearable-technology-worldwide-unit-shipments/>

## 8. Appendix

### 8.1.Descriptive Statistics

Table 8.1.1a

		Gender	Total	
		Female	Male	
What is your age bracket?	20 - 29	18(18%)	26(26%)	44(44%)
	30 - 39	9(9%)	11(11%)	20(20%)
	40 - 49	8(8%)	3(3%)	11(11%)
	50 - 59	5(5%)	3(3%)	8(8%)
	60+	3(3%)	2(2%)	5(5%)
	Under 20	6(6%)	6(6%)	12(12%)
How many years have you used a health and fitness wearable device?	1 or less	21(21%)	25(25%)	46(46%)
	2- 4 years	21(21%)	21(21%)	42(42%)
	5 or more	7(7%)	5(5%)	12(12%)
Which mobile or wearable device do you use?	Apple watch	5(5%)	20(20%)	25(25%)
	Fitbit	9(9%)	10(10%)	19(19%)
	Garmin	12(12%)	3(3%)	15(15%)
	Jawbone	4(4%)	2(4%)	6(4%)
	Mi Band	1(1%)	0(0%)	1(1%)
	MI band	0(0%)	1(1%)	1(1%)
	MI fit band	0(0%)	1(1%)	1(1%)
	Misfit	6(6%)	6(6%)	12(12%)
	Never used one	0(0%)	1(1%)	1(1%)
	Nill	0(0%)	1(1%)	1(1%)
	Pebble	8(8%)	2(2%)	10(10%)
	Samsung	3(3%)	0(0%)	1(1%)
	TomTom	0(0%)	1(1%)	1(1%)
	Xiaomi	0(0%)	2(24%)	2(24%)
	Xiaomi Mi Band 2	0(0%)	1(1%)	1(1%)
Xperia Z	1(1%)	0(0%)	1(1%)	
What features of wearable devices would you like to have?	Blood pressure monitoring	9(9%)	11(11%)	20(20%)
	Breathing monitoring	4(4%)	6(6%)	11(11%)
	Stress mood monitoring	10(10%)	10(10%)	21(21%)
	Glucose monitoring	10(10%)	13(13%)	24(24%)
	Heart rate variability	8(8%)	15(15%)	23(23%)

	Running distance	0(0%)	0(0%)	0(0%)
	Thermometer for outer temperature, barometer, compass	0(0%)	0(0%)	0(0%)
Main reason for wearing the health and wearable device	To stay fit and energetic	6(6%)	10(10%)	17(17%)
	Track progress	6(6%)	9(9%)	14(14%)
	Fashion	5(5%)	5(5%)	10(10%)
	Monitor overall well-being	5(5%)	5(5%)	10(10%)
	Monitor your sleep pattern	6(6%)	4(4%)	10(10%)
	Helps to stay motivated	4(4%)	5(5%)	9(9%)
	Habit formation	5(5%)	4(4%)	9(9%)
	Free work out tips	4(4%)	5(5%)	8(8%)
	Optimize your workout	4(4%)	4(4%)	8(8%)
	Monitor diet	1(1%)	3(3%)	4(4%)
Relative to your use of a wearable device, have you seen any improvement since using the wearable device?	A little	6(6%)	1(1%)	7(7%)
	Big change	0(0%)	6(6%)	6(6%)
	Considerable	24(24%)	28(28%)	52(52%)
	Moderate	18(18%)	15(15%)	33(33%)
	No change	1(1%)	1(1%)	2(2%)
What results have you achieved since you started using a wearable device?	Habit formation	28(9%)	31(11%)	59(20%)
	Improve diet	31(11%)	28(9%)	59(20%)
	Improve heart rate	24(8%)	35(12%)	59(20%)
	Improve sleep quality	20(6%)	13(4%)	33(10%)
	Improved performance when running.	0(0%)	1(0%)	1(0%)
	Stay motivated to do physical activities	18(6%)	30(11%)	48(17%)
	Weight loss	16(5%)	23(8%)	39(13%)
Would you recommend using a wearable device to your friends or colleagues to improve their health?	Definitely would	12(12%)	23(23%)	35(35%)
	Definitely wouldn't	0(0%)	1(1%)	1(1%)
	Not sure	11(11%)	8(8%)	19(19%)
	Probably would	23(23%)	18(18%)	41(41%)
	Probably wouldn't	3(3%)	1(1%)	4(4%)

Which gamification features of a wearable device do you look for when buying?

