INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 4 - V7I4-1824)
Available online at: https://www.ijariit.com

Internet of Things for personal healthcare

Tabeena Reyaz
tabeenareyaz@gmail.com
Adesh Institute of Technology, Gharuan, Punjab

Dr. Rajat joshi
drjoshirajat@gmail.com
Adesh Institute of Technology, Gharuan, Punjab

ABSTRACT

Technologies are not yet up and the idea of the Internet of Things brings many new opportunities for new goods and user applications. All equipment is genuinely personal and medical is not an exception. Telemedicine is a revolutionary diagnosis and treatment method, with intelligent health-care solutions that provide the user the ultimate control over health. My research seeks to comprehend what the eHealth sector is and to provide business and IT experts clear recommendations on how to join the intelligent health market. I have analyzed the current situation on the market, conducted public research at Finland and prepared a white paper with basic rules that could help develop and design a valuable, secure personal use product that offers maximum benefits to the business and ultimate usability and experience for selected users. The paper covers the following issues: IoT healthcare needs and requirements, legislation, acceptance, IoT user experience, security, and so on. I believe that my work will assist specialists in various disciplines comprehend the Internet of Things in personal healthcare and open up new areas of business. Finally, I have implemented all the theoretical information gathered and created the smart insulin pump, a unique and novel product on the market today.

Keywords— *Internet of Things, Personal Healthcare*

1. INTRODUCTION

Internet of Things (IoT, Internet of everything, computer technology, the omnipresent Internet) and its services are becoming a major aspect of contemporary life and of the way business is carried out (Internet of Things Russian research center, 2013). Things like a digital assistant, smart homes, smart cars and the smart environment are being realised through mobile devices, contemporary electronics and the network that connects everything to a vast Internet of Things infrastructure.

Consider a scenario in which you wake up early in the morning and you have already been able to write down how you have slept and uploaded the information to some cloud services. A coffee and microwave got cloud data and realised that you woken up and began preparing your breakfast. After the same band data, light falls into your bedroom. When you leave the room and go to the kitchen, all lights are immediately turned on. You already anticipate a cup of coffee in the kitchen. The robot vacuum cleaner begins cleaning up rooms when you leave the home and go to work.

This is the universe that is built on the IoT idea. Some of the intelligent IoT functions already exist, some are just automated. But the Internet of Things will radically alter the globe, impacting all companies and lifestyles.

The fast growth of IoT was driven by a steady decrease in technological costs. In the past several years, we have seen a constant reduction in the cost of various de-de-vices from 3D printers to smartwatches and fitness trackers. Dramatically lower Bluetooth and Wi-Fi module prices (for example, around EUR 1 per item in a BLE module) enable more and more Internet-connected devices to be connected. (Photovoltaics, 2016)

Electronical sensors cost almost nothing, but may detect everything from temperature and moisture to pressure, distance, sound power, light level, gravity and motion and transmit all recorded signals to installed software at all costs. The cost of computing power fell most significantly so that almost any item could be fitted with computer chips. This has, however, led to the removal of the conventional market barriers for new goods and businesses that produce new ones.

Internet of Things is a natural step for the global network to grow, which first enabled static websites to be seen. Today it leads to interconnected systems using artificial intelligence to adapt to constant changes and human needs in the entire environment. Modern

IoT is not yet established and 99 percent of all potential devices are not linked. This implies that Internet developments have begun, but nothing is obvious and architecture is still developing. The law of Metcalfe states: "The telecommunication network value is commensurate with the number of people connected to the system (n2). Imagine if all the new linked things (sensors, actuators, gadgets, etc.) and people contribute value to the equation and increase dramaticly the efficiency of the Internet. (Photo: Evans & Annunziata, 2012)

According to several estimates, many linked gadgets will reach up to 50 billion in 2020, a huge amount for today's world (Cisco, 2016). Such rapid growth poses a number of technological and commercial challenges. No one understands how to operate companies in the Internet of Things era: technology is not clear, the requirements of customers are not yet expressed and even the users themselves do not know what they wish to purchase. All these problems prohibit IoT managers from investing due to large risks and imprecise job scope. Prod-uct developers have no concept how the end gadget or solution should function and how the project has to be. Even the situation on the market is uncertain. In summary, the Internet of Things is something new and indefinite. The Internet of Things offers numerous opportunities throughout the healthcare industry where correct information is a safe and quick cure deposit. In certain areas of human health, IoT concepts are already being implemented, increasing the quality and drastically lowering expenses. However, of course, not all applications and target patients are covered. As the meth-chances and solutions for data collection, transmission and analysis are steadily increasing, we will observe a huge number of Internet-based, patient-monitoring medical solutions. (Niewolny, 2014) 2014

