

Service Design based on IoT and Technology Comparison for Fine Art Gallery

Arum Park and Kyoung Jun Lee

School of Management, Kyung Hee University, 26 Kyunghedae-ro, Dongdaemun-gu, Seoul 02447, Republic of Korea

Keywords: IoT (Internet of Things), Business Model, Omni Channel, SNS.

Abstract: Services based on the Internet of Things (IoT) technologies have emerged in various business environments. To enhance retailer's service quality and maximize benefits as well as provide seamless customer experience, this study applied IoT technology based on NFC, iBeacon and internet button for fine art gallery. Then we evaluated the best technology for omni channel service. To apply the IoT technology based on NFC, iBeacon and internet button and evaluate what technology is the best for management and user's convenience, we conducted action research in a gallery from April 2014 to December 2016, and the development and evaluation results are aligned to action research framework. At the first two phases, various problems and needs of the gallery were diagnosed through interview with practitioners and observation. Five service models based on IoT technology for offline channel and ten service models based on mobile application for online channel were designed for solving the problems. Service models were applied to the gallery by installing tags, beacons, and buttons at the third phase. At the fourth, NFC, iBeacon and internet button in the service models based on IoT were evaluated in technological perspectives.

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 gallery's omni channel has yet to be conducted. The gallery provides offline channels and online channels, while offline channels are mainly the space where customers evaluate and purchase works and online channels play a role of marketing. The study on the visitors' behavior in exhibition suggests that there is a need to share customer experiences online and obtain and store more information about the arts. Nevertheless, the gallery does not have an omni channel system because of its technical difficulties and lack of funds. The aim of this study is to construct an omni channel service using an emerging technology, IoT (Internet of Thing), for a gallery and to present the insights and knowledge acquired through it.

In this paper, we seek to answer the following research questions: (1) What are the needs of gallery to build an omni channel? (2) What are the feasibility of applying IoT technology and the issues per technology?

2 LITERATURE REVIEW

With advances in technology, there are an increasing number of channels through which companies can communicate with customers, sell goods, and provide services (Dimitrova and Rosenbloom, 2010; Lewis et al, 2014). In recent years, customers are demanding all the benefits offered by the company's online channels, such as great variety products, rich product information and customer reviews. Customers also demand a shopping experience, which is an advantage of offline channels such as personal service, the possibility of touching the product (Rigby, 2012). These benefits are increasingly required simultaneously (Rigby, 2012). Beyond the multi-channel strategy of managing each channel (Pophal, 2015), firms are increasingly managing their channels in an integrated way as an omni channel

strategy to reflect the needs of customers who want to use multiple channels simultaneously (Rigby, 2012). Scholars commonly agree that 'Omni channel is the way for customers to move all channels of the enterprise freely and seamlessly'. In other words, the omni channel strategy is an optimized way to maximize the customer experience, creating synergies by combining the channel's advantages. The purpose of this study is to apply IoT - based omni channel to the gallery in order to maximize the customer experience by creating synergy effect between channels by integrating online and offline channels of retailer. Previous research suggests that retailers are benefiting from the synergy between channels by building an omni channel. The benefits are as follows. It will improve the customer experience, create a unique brand image, increase sales, enhance the ability of e-commerce, and gain a competitive edge (Piotrowicz and Cuthbertson, 2014). Another benefits of the previous study 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 (Zettelmeyer, 2000). 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 estimate 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 Gallery in Paris, France, and STRP Festival in Europe. It has also been actively applied in Korea in museums and Expos as a form of smart tourism since 2011 (Han et al, 2016). In other case, IoT-based services to the hospital have been established to improve the quality of medical services and improve work efficiency (Park et al, 2017). Piotrowicz et al (2014) identified issues

related to omni channel and IT as follows (Piotrowicz and Cuthbertson, 2014). There are 'channel integration, mobile solution, role of social media, changing role of the physical store, diverse customer requirements, personalization vs privacy, supply chain redesign'. In this paper, we use IoT technology to integrate channels, define the role of social media and mobile solution, and find out which technology is the most suitable.

3 METHODOLOGY

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 (Baburoglu and Ravn, 1992.). Baskerville et al (2016) suggested that action research was ideal as systems development methodology for information systems research (Baskerville and Wood-Harper, 2016). 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. We adopted a four phase. At the diagnosing phase, we identified the primary problems that are the underlying causes of the gallery's desire for change. At the action planning phase, we specified gallery'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 determined whether the theoretical effects of the action were realized.

