

# The Research of Ubiquitous Infrastructure of Museum Service Applications in National Palace Museum

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*Abstract* - Based on abundant artifact collections together with the employment of Radio Frequency Identification (RFID) and wireless networking technologies, NPM has been implementing Ubiquitous Project with aims to transform NPM from a traditional museum into a U-Museum and to assist domestic cultural and creative industries in reaching out the world. New technologies also facilitate other missions such as public service, ticketing, digital value-added applications and cultural creativity, while advanced digital technologies bring new excitement and visiting experience to the audience. This essay will highlight the project for digital value-added application in marketing and licensing department of NPM.

*Keywords* - RFID, NPM, Ubiquitous, U-museum, Wireless, Sensor

## 1 Introduction

Moving along with social evolvement, museums have adopted in their recent development sophisticated information technologies into various museum disciplines including collection management and registration, research, curation, exhibition and education. New technologies also facilitate other missions such as public service, ticketing, digital value-added applications and cultural creativity, while advanced digital technologies bring new excitement and visiting experience to the audience.

The goal of establishing an ideal ubiquity environment could not be reached in a single step yet the first light of which would not have been revealed without long-term support and impetus from the government. The "E-Taiwan Initiative" was introduced in 2000 with emphases on construction of information and communication infrastructure. Five years later, based on preliminary achievements of digitization, the "M-Taiwan Program" was initiated as a support to build a wireless broadband network system.

In 2008, "U-Taiwan Project" was launched, in which new technologies of Radio Frequency Identification (RFID) combined with digital database, digital home, internet, wireless network and information appliances were employed to address an "anytime, anywhere, secure and convenient" service network covering Tele-Care, security surveillance, digital entertainment, vehicle navigation, UHF container smart seal, medical waste

tracking and airport baggage claim, with an aim for bringing digital information to a new level through technology integration.

Since the last decade, National Palace Museum (NPM) has achieved the great success in digital heritage development, which include the Digital Archives, Digital Museum and E-learning. Hundreds of thousands of museum objects have been saved in digital forms, which have brought significant benefits to the museum and the society. In the aspect of museum operations, the digital images can enhance curatorial practices, conservation research, learning resources dissemination, cultural marketing, and so on. In the viewpoint of the society, the public has more opportunities to learn the museum collections via a variety of approaches and empowered themselves whatever at work or in life.

NPM has participated in National Digital Archives Program and Museum Digitization Program starting the year of 2000 and accomplished various missions including extensive database building for key collections; launch of websites in ten languages to provide wide knowledge of various subjects; installation of wireless network system; publication of e-journal with a circulation of 190,000; providing e-learning and on-line exhibitions; and application of various electronic media into museum display. During the period of 2008 and 2009, to coordinate with government policy of "U-Taiwan Plan," National Palace Museum mapped out the "U-Museum Project, a NPM New Century Showcase of Using Ubiquitous

Technologies in a Museum Context" so as to attain the goal of "endowing collections with new countenance and creating new values of NPM."

Based on abundant artifact collections together with the employment of Radio Frequency Identification (RFID) and wireless networking technologies, NPM has been implementing Ubiquity Project with aims to transform NPM from a traditional museum into a U-Museum and to assist domestic cultural and creative industries in reaching out the world. During the two-year period, many examples of U-tech applications such as Wireless Communication, Location-Based Services, WLAN Roaming, U-Temperature & Relative Humidity Monitoring System, introduction of RFID management trial system, U-educational theme multimedia and wireless audio-guide system have been created.

This essay was compiled to give a thorough description of various accomplishments NPM has achieved in Ubiquity Project. It is assumed that the digital museum could bring more positive impacts to the society, especially in capacities of learning and economic benefits. Therefore, based on the previous achievement, NPM decided to step further to build the U-Museum service [1], which aims to utilize the Ubiquitous technology across the museum. In the very beginning, we identified our objectives based upon the core mission of the museum.