My thesis aims to comprehend what IoT is, to identify the appropriate methods to conduct companies in the telemedicine industry, and to develop a personal health solution based on a conducted research. The idea, architectural and technological elements of IoT, as well as commercial perspectives, market condition, development issues, future consumers, will be analysed by my emphasis on consumer-oriented health care. This study would help me create a whitepaper with recommendations for medical developers and management

Company that will summarise my research. The research addresses important problems of digital medicine such as views, safety, legislation, user experience of patients, etc. It will assist IT staff and management without a technical background. This output should guide readers into the IoT healthcare world to explain minorities and possible problems in the Thing business segment's Medical In-Ternet.

Why is my study worthwhile? The Internet of Things is now a popular subject, and many businesses want to join the industry. Large opportunities and large target audience make the health sector extremely profitable. However, due of huge demands and restrictions, this is the hardest sector to operate. Before any product development option and planning, it is important to analyse the present circumstances, since the project would contribute to adapt to the technical and economic needs. Target audience research would indicate field interest. It will also describe the anticipated characteristics and any potential difficulties and concerns. Finally, I will evaluate if consumers are ready and willing to use contemporary IoT healthcare gadgets. In summary, I would like to study IoT in health care because without a proper knowledge of the whole field, it is not efficient (and not necessary for healthcare).

The quantity of information produced by the linked devices should shift priority towards critical data security. The first stage in building a safety infrastructure is the assessment of risks to species. In addition to phishing, DoS and DDoS assaults, as well as physical infiltration into the age of widely used devices. Today the market provides a unique automated hacking tool, many of which are free of charge. Indeed, mobile apps are deployed on unregulated mobile device ecosystems in contrast to controlled Web environments. Unprotected mobile code (same code that you download when you install an app from, for example, the AppStore store or Google Play) enables attackers to easily change and exploit these apps for their own benefit. Due to the assaults, nine in ten (90%) companies have had negative impacts on their company, including a delay in product or service development (31%), decreasing their workers' productivity (30%), lowering consumers' reliability (28%) and some pressure (24%) (Compton & Mickelberg, 2014). These all have a negative effect on the reputation of the business and the overall success of the company as well as the trust of its consumers in this sector.

2. RELATED WORK

2.1 Telemedicine, healthcare and medical IoT

The difference of the telemedicine and healthcare/medical Internet of Things is small, however, improper The distinction between telemedicine and the medical internet of things is minor, but an unsatisfactory grasp of the terminology in this area leads to misunderstanding. I explain in this part both the words I use and how they are linked to therapy and IoT.

Telemedicine is the use to enhance, maintain or support the health of patients of medical information sent across sites via electronic communications. The word "telehealth" is closely connected with telemedicine and is frequently used to include a wider concept of remote health care that does not necessarily include clinical services. All telemedicine and telehealth are regarded part of video conferencing, transmission of still pictures, e-health including patient portals, remote monitoring of vital signs, continuing medical education, and nursing call centre. (French version, 2014) Telemedicine is just the Internet of Things that are used for medical reasons, and thus it is a recurring phrase used to define contemporary medical treatments using information technology.

Medical as well as healthcare The Internet of Things is seen as telemedicine, although it is distinct. Healthcare is a kind of medical care designed to monitor normal conditions, support chronic conditions and use preventative approaches to ensure a healthy lifestyle. In the case of IoT, medicine is responsible for emergency care, illness research and medical science. For my thesis I believe that medicine occurs at the hospital in order to recover after an accident or sickness. The Internet of Things is about fixed solutions, medical databases and linked professionals. The Internet of Things healthcare is a collection of various technologies and gadgets

that promote human health. This is why the words IoT healthcare and IoT healthcare may be used interchangeably. Healthcare IoT offers personal services via the use of personal devices and systems designed for a single individual.

The personal internet healthcare of Thingsystems may be regarded continuous glucose monitoring, pacemaker, cloud service with health data and kid tracking device I shall use all the words later on in my article, and occasionally medical IoT may be used to express the whole spectrum of intelligent medical services, because healthcare is a new medicine approach. Even though the terminology are different, they are all closely linked and just one subject cannot be studied since they are all about treatment of human health and none of the areas could be regarded as distinct. Internet of Things contributes to the development of the health system by improving the transparency of procedures and optimization of operational operations, which in turn serves to enhance the quality of patient care. In Section 3 I will explain additional advantages of eHealthcare. "Personal IoT study" and beyond.

