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Development and Evaluation of Omni channel service based on Internet of Things for Hospitals

Research-in-Progress

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Abstract

Omni-channel services based on the Internet of Things (IoT) technologies have emerged in various business environments. To enhance hospital's service quality and maximize benefits as well as provide seamless customer experience, this study applies IoT technology based on NFC, iBeacon(inclusing wearable devices) as an omni-channel service for integration of online and offline channel in hospital. First, we develop services based on IoT technology for omni channel of the hospital. Then, we will evaluate omni channel services from a CRM and BPI point of view through interview.

To develop the IoT technology based on NFC, iBeacon, we conducted action research. The five phases in action research framework research include diagnosing, action planning, action taking, evaluation, and specifying learning phases. In this study, we focus on action planning, action taking, evaluation. At the action planning phases, eleven service models based on IoT technology for omni channel for hospital were designed. Service models were applied to the hospital by installing tags and beacons at the third phase. At the fourth phases, service models issues and knowledge on the whole application process were derived and summarized with respect to CRM (Customer Relationship Management) and BPI (Business Process Innovation) of hospital.

Keywords: Omni channel, action research, Internet of Things, NFC, beacon, CRM, BPI, business model

1. Introduction

The proliferation of smart devices such as smartphones and tablets, simultaneously with recent developments in cloud computing, wireless communications, data storage, middleware and software, is reshaping and revolutionizing business environment. In particular, companies are struggling with the cost and technical aspects of implementing omni channel. Current literature on omni channel is targeting retailers of various industries, but research on the hospital's omni channel has yet to be conducted. The hospital provides offline channels and online channels, while offline channels are mainly the space where patients are provided healthcare services and online channels mainly play a role of giving information on treatment process. The study on omni channel suggests that there is a need to share customer experiences online and obtain and store more information about the product and service. The positive results of omni channel are increased customer value, improved customer experience and convenience, increased customer loyalty and efficiency by channel synergy, customer flexibility, increased database knowledge of customers, economies of scale, differentiated services, reduced channel conflicts, price consistency, improved communication within the company, enhanced

relationships with customers and companies, and increased quality of service[7]. Nevertheless, the hospital does not have an omni channel system because of its technical difficulties and lack of cost. Also, The hospital also has no awareness of the positive effects.

Information systems play an important role in implementing omni channels. Retailers have tried to use various technologies to implement omni channel. Recently, NFC and iBeacon are used among IoT technologies because they are relatively inexpensive and can be easily attached and detached. Especially, the beacon module provides uuid, major, minor, and the received signal strength indication (RSSI) which is the power level of the signal when it reaches the receiver, so that it is possible to estimates proximity. The IoT technologies can facilitate the forming of the omni channels between offline business providers and customers, thereby creating a new consumer behavior pattern. Specially, NFC technology has been applied increasingly more in tours and expositions (Expos), as can be seen in the Museum of London in the UK, Centre Pompidou's Teen Galley in Paris, France1, and STRP Festival in Europe 2. It has also been actively applied in Korea in museums and Expos as a form of smart tourism since 2011 (Checkland, 1991)

The aim of this study is to construct an omni channel service using an emerging technology, IoT (Internet of Thing), for a hospital and to present the insights and knowledge acquired through it. In this paper, we seek to answer the following research questions: (1) What are omni channel service of hospital? (2) How does the omni channel service affect the hospital? To accomplish the objective of the study, we took five phases of action research framework. In diagnosing phase, through interviews, observations, and literature studies, the researchers identify current issues and requirements for hospital. In action planning phase, through the discussion with the staff of the hospital, we have selected and arranged services for solving the problems by priority. In action taking phase, whenever a new technology was developed, NFC and iBeacon were installed in the hospital. In evaluation phase, we analyzed what technology is most suitable in terms of cost, manageability, usability, and efficiency. Finally, in specifying learning phase, the researchers conducted an interview with the director of the hospital to elicit the benefits gained from Omni channel service.