## 2 The Function of Department of Marketing and Licensing in NPM

Main responsibilities of Department of Marketing and Licensing in NPM comprise licensing of copyrighted images and video/audio content, issuing publications and collaboratively developing museum derivative products. Over the years, several warehouses in the charge of the Department have accumulated huge sums of photographic films, publications and derivative products; including 80,000+ photographic sheets; 800,000+ volumes of publications that still growing by 70,000+ annually; and yearly distribution of one million plus pieces of derivative products. Such huge quantities will justify the adoption of warehouse management solution, in which a supply chain/logistics management system is to be implemented to optimize the flow of publications and products from suppliers to customers, covering various activities of design, printing/manufacturing, distribution and sales.

As RFID applications becoming more and more mature with information technologies and innovation models keep taking on new forms, NPM

embarked on the endeavor of "NPM Innovative Value-added Application Services and Implementation of RFID Prototype System" during the period of 2008 and 2009 as part of "U-Taiwan Plan" launched by the government, with an aim to improve service efficiency, lower service costs and achieve the goals of NPM U-Museum Project through the new management model of convenience and intelligence with the employment of advanced technologies.

## 3 The Vision of Project

Originating from Latin, the word "Ubiquitous" means "god being in all places." In the modern digital era of today, being Ubiquitous refers to an ideal condition in which information and services can be accessed through various IT products and Internet.

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As RFID applications becoming more and more mature with information technologies and innovation models keep taking on new forms, NPM embarked on the endeavor of "NPM Innovative Value-added Application Services and Implementation of RFID Prototype System" during the period of 2008 and 2009 as part of "Taiwan Ubiquity Plan" launched by the government, with an aim to improve service efficiency, lower service costs and achieve the goals of NPM U-Museum Project through the new management model of

convenience and intelligence with the employment of advanced technologies.

#### 4 Radio Frequency Identification System (RFID)

RFID stands for radio frequency identification. It is an auto-identification technology, which used radio waves to transmit information. Besides, RFID is a non-contact, automated design that uses radio frequency (RF) technology to read, process and store data through transmission of RF signals with radio waves for the purpose of identification and tracking, which will eliminate constraints from conventional manual barcode scanning that reads two-width data representations one at a time. Benefits offered by the RFID system also include multiple readings, long-distance read range and fast and accurate inventory.

RFID systems generally comprise of three main components, namely: tags, readers, and a data processing system [2]. A tag has a unique identification number (ID) and memory that stores additional data such as manufacturer name, product type, and environmental factors including temperature, humidity, and so on. The reader can read and write data to tags through wireless transmission. In a typical RFID application, tags are attached or embedded in objects that must be identified or tracked [3]. For using in the art piece, RFID will not interfere or transform the artist's result, because they are totally invisible [4]. Like other auto-identification technologies, its underlying purpose is to allow computers to acquire identifying information about physical objects in the real world.

#### 5 The Infrastructure of U-museum Project

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Technologies in a Museum Context." As listed hereunder, a total of four sub-plans were implemented during the two- year period.

The basic goal of this Project is to provide museum information services in an "effective and timely" manner. With completion of wireless network infrastructure that can collect information from a physical environment [5], and active push service through cell phones over WLAN will be the next initiative. The employment of RFID technologies makes it possible to extend services from the gate of NPM to a nearby MRT station so that NPM will be able to send welcoming messages and exhibition information to visitors upon their arrival at the station.

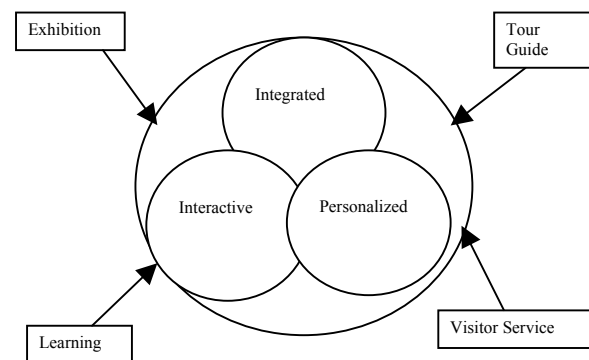


Figure 1. Vision of U-Museum Project

To secure information security, a "multi-tier" and "centralized" approach was adopted for wireless security management with mobility controllers installed for network authentication and backup to regulate wireless equipment and access in the museum (as shown in Fig. 2). The construction of Wireless Network Infrastructure not only opened the gate to NPM U-Museum Project but also laid a sound foundation on which quality information services could be formulated.