2.2 Health Architecture IoT

The Continua Health Alliance has released the end-to-end architecture for interconnected health applications. This is the success of the 220+ Alliance, considered a major milestone in creating an interoperable environment for personal health systems. A high level ecosystem architecture overview, with three interfaces and four classes of reference devices and topological restrictions, is shown in the Continuous-to-end (E2E), Figure8. The new end-to-end linked solution enables devices to transmit data to medical departments, hospitals, patient information systems etc. from consumer health gadgets.

In order to guarantee interoperability of components used for apps that monitor personal health and well-being, Continuous Guidelines for Design (CDG) provide a framework of underlying standards and criteria. It contains also design suggestions that better explain the underlying standards or specifications by restricting options or adding features which do not enhance interoperability. (Continued Alliance 2016) Architecture of Health IoT

The Continua Health Alliance released the end-to-end architecture for connected health apps. This is the success of the 220-plus alliance, which is considered to be a significant milestone in establishing an interoperable environment for personal health systems. The Continua-end-to-end (E2E) reference architecture provides a high-level architectural overview of the ecosystem, with three interfaces and four classes of reference devices and topological constraints, see Figure8. The new connected end-to-end solution allows devices to transfer data from consumer health gadgets to medical centres, hospitals, patient information systems, etc.

The Continuous Design Guideline (CDG) provides a framework of underlying standards and criteria to ensure interoperability of elements used to monitor personal health and well-being applications. It also contains design suggestions that explain the underlying standards or specifications better by restricting options or adding a feature that does not improve interoperability. (The Alliance Continued, 2016)

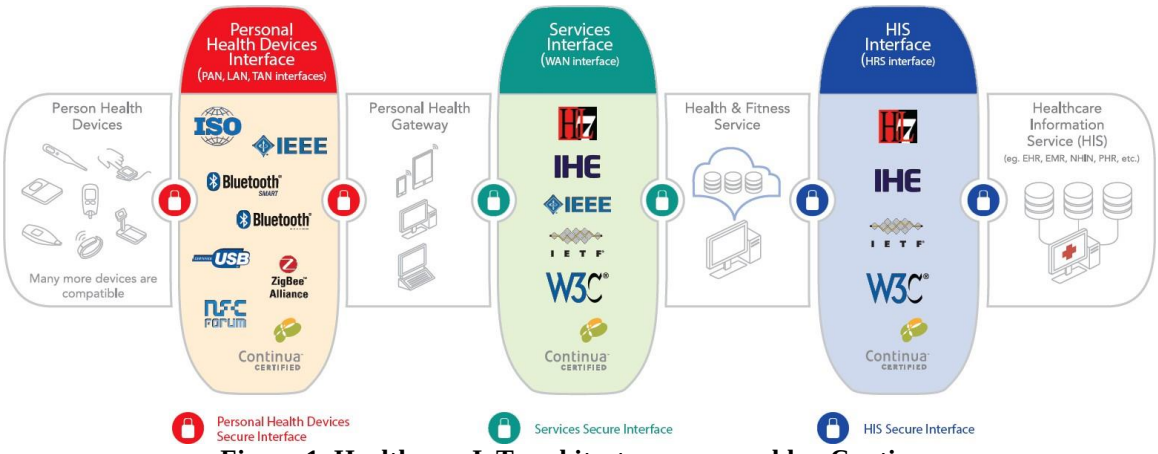

Figure 1. Healthcare IoT architecture proposed by Continua

2.3 Motivation

The initial idea was born some time ago when the understanding of medical automation, healthcare IoT and general the abilities of engineering were inadequate. The necessity for such an appliance was obvious to us, though, and our yearning grew significantly. I want to show first of all why the insulin pump is a good and demanding product. If you review section 3.3. "New audience exploration," it is obvious that individuals with diabetes are not covered by current companies, since they are also in the information searchers category. In addition, businesses need more than simply data monitoring and statistics. It is automation capability. Additionally, the research shows that consumers are ready for smart devices and are able to trust technology but issues of privacy, pricing, security and technical dependability are important. All all, the goal was to create innovative, dependable devices which concentrate on high security, customer support and high interconnection capacity for future IoT healthcare. This implies that our major hurdles have been open standards, a security-by-design strategy and the development of an early ecosystem.