2. Methods

Action research differs from case study in that the action researcher is directly involved in planned organizational change. The action researcher intervenes by creating organizational change and simultaneously studies the impact of this change (Babüroglu and Ravn, 1992). Baskerville et al (2016) suggested that action research was ideal as systems development methodology for information systems research (Babüroglu and Ravn, 1992). Conducting organizational action research enables an organization to solve its problems and become "better" in terms of some of the primary issues such as productivity, the quality of their products and/or services, and working conditions. Furthermore, action research involves collecting, analyzing, and drawing conceptual and theoretical conclusions from organizational research data (Baskerville and Wood-Harper, 2016; Somer and Somer, 1986; Sommer, 1994)

We focused action planning, action taking and evaluation phase of a five phases to development "IoT based Omni channel service for hoapital. Figure1 shows our research process. At the action planning phase, we specified hoapital's actions that should relieve or improve these primary problems. At the action taking phase, we collaborated in active intervention with stakeholders. At the evaluation phase, the collaborative researchers and practitioners determinated whether the theoretical effects of the action were realized, through analysis of practitioner's interview.

3. Results

3.1 Diagnosing and action planning phase

By questioning and conversing with the practitioner, we investigatede practitioner's difficulties and found out the problems. For example, the medical staffes had inefficient business process to give to

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1 C. Swedberg, Centre Pompidou hopes NFC will draw teens to art, RFID Journal (2009) Retrieved from http://www.rfidjournal.com/articles/view?7262

2 RFID switchboard (2015). NFC App for Cultural Participation at STRP Festival. Retrieved August 30, 2015, from

http://www.rfidsb.com/lifestyle-efficiency%E2%80%8F/nfc-app-for-cultural-participation-at-strp-festival/

information on healing tour service , information provision and education, survey on medical services, diagnosis of psychological anxiety. Additionally, they were interupted by patients who had difficulty to detect location. Also, the hospital hoped to improve the medical service for patients.

3.2 Diagnosing and action planning phase

Our research team planned for eleven service models as appropriate actions to improve patients experience and quality of hospital healthcare services. By applying IoT technology to the hospital's offline space, patients have easy access to online channels (offline to online). By developing a mobile channel ('Benple C' application), patients can access information about offline space regardless of time and place through mobile (online to offline). This has led patients to visit hospital again. Staff of the patients can easily upload and modify digital content related to health through the manager page of web. Patients and medical team can experience seamless channel switching and hoapital easily can manage integrated on and off channels through web.

Service model	Scenario
1. Healing tour	• A service in which everyone as well as inpatients individually can move to healing spots designated by the hospital to experience therapeutic culture/art contents on seven healing program • Beacons and tags are attached in the healing spots designated by the hospital, patients consume culture/art contents by reading signal of the beacon and tag with their portable terminals (e.g., a smartphone) and record their participation in each healing spot online • Users can share the information on healing program through a social network service
2. Cancer information/education	• It provide contents such as "health information" to waiting patients through the application of portable terminals (e.g., a smartphone) owned by them, and they share the information through a social network service SNS
3. Survey	• Staff is able to conduct a satisfaction survey of cancer patients regarding treatment programs through the application of portable terminals (e.g., a smartphone) owned by cancer patinets or tablet PC provided by hospital • Staff can share the result with the others
4. NCC psychological assessment	• Patients can do psychological assessment by themselves as often as they want through their smartphone. • Patients and medical staff track psychological assessment records
5. Indoor navigation	• The patient's smartphone will display his current location and show how to get to the treatment location or examination room from the current location
6. Exercise amount check	• Inpatients check their exercise amount using their portable terminal that receives signals from beacons installed in the hospital's exercise course • Medical staff enable to check whether patients exercise and track information on patient's daily exercise
7. Delivering real-time medical information of inpatients on emergency	• Inpatients with chronic diseases are asked to wear a beacon in a necklace form • Information on the patient's current condition, medication, and precautions is provided when a doctor or nurse their smartphone • Safe and effective first aid is possible in case of emergency
8. Monitoring high-risk inpatients	• Patients wear a beacon in a necklace form, and in case a patient needs help from the medical staff, he can press the button on the beacon, which sends a signal to a beacon scanner installed in a certain location in the hospital, which then delivers his name and location to the medical staff.

