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The Integrated Application Trends and Technology Development of Intelligent Healthcare Service

Yi-Chun Lin*
Department of Computer Science, Tajen University, Taiwan
Email: jellyplum@gmail.com / jennielin@tajen.edu.tw

Po-Sen Huang
Research Center of Happiness Studies and Technology, Tajen University, Taiwan
Email: phuang@tajen.edu.tw

Shih-Pang Tseng
Research Center of Happiness Studies and Technology, Tajen University, Taiwan
Email: tsp@tajen.edu.tw

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ABSTRACT. *The impact of aging society is comprehensive, and thus how to face the various challenges is an important issue for each country. Simultaneously, with the advent of an aging society, the demand for medical care will increase dramatically. The ICT (Information and Communication Technology) revolution ushered in the era of Industry 4.0, it uses of the automated robots, sensor IoT (Internet of Things), supply chain internet, sales and production big data analysis, and human-computer collaboration to enhance the productivity and quality of the entire manufacturing value chain. Additionally, with the mature of AI (Artificial Intelligence) technology, the intelligent manufacturing commoditization, and vertical integration of its related industry will become one of the emphasis areas. The development of technologies will facilitate innovation application of IHS (Intelligent Healthcare Service). However, the relatively few studies have to investigated on integrates application trends and technology development of the IHS. Therefore, this paper will give a survey of IHS integrates application trends and development techniques in recent years (2014-2018) for aiding the related scholars to insight the context of its application scenarios and perspective.*

Keywords: *Intelligent Healthcare Service, Internet of Things*, *Artificial Intelligence, Robots, Big Data*

1. Background

The aging of the population is a global problem, due to the decline in fertility and the growth of longevity life. Since the rapid development of ICT, which has gradually played an important

role in the field of healthcare. The application of intelligent technology to the healthcare of elderly people has become a social development trend today. It can be expected the development of the intelligent healthcare service will bring more welfare to the structure of the aging population. On the other hand, with the advent of Industrial 4.0 technology, the healthcare and medical industry is also dedicated to the related technology application and development(Firouzi et al., 2018; S. F. Khan & Ieee, 2017; Perez et al., 2018). In recent years, many medical-care and healthcare service institutions toward to adopt the industry 4.0 concept application, the applications of robot, IOT, big data, and artificial intelligence technology have been united in wedlock to construct the innovation healthcare service(Canhoto & Arp, 2017; Dziak, Jachimczyk, & Kulesza, 2017; Johnson & Brownlee, 2018; Sadegh, Saadat, Sepehri, & Assadi, 2018; Verma & Sood, 2018)). However, in actual situation, the acceptability and adaptability of healthcare personnel are also issues that have to be considered when developing intelligent health services, since most healthcare personnel past of used traditional paper as a record in healthcare services. Therefore, some of research was also dedicated to investigative the adapting information technology of healthcare services in recent years. (Blijleven et al., 2016; Colligan, Potts, Finn, & Sinkin, 2015; Liu, Chen, & Tzeng, 2017; Razmak & Belanger, 2018). In addition, the wearable devices applications bring a lot of data, and then how to use these huge amounts of information to develop new ventures or emerging services is also a concern issue(Firouzi et al., 2018; Krishnan & Ieee, 2016; Manogaran et al., 2018; Vuppalapati, Kedari, & Ieee, 2016). Moreover, the various of industry 4.0 technologies as robots, IoT(Internet of Things), supply chain internet, big data should be vertically integrated with its commoditized application related industries.(Bennett, Rokas, & Chen, 2017; Bhatia & Sood, 2017; Farahani et al., 2018; Ivanovic & Ninkovic, 2017). Therefore, to grasp of the application trend and development restrictions of intelligent healthcare in various technical areas is great importance for the relevant field scientists to inspect new opportunities. According to the previously mentioned principle, this study brings forward a survey of IHS integrates application trends and development technique. Moreover, to provide a view of the novel intelligent healthcare applications enabled by the

technologies of Industry 4.0, with a focus on their research challenges.

2. Literature review

2.1. Trends and Applications

The use of technology products to support the healthcare personnel in healthcare service is more and more be concerned since the trends of aging society. Therefore, many healthcare related organizations are moving toward the intelligent management and service by novel technologies (Car, Tan, Huang, Sloot, & Franklin, 2017; Castro, Lefebvre, & Lefebvre, 2013; Gomez-Sebastia et al., 2016; C. T. Yang et al., 2014). Also, the evolution of usage habit of IT platform from the previous terminal or mainframe to the client-server structure, and in recent years it has been more towards web or app-cloud(Burmaoglu, Saritas, Kidak, & Berber, 2017; Esposito, 2018; Ghanavati, Abawajy, Izadi, & Alelaiwi, 2017; Verma & Sood, 2018). Additionally，since the rise of Industry 4.0, its related technologies, such as the Internet of Things, big data, artificial intelligence, and robots, have gradually been widely used in medical and healthcare service(Aceto, Persico, & Pescape, 2018; Ajami & Teimouri, 2015; Barbabella et al., 2018; Li et al., 2018). Currently，the intelligent healthcare service scope of application includes personal health, sports management, diet management, emergency treatment, teleconsultation, tele-diagnosis, medical-care and support, remote home care and so on. In recent years, with the rise of IOT technology, how to apply sensors and combine intelligent devices to create innovation healthcare service models is currently focused issues in medical-care and healthcare services industry (Chen et al., 2017; Jin & Kim, 2018; Paez, Rodriguez, Sanz, Villalba, & Gil, 2018; Verma & Sood, 2018), especially in providing the applications solutions of IOT and making a service-oriented model (that meaning product as a service)(Cook, Duncan, Sprint, & Fritz, 2018; Rahmani et al., 2018; Zhao et al., 2016). Moreover, since the huge gap between those who need services and those who receive services, socially assistive robotics (SAR) is become a particularly prospective area (Rabbitt, Kazdin, & Scassellati, 2015).