The following is why we selected an insulin pump. There is no personal motive behind it. In my analysis of the medical industry, I discovered that all kinds of insulin injectors are popular since 387 million people live with this illness globally. 56 million people are injecting insulin several times a day in the European region, 61 million in America (37 million in the region of Northern America) and 138 million in the Western Pacific. If we consider an average individual with diabetes injecting insulin four times a day, the number of daily injections in the indicated areas will be above 1B. The number of dia-betics is in reality considerably greater and 46 percent of the total is not diagnosed, making the overall quantity almost twice as large. Statistics are extremely astonishing and

experts anticipate a rise of 205M by 2035. (American Advocates for Diabetes (ADA), 2014) Such a large audience aims at a wide range of current and new gadgets, but that is not true. All existing gadgets may be classified into two large groups:

- Devices from renowned medical firms
- Intelligent solutions from enthusiasts and startups

The first group's solutions lacked insight and were mostly contemporary 5-7 years ago. You can monitor sugar levels and use human computations and some static algorithms to inject an adequate insulin dosage. They are all bulky and hard to keep running. The second group is more interesting, as there is some intelligence in systems, but most want a special proprietary control unit which is not effective since everybody has a smartphone (100 percent of my public students) with powerful calculation and communication capabilities. As an example, I may offer two solutions for the second and first groups, Kaleido (Kaleido, 2016) and Medtronic (Medtronic, 2016) respectively. See also Figure 17 for body appliances.

Figure 2. Kaleido (left) and Medtronic (right) devices on body

2.4 Diabetes

I mentioned in the beginning that the wristband is aimed for individuals with type 1 diabetes. I would like to describe the illness, distinctions between kinds and genesis of the issue in this chapter. Underneath these questions, I have developed a gadget so that I can understand how, what, why and when to inject diabetes.

Diabetes mellitus is an endocrine illness defined by an increase of chronic blood sugar levels (glucose) owing to a lack of absolute or relative insulin. It is a pan-creative hormone. The illness disrupts all kinds of metabolism, harm to the vascular, neurological system and other organs. Many kinds of diabetes exist:

- Type 1. Insulin-dependent diabetes.
- Type 2. Insulin-neutral diabetes.
- Secondary diabetes, diabetes. Also referred to as symptomatic.
- Managemental diabetes.
- Malnutrition-related diabetes.

Diabetes of type 1 and type 2 are most common. The primary explanation for type 1 diabetes is an autoimmune disease induced by the breakdown of the immune system. The body begins to produce antibodies to destroy pancreatic cells. Viral infection or genetic predisposition to the illness are the primary drivers of Type 1 diabetes. Type 2 diabetes may be caused by lifestyle, weight, etc. Whatever the aetiology of diabetes is, the advice is: Not all glucose (sugar) from meals can be used by the body and the remainder in the liver and muscles may be stored. In excess of the blood, unused glucose is circulated. It affects all tissues and organs. Since the absorption of glucose in cells is inadequate, the body starts using fats as a source of energy. As a consequence, greater toxicity is produced in the body and in particular in the brain (ketone bodies), which affects the entire process of metabolism. Typically, type 1 (insulin-dependent) diabetes develops quickly, sometimes abruptly. Insulin-undependent diabetes progressively develops and has mild symptoms. (Fadeev, 2009) 2009)

Diabetes treatment is held for life. The daily usage of insulin is required only for individuals with Type 1 diabetes and second-type diabetes development. If type 2 diabetes additionally develops insulin-dependent, type 1. Type 1. This is why Insula is aimed for diabetics of type 1. As previously mentioned, insulin is a human pancreatic hormone that lowers and controls the amount of blood glucose. Various kinds of insulin are to be injected:

• Simple high-speed insulin •
• Insulin for short-acting
• Insulin intermediate-acting duration
• Long-term or long-term insulin
• Combined • Combined (mixed)

All insulin pumps provide basal insulin and insulin injection in an emergency or elevated glucose level. The main task of basal insulin is to control blood glucose levels, including sleep, during fasting times. While fasting, the liver continually secretes glucose into the circulation, and basal insulin is required to keep these glucose levels under control. Basal insulin may be intermediate or prolonged. Many people with diabetes like basal insulin because it enables them to monitor their level of glucose and make their lifestyles more flexible. However, sugar levels need to be monitored frequently since the circumstances, food and mood change significantly. This is why CGM is the second important component of a good intelligent insulin pump (after the pump itself).

Now, since it's known what insulin is, following variables may be added to Insula requirements:
• The cartridge must have little daily insulin intake
• The patient should load the cartridge depending on the insulin type chosen by the doctor The next logical matter is the needle. Insulin is injected beneath the skin and the needle should thus be 4-6mm at 90 degrees. Additional medical features and processes would subsequently be revealed.