Table 1. Proposed service models for omni channel

3.3 Action taking phase

The omni channel service based on IoT is composed of NFC tags andbeacons, and installed in a hospital, "user applications" used by users through their portable terminal, a "service management system"of Benple for easy management of hardware (tags/beacons) and efficient service provision,

and a "service provision server and engine" for the provision of various services (Figure 1). User interface of services for medical team and patients are showed as Figure 2,3,4.
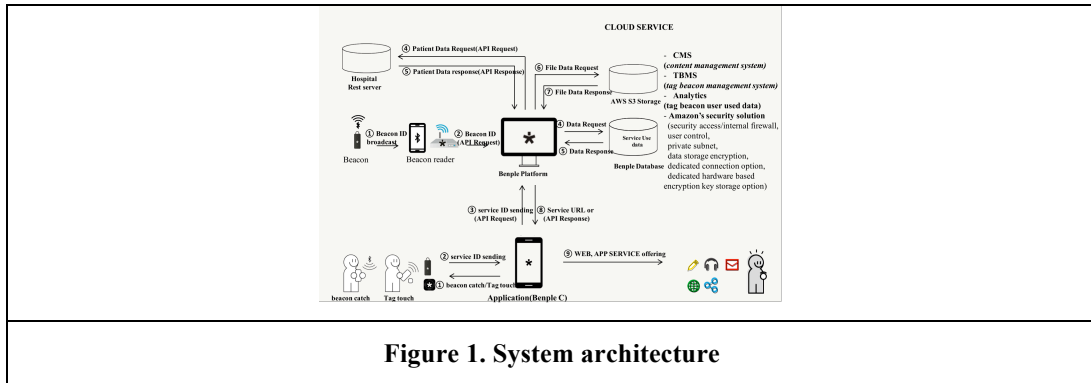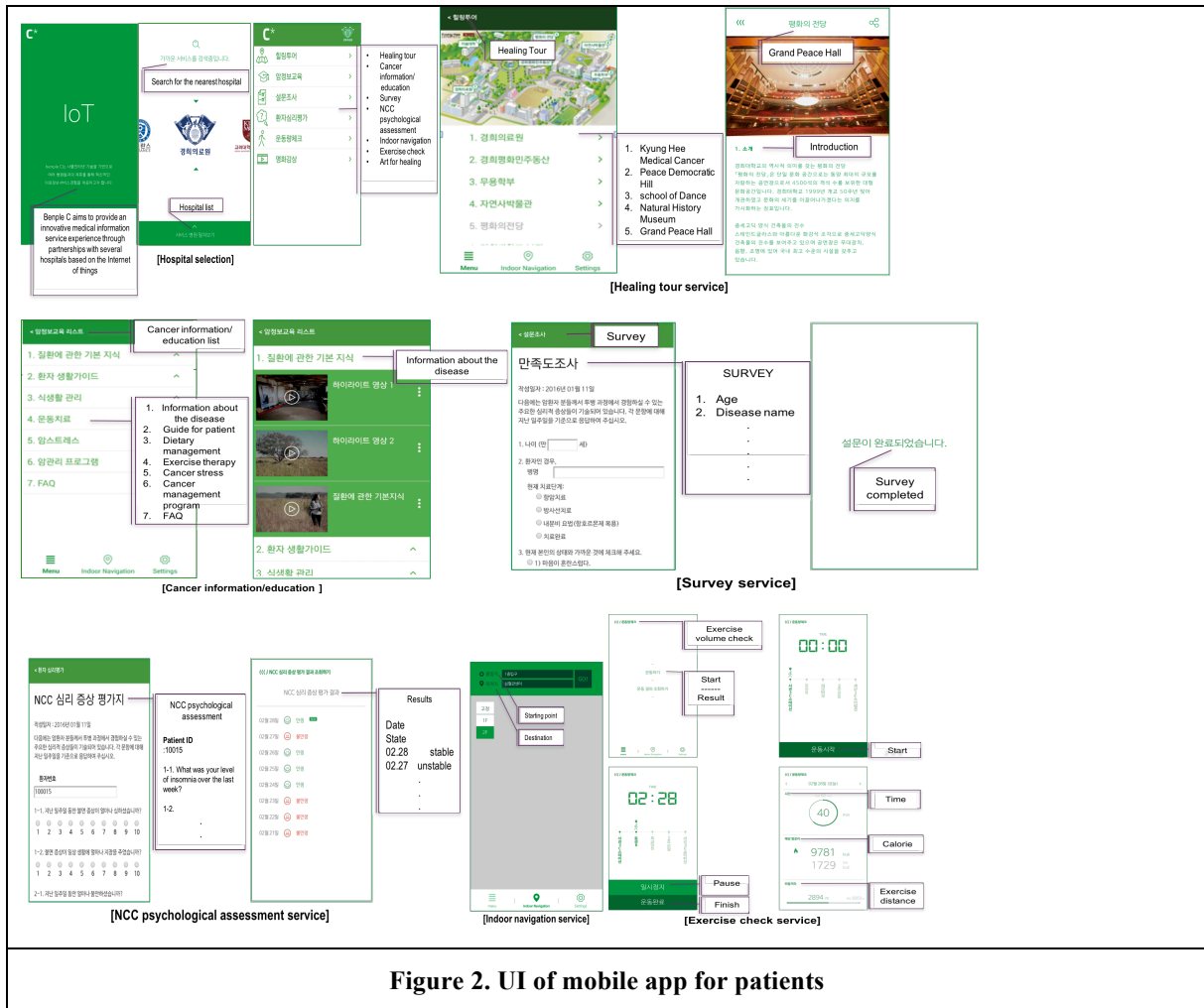