The concept of "Intelligent Museums" has been prevailing in the international community, which refers to the employment of interactive digital technologies into all museum services. The ultimate goal of NPM U-Museum Project was to transform National Palace Museum into a museum with Ubiquitous services. The Infrastructure of service environment is shown in Fig.2. This is a total solution using RFID to integrate museum's service. It comprises three parts for functional implementation, which is the hardware layer such as tag, reader, interface; Software layer such as

middleware and integration user interface; and integration existing Applications into the system [6].

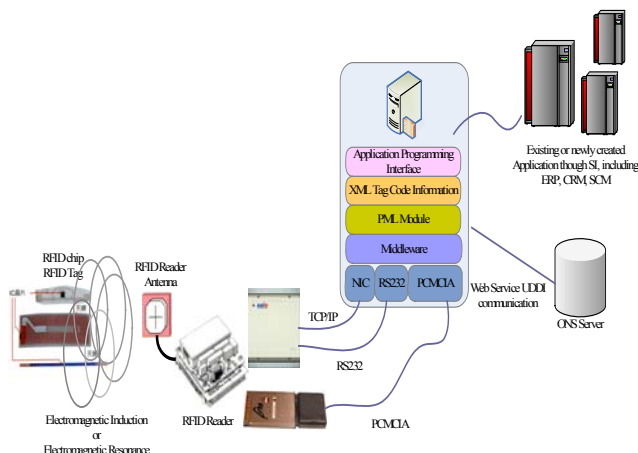


Fig.2 The Infrastructure of U-Museum Service

### 5.1 NPM Wireless Network Service with Ubiquity Technologies

With mobile devices becoming more and more popular, the constraint of accessing network services in front of desktop computers was already lifted. As part of our daily lives, personalized services, once demanded, can be provided at anytime to anywhere. The network cable that hinders mobility has been ripped off by powerful waves of technologies while high availability and popularity of wireless Internet network allow users to access information in a ubiquitous manner.

For visitors and museum staff alike, the deployment of wireless network infrastructure in NPM is sure to be an efficient instrument for information acquisition when entering a new era of technologies. Main concerns to information users in the future will be what devices to be used rather than where the computer is; will be how to manage the explosion of information rather than where to get access to the network.

The main objective of wireless network Infrastructure is to configure a wireless network infrastructure as foundations for providing quality network services and carrying out future development [8] so as to achieve various strategic goals of launching a ubiquitous NPM website of museum digitization, delivering real-time information of museum services, installation of RFID systems and managing antiquity exhibition and storage; aiming for a Ubiquitous Network Society set forth in National Information and Communication Initiative.

The use of wireless network with ubiquitous access, though convenient, may be vulnerable to

security threats. If without proper protection, hackers might take advantage of the convenience for illegal access. Thus, with the implementation of wireless network security mechanism as the key concern in this project, a "multi-tier" and "centralized" network authentication approach was introduced for wireless security management. Integrated with backstage authentication servers, wireless LAN controllers were used to process network traffic and control wireless access points inside the building, assuring all users of a secure and convenient wireless network environment [7].

Wireless network authentication system effectively conducts access control by verifying client users' identities and monitoring connection behaviors at all access points while on-line real-time tracking, administering and accounting of network resource consumption are also performed. When accessing the wireless network, users do not need to change any settings on browsers and no installation of additional software required. That is to say, wireless network was established to provide roaming service across home and visited networks without any change of hardware and usual practice for both service users and administrators, while network security framework and management mode are also maintained.

### 5.2 Features of wireless network

Wireless LAN controllers support Multiple Service Set Identifiers (SSID) such as LAN1, LAN2, etc., partitioning a single physical access point into several virtual access points with each assigned for a specific visitor group, which adopts an on-line authorization mechanism and browsers will be directed to NPM home page. For NPM staff, 802.1X and message authentication code (MAC) are configured to verify data integrity and authenticity, which support Multiple Service Set Identifiers when needed.