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The international federation robotics (IFR) point that the current demand for smart robots in the medical industry will reach 8.15 million units between 2016 and 2019. In addition, according to the industrial economics and knowledge center (IEK) research forecast that the global market for smart robots is expected to grow to US$33.6 billion in 2021, and the service robot market will grow from US$3.6 billion in 2011 to US$17.8 billion in 2021.The smart robot industry is expected to grow about 10% annually. At present, under the government's promotion and resources, Taiwan's robotics industry is estimated to have about a 20% growth rate by 2020.

Therefore, from data acquisition, data analysis to technology integration applications (Figure1), how to build a service-oriented intelligent healthcare service network will become an important issue for development.

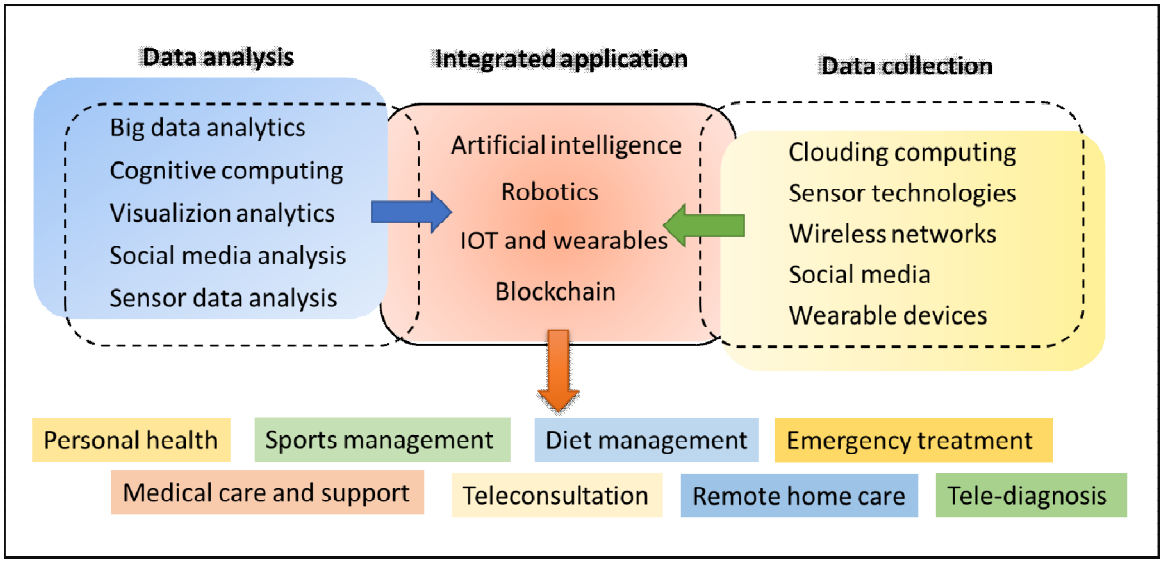

FIGURE 1. The integrated application architecture of intelligent healthcare service

2.2 Technologies for intelligent healthcare service

Industry 4.0 originally is known as a broad term that can be applied to several trends in manufacturing and automation. In the last few years, Internet of Things (Internet of Things) technology has also been widely used in various fields. It can be defined to use advanced data communication and analysis technologies to interconnect machines, equipment, computers and even people to realize the intelligence of industrial production and improve the automation level of manufacturing. It realizes global industrial manufacturing systems and advanced computing,

manufacturing, and ubiquitous (T. T. Yang, Xie, Li, & Zhu, 2017). The integration of the Internet connection is characterized by the adoption of a large number of sensors and the acquisition of various information in the physical world, thereby enhancing the perception of the physical world and realizing the intelligent decision-making and control in manufacturing. In other words, IOT is an intelligent collaboration of sensors and devices as the new technology paradigm that interfaces living and nonliving things through internet. In present, IOT is gained popularity in healthcare applications through networks interconnected with various types of devices as monitoring, diagnosis of diseases, emergency treatment, and so on, even remote surgeries(Car et al., 2017; Li et al., 2018; van den Heuvel et al., 2018; Verma & Sood, 2018). Therefore, many medical-care and healthcare services institution have applied its' related technologies into the construction of innovative and intelligent medical-care and healthcare services, and moreover to support the remote home care(G & G, 2017; M. A. Khan & Salah, 2018; R. A. Khan & Pathan, 2018; van den Heuvel et al., 2018; T. T. Yang et al., 2017) . According to a report from Market Research.com, the market for IoT in the medical field will be ready to reach US$117 billion in 2020 (G & G, 2017).

