A Study of Application of Beacon Technology to Mobile Guide in Exhibition Hall

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Abstract

The popularization of mobile devices and the rapid development of network transmission speed from 2.5G, 3G, 4G LTE to even 5G now, in recent years, have truly changed people's life. To truly realize a digital life, it is possible to establish a mobile guidance system for exhibition hall to provide relevant information to users.

In this study, the primary subject for applying the Beacon technology in mobile guide was the exhibition hall with the theme of "Taiwan's sugar industry development", where five major categories were included: "Historical Changes in Sugar Industry", "New vs. Old Sugar Processing Techniques", "General Knowledge", "Sugar Production Equipment" and "Transportation of Sugar Canes", in the cross-media platform, which was established as a navigational model to provide more exhibition information on mobile devices. Then, the interactive effect and emotional experience from using this navigational model would be evaluated to provide as a reference for other exhibition guidance systems.

Key words: BLE (Bluetooth Low Energy); Beacon; Mobile guide; Emotional experience; Taiwan's sugar industry

Introduction

In recent years, there is a growing trend in the popularization of mobile devices and the rapid development of network transmission speed. When a visitor enters an exhibition hall, such as museum, art gallery, exhibition hall or cultural creativity park, a paper DM is generally given to give a glimpse of the exhibit and a route guide.

To truly realize a digital life, this study would establish a guidance system to provide relevant information to users, and the outcome could serve as a reference for follow-up studies on the navigational model.

Literature Review

Wireless communication and micro-positioning technology

There are many technologies for indoor micro-positioning, such as infrared (IR), ultrasound, RFID, Bluetooth, Wi-Fi, ZigBee, ultra-wideband (UWB) and Beacon. The core of micro-positioning technology includes six features: 1) Offline positioning engine; 2) Triangular positioning; 3) Electromagnetic fingerprint; 4) Inertial navigation; 5) Electronic compass (for defining user orientation); and 6) Indoor and outdoor map integration.

The positioning by the use of Beacon technology primarily relies on micro-sensing and micro-positioning, referring to the intensity of received signal strength indication (RSSI) via BLE of a mobile carrier to determine the distance between BLE and the user, in order to trigger consequential event to interact with the user. Simply put, micro-sensing is more suitable for entrance or specific location (with low precision). Micro-positioning is applicable to permanent or special exhibition, which requires to push special information (with high precision) [1, 2].

Beacon BLE

Currently, Google/Apple smart phone specifications with support of Beacon technology (BLE) are limited to either Android 4.3 with BT 4.0 or higher and iOS 7 or higher (iPad 3/ iPhone 4S, inclusive).

BLE (Bluetooth Low Energy) is an international standard for low-power wireless communication. Devices using Bluetooth 4.0 can be powered by button batteries and connected to other Bluetooth devices [3].

For Beacon technology (BLE), it is a small version of broadcast base, and multiple Beacon points

can form a messaging service network. When a device enters the area, its user can receive the push message from BLE Beacon[4]. The system architecture for BLE Beacon is illustrated in the following diagram (Fig. 1).
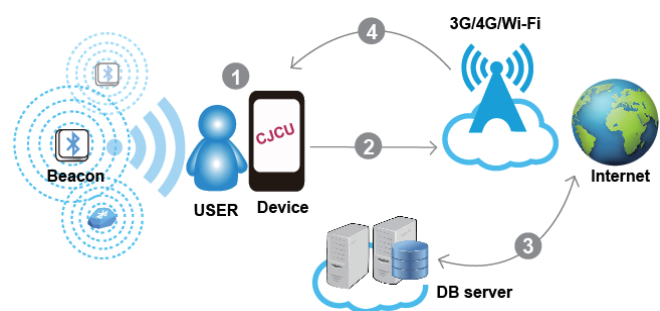

Fig. 1 The system architecture for BLE Beacon

Guide

Guiding is an interpretative process of the exhibits and is a way to assist visitors, that direct and deliver abundant information for visitors to produce an understanding of an object during the process of cognition, participation and admiration, achieving an educational purpose.

A good guide should have six functions: information, guiding, education, entertainment, propaganda and inspirational [5].

In contrast with other navigational models, mobile guide is

currently the best [6].

The navigational function via Location-Based Service (LBS) can be summarized with three levels of interaction: Location, Intimation and Selection[7].

The application of Location-Based Service (LBS) allows a variety of new business opportunities. For example, the Beacon technology is widely used in retails, such as Walmart, Tesco and Macy's, which have all applied Beacon in their stores to provide real-time and appropriate information to the current or potential audiences.

