A Study of IT Convergence for the Mobile Development of U-Healthcare

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Abstract

In order to solve the problem of the ever growing health care aging population, the stress on disease prevention, timely diagnosis and effective treatment and management of disease are needed. IT and Medical convergence have received a lot of interest to develop new diagnostic devices and new medical services. This study aims to develop an IT-medical convergence technologies including u-health, which is the health management anytime and anywhere; life-care, which leads healthy life by management of daily life; point-of-care, which makes on-site diagnostic; genetic analysis, which predicts genetic diseases; IT based new diagnosis and treatment system and components of medical devices.

Keywords: IT Convergence, U-Healthcare, Medical management, Medical Convergence, Convergence Model

1. Introduction

With an ICT (Information Communication Technology) paradigm shift toward ubiquitous technology, homes and cities we are living in are transforming into U-Home (Ubiquitous Home) and U-City (Ubiquitous City); and our surroundings and objects including administration, transportation, environment, education, culture, tourism, healthcare, and medicine are evolving with the aid of ubiquitous technology [1][2]. This ubiquitous paradigm applied to various fields is introduced to the healthcare and medical sector in the name of U-Healthcare as well.

Smart technology does not mean that the technology itself is smart, but can be said that individuals and industry has become smarter. Smart technology providing individualized products and service to quickly correspond, sensitively analyze, predict occurring situations have the five features of sensing, intelligence, mobility, elasticity, and integration. Smart technology creates new business in each industry and will be the role of continuous development. Commonly call the modern society as “digital convergence”. This digital convergence combines existing industry with IT to create new values and even industrial structure [3].
Especially, mobile, smart, cloud computing can be called core technologies of the large technological direction of convergence that “smart” is receiving spotlight as convergence is deepening [4].

U-Healthcare is expected to have ripple effects on economy and industry by reducing medical costs and socioeconomic costs as well as on society and policy by expanding public health services and preventive care management.

Today’s healthcare industry emphasizes safety, efficiency, patient-oriented approach, timeliness and balance. U-Healthcare makes it possible to safely deliver appropriate services from any location at any time. To explain the emergence of u-healthcare, one must invoke, first of all, progress in IT and medical technology, and then the desire and willingness on the part of health care institutions to adopt the new service concept and increased health care demand. Digitalization of information, introduction of broadband communication and leaps made in healthcare technology in recent years have provided the technological capacity necessary for the achievement of u-healthcare.

2. Related Works

Non-existing or impossible new changes in industry have taken place as several smart technologies have been applied in industry areas. For instance, the medical industry will prosper the flower called smart healthcare due to sensing technology and fruits called smart grid will be made by power network and sensing of devices. In recent years, interests in health have been increased according to changes in lifestyle and environment. Also, interest in U-Healthcare, which monitors one’s health and provides specialized healthcare services whenever and whatever it is needed, has increased. U-Healthcare services provide medical and healthcare services continuously and generally for healthy life of customers.

2.1. Smart Healthcare

Using smart healthcare, simple medical service can be possible without visiting the hospital in the future. Through bio sensors attached to our bodies, our heart rate and ECG is monitored by real-time throughout our everyday life. Through this monitoring process, strange symptoms in our body will immediately be detected to send necessary messages. This will prevent losing opportunity of therapy time [5][6]. Also, real-time monitored data will be analyzed based on medical information for simple diseases to be cured without going to the hospital.
2.2. U-Healthcare

U-Healthcare is an IT based technique which enables the management of diseases, health, and life anywhere and anytime and also makes a healthy and safe life possible. The ultimate goal of u-Healthcare is “the pursuit of improvement of the quality of life.” And to realize it, future u-Healthcare based on the generalization of IT/infrastructure such as the improvement of ICT and establishment of network, etc. will rapidly change due to the occurrence of new diseases, aging of the population, increase of consumers desires of health, data development of mass processing and storage technology based on broad band network technology, sensor network development such as RFID, business extension of medical solution providers, governmental health promotion policies, etc. Health care in the ubiquitous society is predicted to evolve based on intelligent health care providing medical and health care based on information acquired by sensors. U-Healthcare with the use of smart mobile health monitoring applications will emerge industry as a new medical service paradigm which uses internet, mobile, among other information communication technology (ICT) in the existing medical system providing medical health information, knowledge, services and products to the consumers.

2.3. Mobile Apps in Healthcare – FDA Issues “Final Guidance”

Back in September the FDA issued what it is referring to as “Final Guidance” concerning how medical device regulations will be applied to mobile medical applications. The push has been on to firm up how these will be regulated within the context of existing rules, primarily due to the focus on pro-active healthcare via technology. With the Affordable Care Act still struggling the healthcare industry is wasting no time in looking forward to how they can begin to drive better patient results now that they drive the system, a complete turnaround from when it was the insurance companies that set the standards.