Remote Authentication Dial In User Service (RADIUS) is used to regulate network traffic by assigning different access time for different user accounts. [9]

Supporting seamless roaming, the wireless network ensures wireless devices' keeping connected to the network without losing the connection when users crossing different Virtual Local Area Networks (VLAN), or migrating from one mobility domain to the other, while audio data flows as well as a shared information and authorization platform among all application controllers are also supported.

With a wireless access framework incorporating Cisco WLAN controllers and 1131AG access points that support Light Weight Access Point Protocol (LWAPP), the wireless network employs a Wireless Control System (WCS) for centralized security management in which Cisco Access Control Server (ACS) functions as a platform for the administration of verification and authentication.

### **5.3 Network security and management capability**

Since wireless access points are installed either on walls or hidden above the ceiling and not necessarily with easy access to power outlets, Power over Ethernet (PoE) technologies are employed to power wireless access points through 10Base-T or 100Base-T, and there is no need for dedicated electrical wiring. PoE switches are also equipped to enhance system flexibility.

Embedded with IEEE 802.11 standard, wireless access points have built-in antennas, which allow administrators to adjust antennas according to specific needs. Antennas come with built-in also saves the installation, as compared with external antennas.

Supporting Lightweight Access Point Protocol, access points do not establish connections with console and wireless LAN controller to avoid adulteration of settings controls all parameters. Without the controller, access point is just an antenna and does not function alone, which discourages the attempt at equipment pilferage.

Operated in 2.4 GHz band, the wireless network uses non-overlapping channels (e.g. 1, 6 and 11) to avoid co-channel interference, while the WLAN Controller in data center will dynamically switch from one frequency to another to achieve better reception.

### **5.4 Security threats in the wireless network**

In addition to application-related issues such as coverage and bandwidth, NPM is concerned for various security threats to the wireless network including rogue access points, unauthorized users, radio signal bleeding, interference among adjacent access points, and whether or not becoming a gangway to cracker attacks.

To achieve the goal of a secure wireless network takes more than detection of intrusion while blocking and preventing are also important. With Cisco Wireless LAN controllers and lightweight access points, equipment used in this project is

capable of not only detecting but also preventing from malicious attempts in a reactive manner. Virtual local area network is separated from the wired network and a software agent in the wireless control system examines network traffic and notify real-time anomaly to the administrator.

To have both benefits of centralized management of user accounts and readiness for users to log in to the wireless network, a built-in account management system is employed to facilitate users' logging in, to enhance network security through multiple encryption processes and to provide seamless roaming features enabling the users connected to one access point to migrate from one AP to the other without losing the connection. The integration of authentication with authorization allows the wireless network to specify different access rights for different users according to a predefined access policy. For example, general users registered with the museum will be granted access to network connection and museum resources, while specific staff users will have an extra access right to system administration with the security protection by 802.11x standard.

Featuring detection and blocking of rogue access points, Cisco Wireless LAN controller is the first defense line against security threats while the separation of Virtual Local Area Network from wired network further ensures the wireless network from wireless cracking.

### **5.5 Achievements and benefits**

A comprehensive wireless network was built in this project covering Main Building, Administration Building, Building for Books and Documents, the Second Office Building, Building of Preservation Department and three storehouses with installation of 121 access points, centralized controllers and a network security system of authentication and encryption. A swift and secure wireless network environment is now ready to provide information to the public through the employment of ubiquity technologies.

Our mission at NPM is to create a secure and sound network-based environment for future development. With the launch of NPM digitization website and providing real-time service information via the employment of advanced ubiquity technologies, it is anticipated that the beauty of ancient Chinese cultural artifacts will be coming alive for public appreciation.

Through the wireless network various functions can be delivered to hand-held devices, including

making phone calls to the museum telephony system; obtaining information of activities, events and exhibits; viewing museum maps and announcements; and receiving notification of opening of showcases. All these functions are already available to museum staff at the exhibition halls to facilitate their work in providing information to visitors and enhance their service quality.

In addition, a temperature and humidity monitoring system based on ubiquity technologies to maintain a stable and optimal environment for antiquity preservation has already been under construction thanks to the effort of NPM staff at Department of Preservation. Temperature/humidity sensors, data loggers, system servers together with the wireless network comprise a remote wireless monitoring system enabling relevant staff to conduct precise monitoring and controlling of preservation environment in a real-time manner.

