Workshop Proceedings of the 10th International Conference on Intelligent Environments J.C. Augusto and T. Zhang (Eds.)
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Home-based e-healthcare for elderly: Implications of demand, research and market

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Abstract. The rapid development of sensing and communication technology is providing us a wide array of solutions that are related to home-based e-healthcare to support the health, safety and independence of older people. While these technologies bring us magnificent prospects, everything is still in its infancy when consumers' demand is unclear, researchers do not judge well among various technologies and marketplace is also too early to be defined. We must realize that it is not just an academic problem, but also is related to the demand and market. To better understand the perceptions from different stakeholders, implications of demand, research and market are discussed here.

Keywords. Elder care, e-health, smart home, home monitoring, wearable device, market

Introduction

In the 21st century, healthcare is facing a serious shortage of financial and human resources due to the global population aging issue. With the largest population in the world, China is aging rapidly. Its sixth national census in 2010 shows the proportion of Chinese elderly persons over 60 rose to 13.95%, with an increase of 2.93% in the past decade [1].

Many of the elderly have various degrees of disabilities as they are aging. Gradually they are more and more dependent on others for their activities of daily living. Though nursing houses and elder care centers have emerged as a possible solution, they are rather expensive and unsatisfactory. Moreover, elderly people do not prefer custodial care but want to be at home where they are not detached from their family, friends and society. It is required that home-based technologies enable older person to adapt to changing physical and cognitive function and preserve living in a familiar environment within an established social network.

In this scenario, e-healthcare technology, which will satisfy the needs of these homebound elders, is just what we want. E-healthcare devices and services are expected to improve a person's ability to live independently and relieve the caregivers of their burden, since their workload can be reduced. To the government, it is also a good method to solve the problem of inadequate and overly expensive medical services, especially in China.

With all these problems, the e-health market is growing fast. According to the survey of ABI company, in 2012 about 3 million wireless wearable sensors were applied in the medical electronics, this figure increased 37% from 2011. It predicts that,

in 2017, applications in remote patient monitoring will account for 20% of the overall wearable device market [2]. While the BCC Research says, the global wireless EHR market is expected to reach \$ 11.2 billion in 2013. This market is further expected to grow up to \$23.5 billion in 2018 with a compound annual growth rate (CAGR) of 16.1% [3].

So this paper includes:

- perspectives from different stakeholders, including users, researchers and producers,
- analysis about limitations on e-healthcare products, troubles in research area, confliction between price and demand.

1. Current Features

1.1. Need of Aging People

Clearly, in view of such a demographic trend, home-based medical assistance to a rising number of dependent elderly is a major problem that we are facing now. E-health providers from upstream and downstream industries have currently given solutions at different levels, from processors to wearable devices, and from relevant research to application development. But what is still lacking in Smart Home (SH) with healthcare technology is inexpensive and effective technology that helps home-bound older adults manage their illnesses and maintain their physical and cognitive function. In addition, one of the most essential factors of the technology is that it should be incorporated into existing homes, so that older adults do not have to move to a new facility.

The overriding concern of elderlies was that spending money on e-health should be worthwhile and should lead to improved health and quality of life. How to monitor functional status, maintain health, promote physical and cognitive abilities, and improve quality of life are regarded as important. Personalized health management at home can reduce the number of visiting doctors. Also, elderly users require intelligent appliances fitted with easy-to-use interfaces, which can be associated with ubiquitous computing, allowing technologies to work together seamlessly and transparently [4].

1.2. Research Situation

The USA is the leading country in the world when it comes to research on ICT-based home healthcare [5], while the European Union has supported research efforts in the field of e-Health for more than two decades now. The technologies developed in hundreds of projects have contributed to improving healthcare provision in varied areas [14,10]. These projects can be used for health monitoring, assistance and in some cases information processing and context inference. Famous examples include MIT's PlaceLab[6], the UK's project SAPHE [7], Georgia Tech's Aware Home [8], the Activity-Based Computing (ABC) project [9] and the Welfare Techno house in Japan [11].

Recently, more and more systems are showing us great potential in exploring solutions for e-healthcare. Wockets is an open source multi-accelerometer system for continuous physical/sedentary activity type, intensity, and duration activity detection for population-scale gene-environment studies [12]. Another program in UCLA, the Physiological Health Assessment System for Emergency Responders program (PHASER), seeks to support the nation's first responders [13].

We can see researchers now emphasize the notion of context awareness in intelligent systems. Most researches in this field use personalized smart devices to monitor and track via wearable or implanted sensors [15,16] and evidence-based algorithms to analyze the sensor data. Systems have been implemented for action monitoring (e.g. fall detection [17]). Telecommunication and information technologies have been integrated to produce systems such as telematics, telehomecare and telemedicine, in which a variety of assistive devices are presented in wired or wireless networks. In order to maintain home comfort heating, ventilation, lighting and other features can be manipulated remotely through information communication technologies (ICTs) [4].

The majority of publications are dealing with vital sign parameter (VSP) measurement in home healthcare sector. Other applications deal with audio and/or video consultations of the type "virtual visit". Specific health conditions addressed in the studies range from diabetes to mental health, from obesity to well-being and postoperative care. Diabetes has received a great deal of attention. Moreover, after grouping the conditions into larger classes, it becomes clear that the focus of e-Health research is chronic conditions, followed by prevention well-being, and acute conditions [18].

1.3. Progress in the Industry Sector

As one of the most promising direction in e-healthcare, wearable technology has won a lot of attention and applauds in the late 2 or 3 years. The development of wearable devices now encompasses rehabilitation engineering, ambulatory intervention treatment, life guard systems and defense wearable systems. But the market is still far from mature. Smart gadgets or prototypes are mostly among three types: wristband, watch and glasses.

