How Augmented Reality Technology Consolidates the SMB Ecosystem of the Tourism Industry in Taiwan

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Abstract. Taiwanese tourism industry has been consisting largely of small and micro businesses (SMBs). Compared to medium and large corporations who achieve quality service by standardizing operations, these SMBs usually provide quality service by emphasizing local cultures, and relying heavily on storytelling and face-to-face interactions with their customers. However, these interactions are neither systematic nor efficient, resulting in random and scattered contact points; and the lack of marketing resource left these SMBs with weak distribution channels. In the meantime, the tourism landscape is experiencing a shift - a shift in travelers' preference from escorted tours toward independent tours with profound local experiences. Even if the shift lessens the profits of individual shops around top tourism destinations, it still sheds light on formations of mutually beneficial local offline business networks for small and micro businesses.

This shift also increases the importance of applying of Augmented Reality (AR) technology in tourism because of its high efficiency and interactiveness. In this research, we set up a project that adapts multiple location-based techniques to provide on-site information and interactions, and display travel information on user's camera screen by calculate camera position and angle and layering corresponding images. The project also introduces virtual currency into our AR service models, aiming to motivate more travel behaviors.

The purpose of this research is to discuss the effects of applying AR technology on forming an offline business network of SMBs, and consequently building a business model with the use of virtual currency in the offline business network. In other words, this research investigates how the AR applications motivate travelers in engaging in more extensive and deeper travel experiences, and consequently transform travel-related non-consumer behaviors into travel-related consumer behaviors. Besides motivating travelers, the circulation of the virtual currency further facilitates mutually beneficial operation of the offline business network.

This research also illustrates how the technology development of the service system and the operational process of augmented reality can be further applied to future researches. After two months of Proof of Services, the project in this research brought nearly 11,000 visits and circulation of 1.9 million of virtual currency, demonstrating that the integration of augmented reality technology and

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business model can effectively build an offline business network and a new form of tourism service value system.

Keywords: Augmented reality · Offline business network · Virtual currency · Human-computer interaction · Tourism

1 Background and Motivation

According to the World Travel and Tourism Council (WTTC), as of 2015, the size of the global tourism industry, was about US$7.17 trillion, nearly 9.8% of the global GDP, making the tourism industry the second largest industry in the world. WTTC also estimates output value will be about US$10.98 in 2026, nearly 20.8% GDP. In contrast, Taiwan's tourism industry made up only 2.48% of the GDP in 2015, with its nearly 10 million travelers. This comparison seems to indicate there is still significant potential growth for Taiwan.

Taiwanese tourism industry has been consisting of more than 95% small and micro businesses (SMBs), including dining, accommodation, transportation, entertaining, and shopping industry. Compared to medium and large corporations who achieve quality service by standardizing operations, these SMBs usually provide quality service by emphasizing local cultures, and relying heavily on storytelling and face-to-face interactions with their customers. However, these interactions are neither systematic nor efficient, resulting in random and scattered contact points, and creating gaps in the service chain. Gaps in the service chain have led to the lack of seamless consumer accessibility, leaving travelers poorly guided, and not able to fully experience the beauty of Taiwan. SMBs usually find marketing costly, without seeing the benefits of increased consumption. Fragmented services do not help to create a clear image of tourism in Taiwan, and make it harder to compete with other countries.

In the meantime, the tourism landscape is experiencing a shift - a shift in travelers' preference from escorted tours toward independent tours with profound local experiences. The tourism industry is currently in need of technology-based integrated value-added services, which are highly dynamic and offer interactivity and entertainment (García-Crespo et al. 2009). Latest mobile technologies have revolutionized the way people experience their environment. This development has led to increased popularity of augmented reality (AR) applications to project augmented information on objects or users' immediate surroundings. Recent research explored the opportunities of using marker-based or GPS-based AR in order to enhance the overall tourism experience (Han et al. 2014; Yovcheva et al. 2012; Claudia tom Dieck and Jung 2015). As such, one could say that mobile AR applications allow users to explore the world by adding new layers to their reality, thus resulting in an interactive and highly dynamic experience (Kounavis et al. 2012; Yovcheva et al. 2014). The change in travelers' behavior results in a shift of tourism landscape - a shift that leaves SMEs who have yet to adapt online advertisements and mobile technologies behind. One of the biggest issue that Taiwanese tourism industry needs to resolve now is how the SMEs can quickly adapt to the travelers' behavior and create new business models to overcome current bottleneck with limited resource.

2 Research Purpose

Recent advances in mobile computing, computer graphics, wireless and sensor technologies allow for the fast development of AR applications on smartphones (Azuma et al. 2001; Yovcheva et al. 2012). AR technologies could project virtual messages in a 3D space, thus creating an interface that agrees to human cognitive experience through smartphones. These AR applications are considered more intuitive than conventional presentations of information, and are widely used to elevate user experience. They enhance B2C business relations, achieving the goal of creating value. However, the act of travelling is not restricted to a single B2C relation, but it is instead multiple BN2C (business network to customer) business relations (ref. Fig. 1). The challenge for the travel industry is to build a shared value ecosystem for business networks. This illustrates the needs of a more open ecosystem business concept through partnerships in the vertical supply chain or even horizontal cross-industries cooperation.