(1 being most important and 8 being least important)

Table 8.1.1b

Rank	Reminders to move		Compete with others		Social quest		Visual story telling		Mentorship		Fitness assessment		Discounts or incentives on insurance, etc.	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M

1	1	2	0	1	1	0	1	4	6	7	8	4	8	6
2	16	15	3	4	7	6	3	3	4	2	8	12	4	1
3	9	14	12	18	6	4	7	5	7	2	3	1	2	5
4	10	1	9	12	12	11	5	8	4	6	3	3	1	7
5	7	5	9	5	5	11	12	14	1	6	5	4	5	4
6	3	5	6	2	5	12	10	8	13	10	3	5	4	6
7	2	2	2	5	7	6	11	4	10	10	13	12	2	7
8	1	7	8	4	6	1	0	5	4	8	6	10	23	15

Relative to your use of a wearable device, please rate your satisfaction for each of these features

(1 being most important and 5 being least important)

Table 8.1.1c

Rank	Calories burned tracker		Sleep tracker		Track exercise/movements		Body temperature monitoring		Pedometer		Weight tracking		Reminders to move	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M
1	1	8	6	6	5	4	11	9	2	4	9	8	2	5
2	9	12	7	11	5	7	3	6	10	8	4	7	10	11
3	12	7	11	13	5	6	3	7	15	11	6	10	7	7
4	20	14	15	12	18	21	11	8	15	17	14	14	22	21
5	7	10	10	9	16	13	21	21	7	11	16	12	8	7

Indicate the effectiveness of the following features to your health

Table 8.1.1d

	Heart rate monitoring		Calories burned tracker		Sleep tracker		Track movements		Body temperature monitoring		Pedometer		Weight tracking		Reminders to move	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
Neither agree nor disagree	3	5	7	3	5	12	6	7	16	17	8	16	8	7	6	6
Somewhat agree	17	8	20	20	14	11	17	15	16	13	20	16	21	20	21	15

Some what disagree	0	2	0	4	3	5	3	4	0	6	4	4	2	4	2	3
Strongly agree	23	33	17	21	22	19	20	22	11	9	16	10	13	13	17	20
Strongly disagree	6	3	5	3	5	4	3	3	6	6	1	5	5	7	3	7

What are the key factors that influence your decision to buy a wearable device? Rank them according to their importance (1 being most important and 8 being least important)

Table 8.1.1e

Rank	Function		Design		Comfort ability		Ease of use		Durability		Brand		Price		Friends & family recommendations	
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
1	20	22	2	4	5	8	5	3	4	2	4	1	4	8	5	3
2	5	6	15	21	8	3	9	5	5	6	2	2	4	4	1	4
3	2	6	9	7	16	22	6	8	10	3	2	3	2	1	2	1
4	6	2	10	6	10	6	12	21	4	9	1	3	3	2	3	2
5	5	8	2	2	6	6	7	5	18	21	7	3	3	5	1	1
6	6	2	5	7	1	4	4	5	6	4	12	19	10	7	5	3
7	4	3	2	3	3	1	3	1	2	5	14	9	14	20	7	9
8	1	2	4	1	0	1	3	3	0	1	7	11	9	4	25	28

Rate the following according to your experience of using wearable device

Table 8.1.1f

	Syncing issues		Damage easily		Poor battery life		Uncomfortable		Data is accurate		Data is not reliable	
	F	M	F	M	F	M	F	M	F	M	F	M
Neither agree nor disagree	8	7	14	11	18	10	8	6	5	9	6	8
Somewhat agree	7	12	9	16	3	14	11	9	26	12	6	12
Somewhat disagree	21	13	19	11	12	14	19	14	1	3	25	17
Strongly agree	9	8	2	4	4	4	2	4	16	23	5	4
Strongly disagree	4	11	5	9	12	9	9	18	1	4	7	10

## 8.2. Questionnaire

The purpose of this questionnaire is to obtain information on the use of smartphones and wearable devices for health and fitness purposes from user perspective. You are therefore requested to participate in this study by completing this questionnaire. The information you will provide will be used solely for the purposes of this study and will be kept confidential. Please feel free to respond to all the questions to the best of your knowledge.