4 SERVICE DESIGN BASED ON IOT FOR FINE ART GALLERY

Fine art gallery operates online channels for marketing purposes and off-line channels for sales, but does not yet have an omni-channel to provide seamless and unified customer experience. This study conducted a longitudinal study from 2015.04 to 2016.12 in order to build and test an omni channel system based on various kinds of IoT technologies, to analyze the effect of each technology.

4.1 Diagnosing Phase

Through the interviews and observations, we identified problems that the current gallery is struggling with and understood the needs of customers (Table 1). The needs and problems of gallery and customers are as following. There is a need for customers to acquire more rich and convenient information and knowledge about the intention of the artist and contents of the work, and the inconvenience to the appointed docent service time. Customers also felt the inconvenience of using audio guides in a fixed flow and order. Customers also take notes on the name of the artist, the year, and the name of the work, or take a label of the art or work to post on the blog. Also, if possible, they would like to share photos and videos related to their works with social media such as Facebook, Twitter, etc. (Kim and Kim, 2014).

Table 1: Analysis of current service channel in a fine Art gallery.

Function of service Channel	Problems and Needs
Facebook Page/ Naver blog/ Instagram (Online channel)	<ul style="list-style-type: none"> • Need to share real-time customer experience in offline space • Difficult to gather opinions and preferences of customers • Ineffective PR and marketing of gallery • Lacks of richness and interactivity by text-oriented information • Sale increase by attracting online customers to in-store stores
Brochure (offline channel)	<ul style="list-style-type: none"> • Convenience of collecting and storing information
Docent service (offline channel)	<ul style="list-style-type: none"> • Voice service required due to lack of personnel
Guest book (offline channel)	<ul style="list-style-type: none"> • Risk of disclosure of personal information • Digitalization business process (automation)

4.2 Action Planning Phase

Our research team planned appropriate actions for ameliorating the problem and fifteen service models, were proposed to improve customer

experience and quality of fine art gallery services. By applying IoT technology to the gallery's offline space, customers have easy access to online channels (offline to online).

By developing a mobile channel ('Benple G' application), customers can access information about offline space regardless of time and place through mobile (online to offline). This has led customers to visit their offline stores. Staff of the gallery can easily upload and modify digital content related to the art through the manager page of web. Customers can experience seamless channel switching and galleries easily can manage integrated on and off channels through web (Table 2).

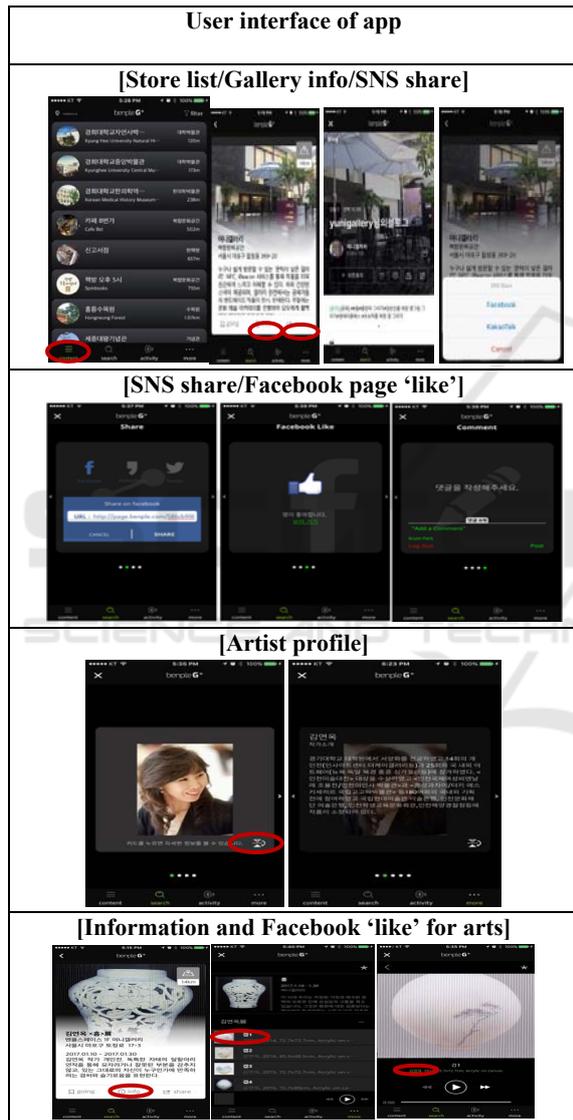
Table 2: Proposed service based on IoT ('benple G' app service).