Figure 1. System architecture
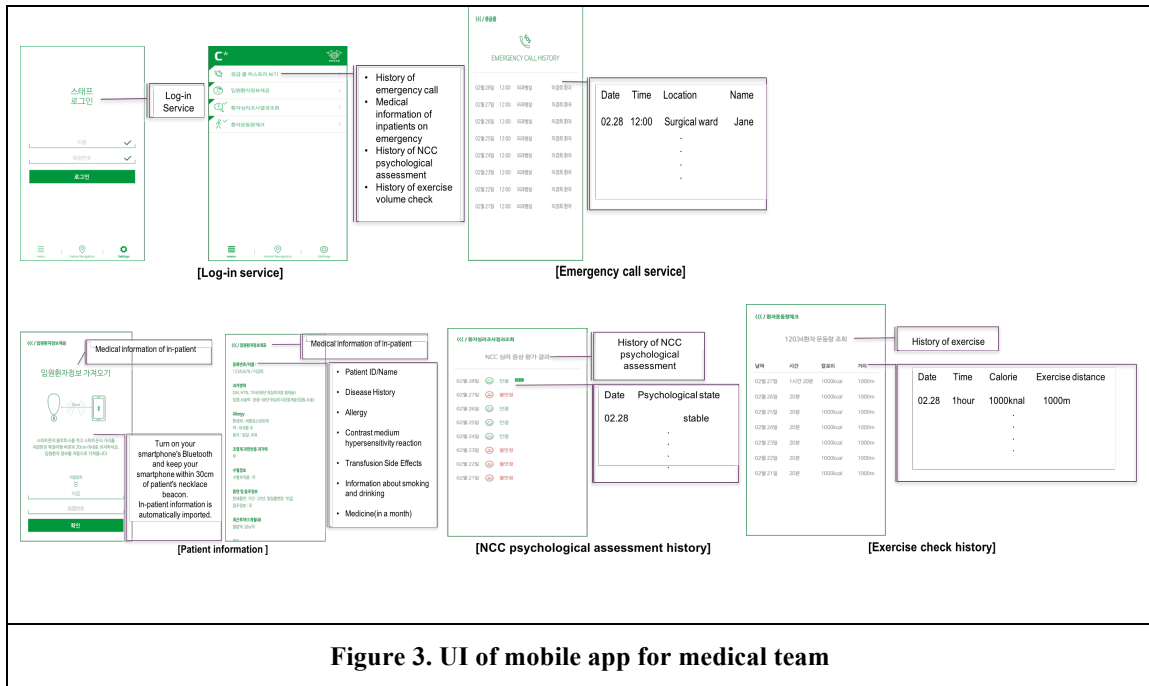

Figure 2. UI of mobile app for patients

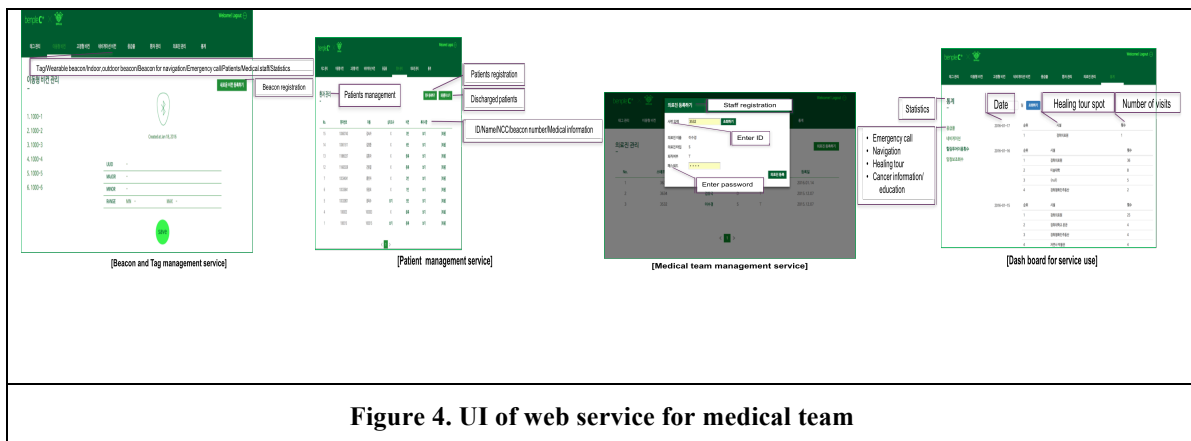**Figure 3. UI of mobile app for medical team**

Figure 4. UI of web service for medical team

3.4 Evaluation phase

In this section, to analyze the advantages and disadvantages of omni channel service from various perspectives, we conducted a two - hour interview with the medical team manager who runs the project during the research period(2016.09~2016.12).

Question	Answer
How are patients using omni channel services based on NFC and iBeacon responding?	Android users using NFC perceived that it's convenient because they did not need to install the app. If they want to gain information about lots of healthcare information, they got the information without additional effort after installing the app, so they preferred ibeacon catch to NFC touch needing to touching NFC whenever they want to gain information. Beacon signals are unstable sometimes, however, most of high-risk patients want to call the medical team immediately when they are in emergency. So, they had little disinclination to wear a iBeacon based wearable device that could identify their location. Patients were interested in our service. When they got enough information about their health status index as expected and were happy with this service, they wanted to save and share their

	health record.
Do you think medical team can manage patients more efficiently than before?	Sure. Before that, there was no information system to manage high-risk patients. The medical team easily acquire information about emergency patients through their own smartphone and web, and can provide timely medical services to patients.
What is the medical team and staff reaction to omni channel service?	IoT based omni channel service automate business processes. Then, administrative staff easily upload and edit content and reduce business hours. Patients share the satisfied medical service through SNS. As information about medical services of the hospital is shared with SNS, the hospital get the marketing effect. In addition, patients use the services provided by hospitals periodically after they are discharged. By obtaining information from hospital with their mobile phone, patients can form a relationship with the hospital and grow loyalty to the hospital.

4. Conclusion

The finding of this study is consistent with previous findings that the hospital can strengthen sales, brand awareness, work efficiency and competitiveness through omni chanel that result from integration between online and offline. Interestingly, however, while previous work indicated that firms may suffer from tremendous initial costs of omni channel development, this study has identified that IoT-based omni channel service could help hospital to carry out omni channel strategy at a reasonable cost. From a marketing point of view, it is a wom (word of mouth) effect through the voluntary sharing behavior of the heads, and artists and retailers can easily and quickly share already created digital contents through social media, helping patients participate in marketing activities. As a result, the IoT-based omni channel service has a positive impact on the hospital's marketing capabilities.

Acknowledgements

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