Emotional experience

Many experts and scholars' views on emotional experience are related to individual, consciousness, emotion, learning and user and experience [8]. Davitz (1969) believes the meaning of emotion lies in the personal experience of a matter [9]. Mehrabian and Russell (1974) proposed that it included: pleasure, arousal and dominance [10]. Havlena and Holbrook (1986) pointed that the most influential factor in experiential consumption was the emotion [11]. Russell & Snodgrass (1987) and Strongman (1993) also suggested it as the emotional state, subjectively perceived and felt by the person[12, 13]. You (1996) stated that emotional response involved physiological, behavioral and psychological components[14]. Zhong (2000) defined it as the emotion and feeling, which were experienced and expressed by a learner[15]. Yang (2007) believed it as a trigger to instinctual feeling, affection and need [16]. Norman (2002, 2013) [17, 18], Norman, D., & Nielsen, J. (2016) suggested issues such as emotional experience, user-centered concept and learning[19].

Development of Taiwan's Sugar Industry

It has been more than one hundred years in the history of development of Taiwan's sugar industry since 1900, including the Dutch colonial period, the Qing dynasty, the Japanese colonization and the post-war National government. This research would establish the digital content of the sugar industry according to the five major themes: "Historical Changes in Sugar Industry", "New vs. Old Sugar Processing Techniques", "General Knowledge", "Sugar Production Equipment" and "Transportation of Sugar Canes"[20].

Research design and architecture

This research would use the campus of C University as the testing field to establish multiple Beacon sites to provide diverse and customized navigational routes with different levels of navigational design and time-limited event information. Various micro-positioning technologies were used to set up a MMS map platform, where indoor and outdoor maps were integrated to extend the experience further from the exhibition to the outside field.

The overall architecture was based on Content Data System (CDS), Map Data System (MDS) and a user interface (Fig. 2).

The integrated web platform was presented in a web-app format, in which the interface would provide four modes: input of exhibition number, scan of QR code, click on exhibit thumbnail and map navigation. The user could switch to navigation mode by map marking or exhibit anchor point, that in addition to search by theme, it can also be selected by picture,

actively search the position of exhibit, or browse through the content of exhibits.

Content Data System (CDS)

The CDS integrated the contents of resource platform and provided relevant management function to exhibits, exhibitions and areas.

Map Data System (MDS)

It provided the engine for indoor micro-positioning service, with support of iOS and Android, where system maps could be edited.

User Interface

The APP interface would present an exhibition or an event (Fig. 3). Once simulated the start of APP by user, he or she could click on the exhibition or the event of interest to know relevant information before using micro-positioning service, such as positional navigation or exhibit guidance.
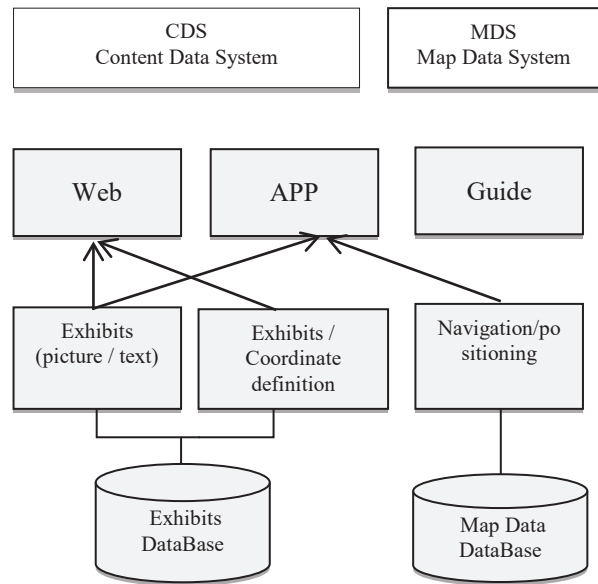

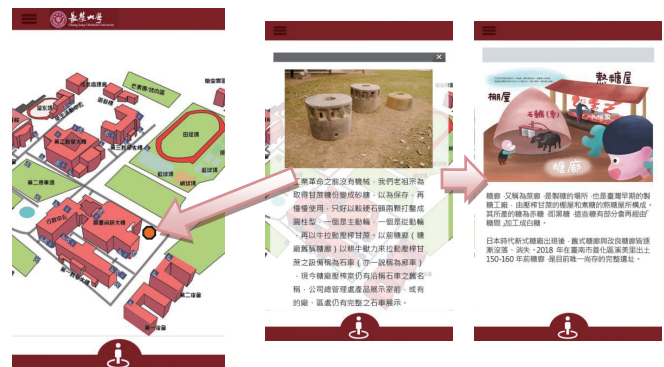Fig. 2 Content Data System (CDS) and Map Data System (MDS)

Fig. 3 User Interface & Navigation that would present an exhibition or an event

Conclusion and Suggestion

The continuous improvement of mobile guide technology, from outdoor GPS to indoor micro-positioning, is the reliance of technologies to enhance user experience. Furthermore, with the rise of Internet of Things (IoT) and the popularization of wearable devices, the extensive application of various micro-positioning technologies will only mature through time. The question to apply these technologies in link with user's daily life to improve their experiences is the key.

For the follow-up, this study suggested Beacon's augmented reality, electronic stamps and various gaming functions to enhance entertainment, the Big Data and mobile payment system, as well as reinforcing the integration of marketing with cultural products.

Acknowledgments

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