## 6 Applications of Digital Value-Added Application in Marketing and Licensing Department

Main responsibilities of Department Marketing and Licensing in NPM comprise licensing of copyrighted images and video/audio content, issuing publications and collaboratively developing museum derivative products. Over the years, several warehouses in the charge of the Department have accumulated huge sums of photographic films, publications and derivative products; including over 80,000 photographic sheets; over 800,000 volumes of publications that still growing by at least 70,000 annually; and yearly distribution of one million plus pieces of derivative products. Such huge quantities will justify the adoption of warehouse management solution, in which a supply chain/logistics management system is to be implemented to optimize the flow of publications and products from suppliers to customers, covering various activities of design, printing/manufacturing, distribution and sales.

The huge collections of NPM together with ever-increasing new creations coming up in various forms have made registration of diverse museum collections a difficult task. The deployment of RFID systems for films, multimedia discs and publication stack rooms will facilitate collection management and effectively help to protect intellectual property rights of cultural creativity source material.

The Department of Marketing and Licensing undertakes this project. The objective of this project is to set up an effectively manage digital assets of image archives, publications and products for the aim of cultural marketing and licensing. In the previous project, NPM has digitized enormous amount of museum collections into digital form, and reproduce them into a variety of formats, such as multimedia DVDs, films, web sites, publications, and products. It is estimated the there are approximately 4,000 kinds of commissioned products or replicas produced every year and sold in NPM gift shop.

Therefore, in order to effectively manage these products, NPM decided to use RFID technology in management system. The integrated management system consists of three sub-systems, including Image Archive Management System, Publication Management System, and Products Management System.

The Image Archive Management System aims to manage the Positive Film Archive and the Digital Images Archive. Prior to the application of digital cameras, the museum had stored a great amount of positive films taken by traditional cameras. In order to integrate two types of image archives, the RFID tags were attached to the outer of positive films. Then each film could be found by RFID readers, which can automatically transmit data to management system. In this way, the administrators can easily find out the required image and process the image loan service or image licensing. The RFID tags were used in publications management system as well as the products management system. That was learned from the successful experience of the giant retailer Wal-Mart in the world, the RFID had been effectively applied in the warehouse management system.

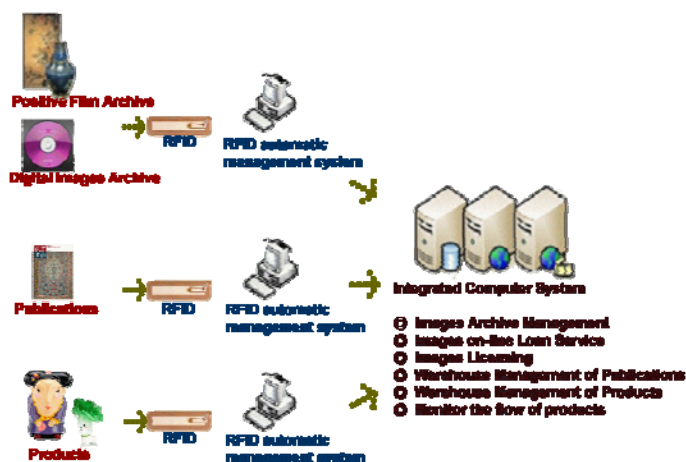


Fig.3 U-Intellectual Properties Management System

## 7 Methodology

### 7.1 Implementation of RFID prototype system: site survey and requirement interviews

Based on modern technologies, RFID employs radio frequencies for data transmission and exchange. In real practice, stability of background electromagnetic waves (i.e. low interference) is critical. Site surveys were conducted to determine the presence of RF interference and identify optimal frequencies to be used. RF interference was measured by Spectrum Analyzer within the range of 10KHz to 6.2GHz; i.e. LF (125-135KHz), HF (13.56MHz), UHF (433MHz, 866MHz, 915MHz) and Microwave (2.45GHz, 5.8GHz). Results showed that the least interfered frequencies were 13.56MHz, 433MHz and 915MHz. [10]

In addition, photographic sheets, publications and museum derivative products are under the administration of different Sections in Department of Cultural Creativity and Marketing; namely Licensing Section, Publishing Section and Museum Fund Section. The loan and return of photographic sheets, for example, is under the charge of dedicated staffers in Licensing Section. Prior approval is required no matter the application is domestic or from abroad; for commercial purposes or for academic research; or even for illustrated catalogues of NPM theme exhibitions.