In addition, the sensor is also gradually used in the hospitals to construct a health care service network. The tiny-sized sensors could be performed physiological measurements for record various physiological parameters and transmitted to other devices. It can be used for diagnosing of disease and developing serious health-complication alert systems. Therefore, the latest advancements technologies of the communication architectures, wireless body area sensor network applications, programming frameworks, security issues, and energy-efficient routing protocols have been concerned and discussed in some studies(M. A. Khan & Salah, 2018; R. A. Khan & Pathan, 2018; Queiroz, Alencar, Gomes, Fonseca, & Benavente-Peces, 2017). The Yang et.al scholars point that the most advanced wearable tactile sensors involve basic concepts, functional materials, sensing mechanisms, promising applications, performance optimization strategies, multi-function sensing and system integration. In addition to the development of sensors, it packaging, and integration of the rest of the tactile device system to build a wearable

platform also has also become a major research frontier in recent years(T. T. Yang et al., 2017).

In the past few years, the United States health care system is use electronic health records to increase the quantity of clinical data and reduce their healthcare costs(Bemelmans, Gelderblom, Jonker, & de Witte, 2015). However, the data security is a key requirement in healthcare big data system(Kim & Lee, 2017). Therefore，some scholars presented a new structure, Meta Fog-Redirection (MF-R) and Grouping and Choosing (GC) architecture for a large number of data produced by medical devices with a transmitter to store and handle large data used in healthcare applications, and that use the secret management service and data classification functions to provide security services(Manogaran et al., 2018). However, in spite of the m-healthcare applications based on IOT have provided multidimensional aspects and real-time services in the past few years, there are still some issues to be resolved in their security mechanisms(Verma & Sood, 2018). About the IOT security solution, a research proposed an end-to-end security scheme for mobility enabled healthcare IOT, which consists of (i) a secure and efficient end-user authentication and authorization architecture based on the certificate based DTLS handshake, (ii) secure end-to-end communication based on session resumption, and (iii) robust mobility based on interconnected smart gateways(Moosavi et al., 2016). In recent years, blockchain technology is an emerging application technology in healthcare service that enables data sharing in a decentralized and transactional fashion. It can be leveraged in the healthcare domain to achieve the delicate balance between privacy and accessibility of electronic health records. The Yue et.al proposed an App architecture based on block chain to enable patient to own, control and share their own data easily and securely without violating privacy(Yue, Wang, Jin, Li, & Jiang, 2016).The Griggs et.al scholars proposed a private block chain based on the Ethereum protocol to resolve many security vulnerabilities associated with remote patient monitoring(Griggs et al., 2018).

Moreover，the number of patients with chronic diseases is rapidly increasing, which provides the medical industry with more challenging issues. Until now several ontology and IoT-based healthcare systems cannot be utilized to extract precise physiological information about patient.

Therefore, some scholars proposed a 2 fuzzy-support recommended system for medical care based on IoT, which is effectively control the body of a patient when it is recommended for certain foods and drugs (Ali et al., 2018). In addition, since the increased demand for elderly care, the development of socially assistive robot technology will be the new roles in the research field of health and social care(Abdi, Al-Hindawi, Ng, & Vizcaychipi, 2018; Banks, Willoughby, & Banks, 2008; Bemelmans et al., 2015). The Kim et.al scholars point that The emergence of smartphones and tablets has transformed the way m-Health interventions support chronic disease management for older adults. However，How to generate evidence for a program based on intelligent devices, using patient-generated data for high-level data mining techniques, patient decision support systems, and the development of innovative techniques to expand the medical practices is a focal point of the future study (Kim & Lee, 2017).

3. Conclusion

Nowadays, the integration of the medical informatics technologies has become a global trend, and it is also an effective solution to improving the performance management of the research. The global population structure is still aging, and the demand for healthcare is increasing in the future. Usually, high-aged patients have multiple/complex diseases that make the medical-care and healthcare with more challenges. Therefore, the intelligent technologies applying on the medical-care and healthcare service model will become a new trend for the medical-care and healthcare development. In addition, with the development of various sensing devices technologies, big data in the health care market will drive the future of medical research, treatment options, the telemedicine and other medical applications. However, in this future medical-care and healthcare environment, personal information confidentiality and security issues, and how to achieve the goal of effective information sharing and exchange, still need to be strengthened. In view of the rising of intelligent healthcare, the traditional hardware manufacturing thinking will gradually turn to the innovative operational service model of integrating hardware and software integration with smart analysis. Therefore, the development

of a patient-centered hospital information service system, the construction of a regionalized health information platform, the enhancement of the reusability of electronic medical and health records, the development of telemedicine systems and remote home care services will become the blueprint for the integration of medical and healthcare services. In the future, ICT technologies such as the IOT, big data, artificial intelligent, block chain and mobile platforms will be combined for intelligent medical-care and healthcare application to creating new business opportunities.

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