Overview and Purpose of Service
<p>[Check in service]</p> <ul style="list-style-type: none"> • When tag is touched or beacon signal is received by employee's smartphone, whether or not to leave work and time is saved • Digitized information increases the efficiency of attendance management
<p>[e-guest book service]</p> <ul style="list-style-type: none"> • When you touch a tag or receive a beacon signal with customer's smartphone, go directly to the gallery's Facebook Like page • Efficient collection of customer information for customer management, reduced risk of privacy breach
<p>['like' of Facebook Page service]</p> <ul style="list-style-type: none"> • When you touch a tag or receive a beacon signal with customer's smartphone, go directly to the gallery's Facebook Like page • Save information about preferred galleries and provide convenience of sharing experiences and uploading opinions about galleries → promotion gallery, getting feedback from customers
<p>[Facebook 'like' service for arts]</p> <ul style="list-style-type: none"> • Save information about preferred arts and provide convenience of sharing experiences and uploading opinions about arts and artists → promotion artist, understanding customers' preferences
<p>[Information service on arts]</p> <ul style="list-style-type: none"> • When you touch a tag or receive a beacon signal with customer's smartphone, easily obtaining as information of text and audio type about arts • Providing convenience of acquiring information and knowledge about arts and artists

4.3 Action Taking Phase

The omni channel service based on IoT is composed of NFC tags, beacons, Internet button and installed in a gallery, “user applications” used by users through their portable terminal(table 3).

Table 3: UI of ‘benple G’ app.



After software was developed, this hardware from NFC to iBeacon and internet button were installed. Figure 1 presents partial installation of internet button hardware. The hardware for obtaining information related to the arts is near the arts, the hardware for getting information

related to the gallery is located near the information desk, the hardware for leaving the guest book is installed near the door, respectively.



Figure 1: Installation of hardware.

4.4 Evaluating Phase

One significant application of Internet of Things (IoT) is people in real world being able to interact with offline places and objects. Unlike prior internet services that allowed interaction with web browser and programs on PC or that with application and browsers on smartphones and tablet PCs, IoT showed the possibility of a new UI/UX by going beyond browsers and applications. Then through which UI/UX will IoT spread out explosively?

The first candidate is NFC (Near Field Communication). NFC is activated by touch (or tap) between devices. It is constructed to communicate when devices are put close within 1cm or 1 inch (conceptually, within 4 inches). Ok et al (2011) studied the merits and business value of NFC technology [27]. The primary advantage of NFC technology can be integrated into mobile phones and thus benefit from mobile phones' capabilities. Another feature of NFC is that NFC enabled mobile devices can both read/write data from/to NFC tags and also can be used as a digital storage for NFC readers. NFC provides three operating modes which are; Reader/Writer, Card Emulation, and Peer-to-Peer.

We started to provide the service by applying Reader /Writer mode of NFC in the early stage of research.

However, as to now, Jan 2017, interaction through NFC touch has not become generalized because Apple did not apply NFC's tag reading

in their iPhone. Beacon, which Apple brought into fashion, and iBeacon protocol has its technical foundation in BLE (Bluetooth for Low Energy). Existing studies applying beacon technology to proximity target marketing (Allurwar et al, 2016) and O2O marketing (Kwon et al, 2014) examined business value of iBeacon. Users catch beacon signal that is transmitted from a nearby beacon. However, this signal is not stable. That is, there are cases when beacon signal is not received when users are expecting for it. Also, beacon sends signals even when it is not needed because it continuously transmits signals for 24 hours. The fact that it sends signal when users are not aware and that it could be used without notice give users anxiety. Moreover, beacon consumes battery non-stop while it is continuously transmitting signals. This is not only a waste of energy in the perspective of environment, but it also leads to unnecessary cost such as purchase and change of batteries. iBeacons are therefore only installed for the purpose of tracking customers' location and movement trajectories (Allurwar, 2016).

A new UI/UX, Button Internet, that overcomes the downsides of NFC tagging system and BLE Beacon while bringing out the best of the two. It has been in its trial application stage in Yuni Gallery (located in the first floor of Benple Space) from Oct 2016. Visitors download Benple G application in their smartphone and press the button attached inside the gallery. Then the smartphone will give information about the work. With Button Internet, the visitors' smartphone will be able to interact with numerous buttons without any pairing.

In order to comparison the advantages and disadvantages of the technologies from various perspectives, we conducted a two - hour interview with the gallery director who runs the gallery during the research period.

Table 4: Comparison by technology.