Publication handling involves more personnel, sections and organizations, including warehouse keepers, publication designers, printing management staff, distribution management staff, printing press and scores of bookstores. The scope of management for museum derivative products is also extensive, covering procurement, vending, ordering, incoming, warehousing, outgoing and distributing with hundreds of vendors and several distributors involved. To ensure the design of a smooth workflow, the work content of all personnel throughout entire processes at every step needs to be well defined. The complexity and diversity of job descriptions; however, have made the workflow design a complicated task, and there is yet a precedent for reference. Hence, besides the site survey, comprehensive interviews with all participants in the workflow were conducted individually to examine and understand their work content and responsibilities so that an optimal workflow can be proposed, rectified and finalized through integration and analyses.

### 7.2 Verification test prior to implementation

#### 7.2.1 Verification method

Since various manufacturers with different specifications generally offer different components of a RFID system, ambient working conditions and compatibility among different components would be main concerns for achieving optimal overall performance. In order to establish a miniature prototype RFID workstation that adapts diverse application environments of photographic film depository, book vaults and derivative product warehouses and gift shops, Proof of Concept (PoC) testing has been conducted targeting various event-based operations, packaging types and tag placement with different combinations of hardware to choose from a number of manufacturers a reader that provides the best performance in terms of picking up signals from a reputable master tag with reasonable cost as the reference.

#### 7.2.2 Purpose of verification

Three types of tag readers, handheld, desktop integrated with work station and fixed type installed in RFID gate were tested targeting UHF band of frequencies while HF band for PJM (Phase Jitter Modulation) and 2.45 GHz for  $\mu$ -chips were also covered. Purposes of the test were to identify tags with higher successful read rates and to understand the influence on read rates caused by various factors such as passing speeds, packaging types, tag placement and material of objects. [11]

### 7.3 Implementation of RFID prototype system into management of photographic sheets

Current total number of photographic films of NPM collections is between eighty and one hundred thousand in various film formats of 8×10 slide, 4×5 slide, 135mm slide and 4×5 negative. Preserved in acid-free paper bags and enclosed in Kraft envelopes, the huge amount of films are stored in steel desiccant cabinets by categories of calligraphy, paintings, utensils, documents and curios. To support a variety of activities of printing illustrated catalogues for NPM theme exhibitions, publishing NPM Monthly of Chinese Art, licensing copyrighted images and conducting academic studies, these films tend to get quite inundated with frequent ins and outs. Taking measures for effective preservation and control of the films and even of antiquities themselves has been an important issue for NPM.

Without proper tools and adequate technologies, management of the films has always been relying solely on manual data entry, filing and inventory, which is not only time and labor consuming but hard to avoid human error. The implementation of a RFID-based management system with customized work flows adapt to ins and outs of photographic films will dramatically lower labor cost and enhance service efficiency for NPM, while the project itself provides a vehicle for local industries to expand research and test potential and move forward to an advanced level. Shown hereunder are RFID-based workflows for management of photographic films, divided as New Registration, Loan, Inventory and Return.

#### **7.4 Implementation of RFID prototype system into management of publications (book vault)**

Including NPM Monthly of Chinese Art, NPM Quarterly Journal, illustrated catalogues of theme exhibitions, guidebooks to exhibits, series books, postcards and calendars, the number of NPM publications has reached over 900,000 and keeps increasing at an annual rate of 100,000.

With a long supply chain covering printing in the press (supplier), delivery, receipt/incoming, distributors' purchase order handling, order picking, outgoing/shipping, returns/exchanges and inventory making, the huge quantity of publications have always counted on manual operations, among which, storage locations are highly human memory dependant and allows of the least labor replace ability, not to mention the time cost.