Smart wristband used to monitor our health status when we doing sports and sleeping, has been popular for some time. The famous Google Glass displays information in a smartphone-like hands-free format [19]. It can communicate with the Internet via natural language voice commands. As for smart watch, Sony's second generation SmartWatch, Samsung Galaxy Gear 2, ZTE's Grand watch and many other watches will make their debut in early 2014. They are now competing with each other by integrating more apps and taking notification tools and access to Internet as their trump card.

Current difficulties in wearable market lie in the sensor technology, user friendliness and its cost. Despite the difficulties ahead, healthcare will be a new battleground among all smart device manufacturers. Apple's much-anticipated iwatch is to be launched this year, which is expected to embed heart rate (HR) and oxygen sensors within. Other companies are planning their own next-generation wearable device on healthcare, like ZTE, its new smart wristband which can monitor HR and sleeping status will be issued.

A quick scan about the latest CES (6th International Consumer Electronics Show) shows us the cutting-edge technology applied in the intelligent healthcare. Smart wristbands and watches improve their appearances a lot, but there is few revolutionary progress. Baby monitor is one of the interesting products exhibited in the CES. Moneual Smart Wristband Baby Monitor [20] is a specialized baby monitor for the hearing-impaired, remotely alerting the user by LED light and vibration on a wristband, while Rest Mimo Baby Monitor[21] has organic cotton kimono which is fitted with non-contact machine washable sensors that measure a baby's respiration. Another gadget called Mother [22] is designed to serve as a hub for a series of Motion Cookie tracking devices. Dubbed cookies, that can sense motion and temperature, will interact with Mother and help people in daily life: fitness, well-being and security.

In addition to these smart types, appearances of other smart wearable devices remain scarce. Producers are more rational about the wearable market, where the consumers' eager expectations are far more than their payment willing. These products are more exploratory before technology advances and market grows.

2. Analysis

The main concerns for e-healthcare technologies involve cyber security, privacy issues, costs, user friendliness and lots of other considerations, most of which have been discussed in detail before. So here we choose bottlenecks and conflicts in the current research and industry environment as our topic typically.

2.1. Bottleneck

As highlighted in previous chapter, user friendliness remains a concern. For wearable gadgets, there are two possible ways to solve the problem: to make it extremely fashionable or overwhelmingly practical. Wearable gadgets are far from unobtrusive and adaptive to the daily life. The reason not only lies in the design concept, but also lies in the limitation of the assemblies itself. Technology of flexible screen, micro-processor and sensor is advancing rapidly, but the day of wearing the computer is still far away. By the same token, e-healthcare systems or services need to surpass existing achievements, no matter in simplifying learning process, in reducing operation difficulty or in integrating functionalities.

Research work was somehow held up in bottlenecks recent years, partly because the healthcare is so large a research area that few of researchers will know every aspect. As research in academic is fast developing and products are upgrading quickly, we can see that quite a lot of papers and products been published. The demand from researchers to read such overviews or know new features latest product is high. As a matter of fact, due to writers' limited knowledge and fast-changing environment, it is always difficult to generalize all works and thus, his research may not have a general view.

Under these circumstances, we require a convergence in three levels. Firstly, researchers are demanded to gain a thorough knowledge of different focus points.

Secondly, a multidisciplinary cooperation in e-healthcare is inevitable. Last but not least, appropriate mechanisms for knowledge transfer between research and industry is quite essential.

2.2. Conflicts

Can e-healthcare technology address the problem in China which is described as too expensive and too difficult to access the doctor? There are possible conflicts at present hindering the popularization of the technology.

The cost of the e-healthcare products or services may be a critical factor for its usage amongst all the houses to support elderly people. In China, unbalanced medical resources in different areas aggravate the regional inequality, and gap between the rich and the poor widen the possibilities of getting treatment. Compared to the richer east China, the inland and western region are even urgent to draw support from the e-healthcare technology, but ironically these people with far lower income are the ones to pay with least possibility.

Resistance is quite large when pushing old people to use e-healthcare products. It is not only a matter of cost, but also a matter of their consumption habits. Most of the old are conservative and hardly pursue new things. Some of them even have no access to smart mobile phones. It's normal for them to use mobile phone to call or send messages, but not natural for them to operate with WiFi or e-health apps. They are not the generation born with Internet around them, so they hesitate, doubt and have no idea how to use it, which determines that they may not be the mainstream consumers. The real mainstreams in China are still in their thirties, who will be willing to pay for e-healthcare products for their parents after 10 more years.

We can understand the reason why popular wristbands or watches at exhibitions or shops focus on sports, music and social functionalities, that's because the buyers are at their ages with these demands. So we have to wait at least 10 years to witness the prosperity of e-healthcare.

3. Conclusion

In this survey, we explored the different researches, products and applications of homebound e-healthcare for elderly people from various perspectives. We discussed from the need of the elder people to the actual research status as well as industry prospect. From consumer's point of view, high-quality and cost-effective e-healthcare solutions are welcome, but how appliances could be more seamless and transparent remains a big challenge. From a researcher's perspective, there is a need for better design considering the need of the elderly people and new cross-disciplinary solutions for ICT-based home healthcare.

However, we are aware that all expectations in healthcare are not easily achievable. Markets have not grown up to be totally mature. Possible conflicts between cost and willingness to pay may be obstacles. But at least, it's not a daydream anymore. We are confident that e-healthcare for elderly people will be recognized as a feasible tool to provide equitable access to timely, efficient, and high quality healthcare.

Acknowledgement

This work was carried out as part of the Project Supported by Key Technologies Research and Development Program of China under Grant No. 2012BAH55F01 and No. 2012BAH55F02.

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