2.5 Bracelet design and technologies

Figure 3. Insula bracelet Solidworks model

Figure 4. Insula bracelet view from top

Figure 5. Insula bracelet strap

2.6 Application design

The smartphone app is used to regulate the wristband for insulin. It receives CGM data performance and analyses the information

to forecast dosages and crucial selection based on current blood indexes and nutrition. In addition, data and insights are provided. It is also possible to touch the personal doctor and community. All in all, the application is the whole device's management unit. For application mockups, see Appendix 4.One of the greatest problems to overcome was the app design. My findings show that any intelligent health application should be simple and intuitive. I chose to eliminate any settings for glucose level monitoring that are unneeded. IBM Watson Alchemy and Google Nutrition API enable users to define in plain language what they consume (Michelle, 2011). It makes the application more intelligent and easier.

2.7 Aspects of business

The business component of the Insula project is now extremely important. It is essential to find suitable partners in the eHealth industry and in manufacturing. The precise amount of investment required and the exact price of the bracelet with the entire system is very difficult to say at this time. How-ever, I've got some target estimates. The device should be inexpensive for everyone with diabetes. The choice of such a price building approach also attracts more customers since the obvious advantages of smart devices and excellent prices eliminate all current products from top market positions. At now, the price of bracelets and materials is approx. 20-30 euros, but it needs a bespoke chip, which may raise costs. For customers, the whole Insula ecosystem must be EUR 80-120. This pricing would enable profit to be obtained while fostering and increasing consumer scope.

3. CONCLUSION

Healthcare and medicine are very significant social sectors and there is a constant increase in the demand for technical assistance as instruments and treatment technology are growing. Modern telecommunications and machine learning have opened up new avenues for diagnosis and therapy. Internet of Things provides the idea of a linked society where every element of the globe, from nourishment to transportation, is supported by medical services. In total, the benefits of intelligent services in personal healthcare throughout the research overcome all disadvantages. However, safety and privacy, user experience and adoption are important topics to study and improve.

The research recently concluded focuses on the Internet of Things for personal health care, which offers the user with digital medical and wellness services or applications. It is the largest portion of the whole medical industry, since a number of healthy people are larger and it's essential to concentrate on health before severe medical problems develop.

Hopefully, my research results are helpful for all kind of companies but it is good to realise that even in health care, where numerous rules apply, there is no gold standard for companies. The aim of my job is to offer insights into the intelligent health industry and to deliver important discoveries for IT professionals who cannot utilise technology to create the right product, as well as business specialists who can't connect the potential of advanced technology with customer requirements. My report should bridge the gap between two closely linked groups of individuals and provide knowledge on the whole sector and need for new goods.

4. REFERENCES

[1] (PwC), F. W., 2014. *Making Care Mobile: Introducing the apps pharmacy,* s.l.: s.n.

[2] American Diabetes Advocates (ADA), 2014. *Global Diabetes Population.* [Online] Available at: http://www.americandiabetesadvocates.org/ [Accessed November 2016].

[3] Christina, F., 2014. *Exclusive: Two Apple medical trials shed light on how HealthKit will work,* s.l.: Reuters.

[4] Cisco, 2016. *Internet of Things.* [Online] Available at: http://www.cisco.com/c/en/us/solutions/internet-of-things/overview.html [Accessed September 2016].

[5] Compton, M. & Mickelberg, K., 2014. *Connecting Cybersecurity with the Internet of Things,*s.l.: PwC.

[6] Continua Alliance, 2016. *H.810 Interoperability design guidelines for personal connected health systems,* s.l.: s.n.

[7] Erika Gebel Berg, P., 2014. Anatomy of a CGM Sensor. *Diabetes forecast.*

[8] European Heart Rhythm Association, 2014. *Statistics on the use of cardiac electronic devices and electrophysiological procedures in the European Society of Cardiology countries,* s.l.: s.n.

[9] Evans, P. C. & Annunziata, M., 2012. *ndustrial Internet, Pushing the Boundary of Mind and Machines,* s.l.: s.n.

[10] Fadeev, P., 2009. *Diabetes.* Moscow: Oniks.

[11] Finkle, J., 2014. *U.S. Government Probes Medical Devices for Possible Cyber Flaws,* s.l.: Reuters.

[12] Fox, S., 2010. *Mobile Health 2010,* s.l.: s.n.

[13] Gang, G., 2011. *Internet of Things Security Analysis, International Conference on Internet Technology and Applications.* s.l., s.n.

[14] Google Trends, 2016. *IoT search term.* [Online] Available at:https://www.google.com/trends/explore?date=all&q=%22internet%20of%20things%22&hl=e n-US[Accessed September 2016].

[15] Harries, P., 2014. *The Prognosis for Healthcare Payers and Providers: Rising Cybersecurity Risks and Costs,* s.l.: PwC.

[16] Higgs, R., 2014. What is telemedicine?. *ICUcare LLC.*