Multiple organizations now exist for the sole purpose of promoting more communications technology solutions for patient care. Many of these were started by the insurance providers, particularly those in the category of known as “provider of last resort”. Non-profit companies like the Blue Cross Blue Shield Network were among the early supporters of efforts like this.

This focus on using application development on devices that have historically not been used in patient care made it necessary for the FDA to give the firms a framework. The “guidance”, which is available, is described as containing “nonbinding recommendations”. It is very detailed in what parameters you will need to consider when developing patient targeted apps.

Despite the fact that it is described as “nonbinding” it will be taken by most in healthcare seriously nonetheless, particularly as “not following” the guidance could expose them to legal problems if a patient suggests they have been adversely affected by an applications use. The guidance covers both the device and the
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platforms that exist to support the app [7-9]. This smart mobile health monitoring application must need crucial and depth knowledge of the physician for the accurate result.

2.4. Regulation of medical software and mobile medical ‘apps’

Software is becoming increasingly important in medical devices; however, its rapid evolution, particularly in relation to mobile technology, presents new and complex challenges for the TGA and regulatory agencies internationally.

The following is intended to provide guidance on the regulatory arrangements pertaining to medical software and mobile medical apps by addressing some questions frequently put to the Therapeutic Goods Administration (TGA).

2.4.1. Are Medical Software Products considered to be Medical Devices?

A software product is considered a medical device if it fits the definition in section 41BD of the Therapeutic Goods Act 1989.

A medical device is:

A. Any instrument, apparatus, appliance, material or other article (whether used alone or in combination, and including the software necessary for its proper application) intended, by the person under whose name it is or is to be supplied, to be used for human beings for the purpose of one or more of the following:

1. diagnosis, prevention, monitoring, treatment or alleviation of disease;
2. diagnosis, monitoring, treatment, alleviation of or compensation for an injury or disability;
3. investigation, replacement or modification of the anatomy or of a physiological process;
4. control of conception;
5. and that does not achieve its principal intended action in or on the human body by pharmacological, immunological or metabolic means, but that may be assisted in its function by such means.

Software that satisfies this definition may include programs or operating instructions that control the functioning of an electronic device, such as:

- Smart phone apps that measure blood glucose levels and patient body temperature
- X-ray image-processing software
- Diagnostic software

Such software may be used with or in devices such as:

- Computers*
• Mobile phones*
• Tablets*
• Analysers used for pathology/detection of disease
• Patient monitors
• Pacemakers (which are medical devices themselves)
• Infusion pumps (which are medical devices themselves)

*NB a mobile phone, computer or tablet not intended by its manufacturer to be used for therapeutic purposes would not meet the definition of a medical device.

Not all forms of 'medical software' come within the definition of a medical device. A software product that is limited to managing and presenting information - such as a medical records management system or a dosage calculator - would not usually come within the definition unless it also incorporates a therapeutic or diagnostic function.

Many mobile apps are simply sources of information. The TGA does not have a role in regulating advice to health professionals or consumers other than when it relates to the advertising of therapeutic goods, or labelling and instructions for use.

However products that have a role in diagnosing or managing illness using software that analyses clinical data, such as the results of blood tests or ECGs, would, if they come within the definition above, be considered to be medical devices and would therefore be subject to TGA's regulatory oversight.

The TGA already regulates medical device software used for therapeutic purposes under the medical devices regulatory framework. Mobile apps would be considered within this framework [10].

3. A Conceptual Model of U-IT Healthcare System

Ministered by the explosion of smart phones and wireless technology, the u-health revolution has helped people become more personally accountable for their lifestyle choices. Mobile applications (apps), engage people in a way that enables them take better care of themselves and manage ailments. The electronic or digital data gathered in real time is useful to motivate, inspire, track progress and reward effort, which is crucial to success. These gadgets and new app technologies have become more slim and lightweight to accommodate the longest run or walk around the park.

One of the key benefits of mobile medical tools is fostering a sense of patient efficacy. For medical professionals, more data is useful when helping a patient make informed health care decisions. Using smart phone medical application that checks other symptoms provides physicians with a wealth of clinically useful
information. This is why medical monitoring application is one of the most important technological tools to promote ‘self-care’ and prevention of disease.