	NFC	iBeacon	Internet button
Research period	2014.4~2014.12	2015.01~2015.08	2015.09~2016.12
Cost/per device	• NFC<Internet button=iBeacon		

Energy consumption	<ul style="list-style-type: none"> • NFC<Internet button<iBeacon • NFC: No need • Internet button: Energy consumption while pushing • iBeacon: Always energy consumption 		
Communication type	<ul style="list-style-type: none"> • One to one 	<ul style="list-style-type: none"> • One to many 	<ul style="list-style-type: none"> • One to many
User coverage	<ul style="list-style-type: none"> • Android phone user 	<ul style="list-style-type: none"> • Android phone user • iPhone user 	
Advantage	<ul style="list-style-type: none"> • Easy to implement: no need to application installation 	<ul style="list-style-type: none"> • Low possibility to service delay • Serving without any OS limitation • Possibility to design different services according to distance from beacon • Possibility to identifying customer's location and route 	
			<ul style="list-style-type: none"> • Increased energy efficiency because the signal is transmitted only when pushing the internet button • Intuitive UX called 'push'
Disadvantage	<ul style="list-style-type: none"> • only for Android users • communicating in one-to-one way → service delay 	<ul style="list-style-type: none"> • 24 hour beacon signal operation → Low energy efficiency, possibility to be recognized as spam • Invisible installation → low utilization rate • Unstable signals 	

5 CONCLUSIONS

In most galleries that are not sponsored by the company, all the work is actually conducted by a small number of employees due to the number of staff and the lack of budget. However, this service makes a significant contribution to cost and manpower savings by automating key roles of employees, such as providing information of arts and artist.

In terms of customer relationship management, customers can voluntarily establish relationships with retailers through social media such as Facebook page, allowing retailers to analyze customer data acquired from online and offline channel to manage customers.

In an effort to build an omni channel for the gallery, our researchers acted as practitioners as well as researchers. In following paragraph, we suggest practical implications. In order to find out what is the most appropriate and valid IoT technology in the context of this study, we have continually tried and tested new technologies such as iBeacon and internet button as well as NFC. Considering various aspects, the internet button was evaluated as the most suitable technology in the current situation (Ok et al, 2011).

ACKNOWLEDGEMENTS

This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government(NRF-2014S1A5B8060940).

REFERENCES

- Allurwar, N., Nawale, B., & Patel, S., 2016. Beacon for proximity target marketing. *Int. J. Eng. Comput. Sci*, 15, 16359-16364.
- Babüroglu, O. N., & Ravn, I., 1992. Normative action research. *Organization Studies*, 13(1), 019-34.
- Baskerville, R. L., & Wood-Harper, A. T., 2016. A critical perspective on action research as a method for information systems research. *In Enacting Research Methods in Information Systems: Volume 2* (pp. 169-190), Springer International Publishing.
- Dimitrova, B., & Rosenbloom, B., 2010. Standardization versus adaptation in global markets: is channel strategy

- different?. *Journal of Marketing Channels*, 17(2), 157-176.
- Han, H., Park, A., Chung, N., & Lee, K. J., 2016. A near field communication adoption and its impact on Expo visitors' behavior. *International Journal of Information Management*, 36(6), 1328-1339.
- Kim, C., Kim, B., 2014. A study on the status of exhibition guide program and the necessity of exhibition cooperation program-based on the analysis of the visitors' In depth interviews through the case of Daelim Museum, *Journal of Digital Design*, 14, 233-242.
- Kwon, Y. M., Park, J. S., Lee, H. J., & Kim, M. G., 2014. Beacon-Based O2O Marketing for Financial Institutions. *The International Journal of Industrial Distribution & Business*, 5(4), 23-29.
- Lewis, J., Whysall, P., & Foster, C., 2014. Drivers and technology-related obstacles in moving to multichannel retailing. *International Journal of Electronic Commerce*, 18(4), 43-68.
- Ok, K., Aydin, M. N., Coskun, V., & Ozdenizci, B., 2011. Exploring underlying values of NFC applications. *In 3rd International Conference on Information and Financial Engineering IPEDR* (Vol. 12).
- Park, A., Chang, H., & Lee, K. J., 2017. Action Research on Development and Application of Internet of Things Services in Hospital. *Healthcare Informatics Research*, 23(1), 25-34.
- Piotrowicz, W., & Cuthbertson, R., 2014. Introduction to the special issue information technology in retail: Toward omnichannel retailing. *International Journal of Electronic Commerce*, 18(4), 5-16.
- Pophal, L., 2015. Multichannel vs. Omnichannel Marketing: Is There a Difference, and What Does It Mean to You?. *Econtent*, 38(2), 15-+.
- Rigby, D., 2012. Die Zukunft des Einkaufens. *Harvard Business Manager*, 12. 22-35.
- Zettelmeyer, F., 2000. Expanding to the Internet: Pricing and communications strategies when firms compete on multiple channels. *Journal of Marketing Research*, 37(3), 292-308.