### Section A. Demographic Information

1. What is your age bracket?

- Under 20                            20 – 29 years
- 30 – 39 years                       40 – 49 years
- 50 – 69 years                       60+ years

2. What is your gender?

- Male                                       Female

3. How many years have you used a health and fitness wearable device?

- 1 or less
- 2 – 4
- 5 or more

4. Which mobile or wearable device do you use?

- Apple watch
- Fitbit
- Garmin
- Misfit
- Pebble
- Jawbone
- Others\_\_\_\_\_ please specify.

5. What is your main reason for using a wearable device? (Choose as many as applicable)

To stay fit and energetic

Fashion

Track progress

Optimize your workout

Monitor sleep pattern

Monitor overall well-being

Monitor diet

Free work out tips

Habit formation

Helps to stay motivated

**Section B: The use of health and fitness wearable devices has an impact on the usage of treatment services from medical practitioners.**

6. Using a wearable device to monitor your health influences the frequency of your visits to a doctor.

Strongly agree

Somewhat agree

Neither agree nor disagree

Somewhat disagree

Strongly disagree

Explain.

7. Would you consider incorporating your health data from a wearable device to your

medical records?

Definitely would

Probably would

Not sure

Probably wouldn't

Definitely wouldn't

Explain

--

8. The fitness wearable device meets your needs.

Strongly agree

Somewhat agree

Neither agree nor disagree

Somewhat disagree

Strongly disagree

9. What features of wearable devices would you like to have? (Please select as many as applicable)

Heart rate variability

Glucose Monitoring

Stress Mood Monitoring

Blood pressure Monitoring

Others \_\_\_\_\_ please specify.

10. Using a fitness wearable device helps you reduce the risk of getting sick.

Strongly agree

Somewhat agree



Neither agree or disagree

Somewhat disagree

Strongly disagree

11. The data provided on your wearable device enables you to detect early health problems.

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

12. Using a wearable device reduces your medical – health associated costs.

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

**Section C: Having a wearable or mobile devices for health fitness motivates people to engage in physical activity.**

13. The gamification features of the wearable device helps you increase your physical activity.

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

14. Which gamification features of a wearable device do you look for when buying?

Rank according to its importance. (1 being most important and 8 being least important)

Fitness goal

Reminder to move

Compete with others

Social quest

Visual story telling

Mentorship

Fitness assessment

Discounts or incentives on insurance, etc.

**Section D: Using wearable and mobile devices improve the health of the user.**

15. Relative to your use of a wearable device, have you seen any improvement since using the wearable device?

Big change

Considerable

Moderate

A little

No change

16. What results have you achieved since you started using a wearable device? (Please select as many as applicable)

Weight loss

Improve sleep quality

Improve diet

Improve heart rate

- Habit formation
- Stay motivated to do physical activities
- Others \_\_\_\_\_ please specify.

17. Relative to your use of a wearable device, please rate your satisfaction for each of these features. (1 being the lowest and 5 being the highest)

- Heart rate
- Burn calories
- Track sleep quality
- Track exercise/movements
- Body temperature
- Distance covered
- Breathing rate
- Speed
- Others \_\_\_\_\_ please specify.

18. Indicate the effectiveness of the following features to your health.

*Heart rate monitoring*

- Strongly agree
- Somewhat agree
- Neither agree or disagree
- Somewhat disagree
- Strongly disagree

*Calories burned tracker*

- Strongly agree
- Somewhat agree
- Neither agree or disagree

Somewhat disagree

Strongly disagree

*Sleep tracker*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Track movements/physical activities*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Body temperature monitoring*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Pedometer*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Weight Tracker*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Reminders to move*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

**Section E: The usability and wearability of wearable and mobile devices to a large extent affects their use.**

19. What are the key factors that influence your decision to buy a wearable device?

Rank them according to their importance. (1 being most important and 8 being least important)

Function

Design

Comfortability

Ease of use

Durability

Brand

Price

Friends and family recommendations

20. Rate the following according to your experience of using wearable device.

*Syncing issues*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Damage easily*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Poor battery life*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Uncomfortable*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Data is accurate*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

*Data is not reliable*

Strongly agree

Somewhat agree

Neither agree or disagree

Somewhat disagree

Strongly disagree

21. Would you recommend using a wearable device to your friends or colleagues to improve their health?

Definitely would

Probably would

Not sure

Probably wouldn't

Definitely wouldn't

Thank you for your participation!