Further, the abundantly illustrated, handsomely produced publications of multilingual catalogues and journal issues, though convey the genuine beauty of antiquities, may be vulnerable to unauthorized excerpting, reproduction or even pirating in areas where protection of intellectual property rights is ineffective. With the implementation of RFID-based warehouse management system, each copy of the publication will have a RFID tag attached to it, giving it a unique identity, which then brings in many beneficial applications such as pinpointing the exact location of storage, real-time data synchronization, and facilitated sales and inventory management. Shown hereunder are publication management workflows based on RFID systems, including Incoming, Outgoing, and Inventory and Information enquiry. [12]

#### **7.5 Implementation of RFID prototype system into management of museum derivative products**

Mainly as souvenirs for visitors with sales volume exceeding one million pieces per year, NPM derivative commodities are made of a great variety of material such as bronze, ceramic, plastic, silk, paper, silica gel; and for diverse purposes like gifts, replica collection, apparel and accessories, multimedia publications, stationery, figurines, consumer electronics, snacks and daily necessities. Manual handling of huge quantities of incoming from vendors (OEM suppliers, joint ventures and licensees) and outgoing to distributors each day is not only time-consuming but hard to avoid human error, and what is more, reference data for marketing and product design are difficult to come by.

The implementation of RFID system will benefit overall operations in many ways such as enhancement of inventory accuracy and efficiency in warehousing, while data stored in the tag provide a complete product pedigree that will help to ensure consumer protection and facilitate customer relationship management. Data collected may reveal consumer preferences and product popularity and improve product availability.

#### **8 Advantages of Digital Value-Added Application in Marketing and Licensing Department**

The trend of using RFID technology on museums is growing fast. It will not only save time of museum's manpower, but also process full information and extend the services of museums. There are several new ways to apply RFID in museums in this article, from entry management, self-guide introduction, collection management, inventory and asset tracking, and control of publications management. The advantages of RFID application completely fulfill from the attraction of RFID such as to help the self-guide introduction, to improve the study effect, to shorten the inventory tracking, and to access control. Therefore, museums should enhance the technology of RFID and computers to design each needs, to show newly different function and diversification for visitors.

As cultural creativity industries become more and more flourishing in recent years, museum derivative merchandise has exhibited great diversity and increasingly high sales volume. The implementation of RFID-based management system



will introduce innovative workflows that enhance efficiency. In addition, database built up by the new system can be further categorized, analyzed and utilized for mutual sharing. With the aid of modern multimedia technologies, the profound cultural value of each antique object may also inspire sparkling creativity to set brilliant examples of aesthetic economy that establish dynamic links among antiquities, merchandise and audience delivering novel museum experience of extended interest together with shopping pleasure to visitors. Listed hereunder are feasible museum developments in the future aiming for missions of comprehensive and diversified values:

- To record a complete product pedigree and ensure product safety, logistic efficiency and asset management.
- To improve supply chain management and achieve better operation efficiency by enhancing product availability and reducing order picking time.
- To provide visitors with shopping pleasure and long-lasting cultural educational value.
- To provide reference for diverse marketing events and enhance competitiveness and brand equity through differentiation.

## 9 Conclusion

Riding on the ever-changing waves of digitization in the 21st century and bringing into execution the NPM U-Museum Project, NPM has successfully created and developed innovative web-based information services in a museum context. After the NPM U-Museum Project came to an end in 2009, a new "NPM Intelligent Cultural Creativity Project" will commence starting 2010 with an aim at merging museum services with creativity, daily lives and technologies and marching toward the vision of "endowing collections with new countenance and creating new values of NPM."

U-Museum Project requires a lot of efforts, from initial user need investigation and merchandiser selection through designing and implementing the construction to ongoing maintenance and evaluation. So far, RFID is a successful technology to use in variety of areas. Museum can take advantage of this emerging RFID technology to help routine and daily jobs. [13] Therefore, museum could emphasize more efforts on its educational missions and less on time-consuming tracking issues.

This paper presents the best practice of NPM

adopting RFID technology for U-Museum Project infrastructure. It will continuously build up for several years. Research on the actual achievement of the promises of RFID and a more detailed understanding of effective implementation strategies also need to be undertaken.

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