![U-IT Healthcare System](image)

Mobile device can perform actions such as communicating with other devices, storing information, and retrieving online documents. If we consider a typical mobile user for example, an agent might operate on their smartphone or PDA, monitor the user’s behavior in an autonomous fashion, react to any perceived changes in the user’s status, and proactively anticipate what the user’s future behavior will be.

3.1. Smart Mobile U-Healthcare Application Model

Mobile devices and their services play a significant and mounting part in a global world of computing. Software infrastructure that construct and establish application functionality, unified passage of reasoning among mobile devices and other environment, mobile devices software modeling, and scalability of the results should be transpire in order to create a quality of software infrastructure for mobile device. There is no standard model or rule to design and develop mobile u-healthcare applications. In order to support the medical specialists such as doctor, physician and therapist for developing personalized mobile u-healthcare applications, an application model for the mobile u-healthcare applications should be defined prior to the implementation of the workbench.

Remote u-healthcare smart mobile medical monitoring application development platform is implemented in the form of a workbench so that the medical specialists develop their own u-health services according to the guideline derived from the application model in the above. Where patient is the person whose medical condition is monitored by the health-monitoring system.
Mobile devices, such as smartphones, mobile internet devices and web-enabled media players, are becoming widespread. These devices possess limited resources, which motivates resource optimizations. Mobile devices are hawking the marketplace over their stationary counterparts. This involves Interaction- where mobile devices as control device either to play/suspend/ stop/resume time-based multimedia or to trigger operations, to navigate (hyperlink traversing).

This application model focuses on the collaboration environment which includes the interaction of management server, patient and physicians. This approach is specified to be a decentralized approach; data is analyzed and decisions are made in each level to provide mobile patients with the crucial feedback of his/her health condition, temporary advice, recommendations and response to any emergency situation that may happen anytime at any place.

3.2. Software Framework

It is designed and implemented as software framework to be able to provide a set of generic functionalities that can be selectively utilized by application developers, thus providing application specific software focusing on monitoring of different health problems. As part of the framework, it offers a software library providing application programming interfaces (APIs).
Data Service manages record between platform and devices get the records used for retrieving patient records from personal devices, which could be health information systems or medical application servers. Medical services provide diagnosis and medication for all the symptoms given by the user generated from the health information system and medical application platform. Health information system provides information pertaining to the symptoms or disease given by the user. Personal self-monitoring and remote physicians provided proper medical assistance to the user. Software and hardware on mobile devices and smart phones make tracking one’s own health a part of everyday life. At the same time, researchers can mine these data streams to preempt future health problems, incorporating flags into the software to make individuals aware of possible problems in real time – long before they manifest themselves. This platform is responsible for communicating with external health information systems, connecting to medical devices that provide patient data and terminologies to the smart mobile medical monitoring application. It provides several modular patient health monitoring applications with the graphical user interfaces to allow patients to view their ailments and proper medication.

4. Convergence System Components for U-healthcare Service

Using smart healthcare, simple medical service can be possible without visiting the hospital in the future. Through this monitoring process, strange symptoms in our body will immediately be detected to send necessary messages. This will prevent losing opportunity of therapy time. Also, real-time monitored data will be analyzed based on medical information for simple diseases to be cured without going to the hospital.

![Convergence System Components](image)

Medical data of patients will continuously be accumulated and managed. Based on this collected data, the condition of patients will comprehensively analyze with medical records from the past until today.
[Fig. 5] Development of the Patient-Specific Healthcare Platform

Professional medical institutes will be linked to receive remote diagnosis which will substantially improve medical service level to citizens far from medical institutes. Diagnosis and therapy is important, but 24 hour ‘home nursing’ using smart technology will become possible at home.

5. Conclusion

The development and spread of IT has brought about sweeping changes in life styles by innovating paradigms of the entire society. Advancements in ubiquitous technology ushers us into a new world. This technology is spreading into various fields such as administration, transportation, environment, education, culture, tourism, healthcare, and medicine. Therefore, the development of mobile U-healthcare system responding to such trends, this study aims to develop a IT-medical convergence technologies including u-health, which is the health management anytime and anywhere, life-care, which leads healthy life by management of daily life, point-of-care, which makes on-site diagnostic, genetic analysis, which predicts genetic diseases, IT based new diagnosis and treatment system and components of medical devices.

In the future, U-Healthcare will be further integrated into our daily lives such that we will not perceive its presence consciously, and it will allow us to monitor our health status naturally and continuously. However, even the most highly developed technology can be neglected by consumers if it is not user-friendly. Therefore, u-healthcare needs to fully reflect the required services to obtain maximal participation and behavioral change. U-Healthcare market will be reorganized as healthcare device and platform in the near future. Non-standard private healthcare device does not support compatibility among other devices.
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References