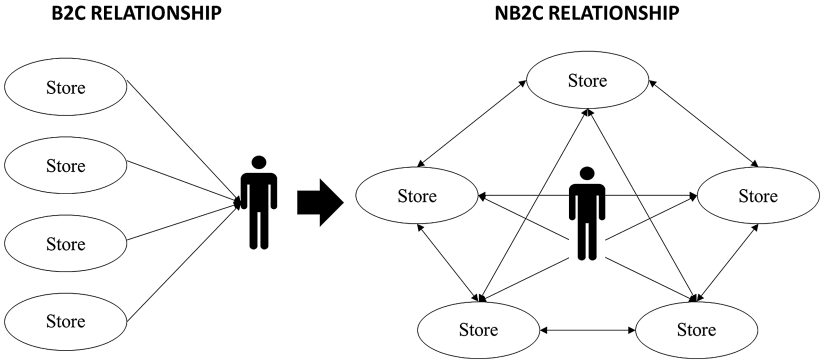


Fig. 1. B2C and BN2C conceptual model

Thus, this research will propose an API-Centric Architecture integrating AR-Based Virtual Currency Solution in tourism, especially applying AR technology on forming a more extensive and deeper travel experiences, and consequently building a business model with the use of AR and virtual currency mechanisms. The purpose of this research is to investigate how the AR applications motivate travelers to transform travel-related non-consumer behaviors into travel-related consumer behaviors and support cross-industry integration and operation, enabling new service models to integrate the tourism-based value chain effectively and create a shared, common platform with dining, transportation, shopping, and other entertaining business.

3 Literature Review

3.1 Online to Offline (O2O)

Travelling is an extensive offline activity. It cannot be replaced by online experiences, but it can be greatly assisted and reinforced by online information and services. With

the continued growth of population who regularly surf the Internet, the World Wide Web (WWW) has become the indispensable channel for people seeking to use tourism information (Buhalis and Law 2008). Online-to-Offline Commerce is a business strategy to link online information to offline stores and services. Our research is applying the concept of O2O onto mobile services. Smart phones are prevalent and universal tools for bridging online information to offline context, thus providing an environment for O2O interactions and business opportunities. The most primitive form of O2O business model consist of "search than purchase" (Wang and Lai 2014), meaning that the information flow is consistent through online channel to offline shops. The application of AR technology allows us to provide a more context-specific environment for O2O business.

3.2 Augmented Reality in Tourism

Augmented Reality (AR) technology refers to any enhancement or augmentation on our reality with computer-generated content. (Jung and Han 2014). Researchers and people with business acumen have been discussing possible applications of AR since the 90s because they believed that these applications would innovate human-technology interaction and thus bring in business opportunities. However, the environment for wider applications of AR is only more mature in the 2010s, where the wireless infrastructure and smart phones are a lot more prevalent. Smart phones in 2017 mostly provide internet access, GPS system and multimedia displayer, allowing more applicability and possibilities of AR mobile applications.

AR mobile application is a great fit for tourism industry because AR is relevant to the context of immediate location (Väänänen-Vainio-Mattila et al. 2015). Many have high expectations of the AR technology to revolutionize traveler's experience by making the planning journey much more seamless, interactive, and simple. Christina's (2016) article on Industry & Augment News illustrated a vision of how AR can become a smooth user interface in tourism technology. Using AR, services such as booking hotels, accessing information locally, navigating around destinations, translating written or spoken signs or conversations, and locating dining and entertainment options can all be done simply through an app on your mobile devices.

In the 2010s, many travel mobile applications have started to adapt AR technology. There is ample literature on analyzing functions and technologies of these mobile applications. The table below draws upon the studies from Kounavis et al. (2012), Yovcheva et al. (2012), Buhalis and Yovcheva (2016) and our own research. Exemplary applications that provide AR view on smartphones were summarized in Table 1.

Several scholars pointed out the directions of future development of AR applications in tourism. Han et al. (2014) stated that the application of AR technology is "becoming a necessity of many destinations to stay competitive and attractive to the modern tourist [sic.]". However, they argue that the early employment of AR on mobile applications mainly focused on pushing information onto users, lacking the interactive aspect. Their research proposed to draw more attention to the end-user's point of view and consider engaging them more in the development of AR in tourism. And in order to attract travelers and encourage regular use, their research provides the design guidelines to tend to multi-language functionality, ease of use and personalization.

Table 1. AR on mobile applications

Functionality	Application name	Description
Context-aware push	Field Trip, Travel Guide	Using ibeacons, GPS location or even Google Awareness API to push context-specific messages
m-Commerce	Concerto Timer, IKEA catalog	Exhibit items in 3D mode thus attracting users to purchase the item
Feedback & social network	Aure, WhosHere, Circle	Location Based information sharing
Routing and navigation	iOnRoad	Planning and directing the users to a destination
Interactive AR view	Yelp Monocle, Wikitude, Panoramascope, Spyglass, Peaks, Nearest Tube	Serving as an alternative user interface, providing information that is augmented on the reality
Visual augmentation	Timetraveler Die Berliner Mauer, Theodolite, Layar	Augmenting image layers on camera view to provide more information, such as overlapping an old picture on the current street view or showing POI (Points of Interest) names and information on the camera view
Image recognition	Google Goggles, Google Translate, Word Lens	Recognizing images and able to decipher writings on the images
Marker detection	In2AR, Digital Binocular Station	Detecting markers to trigger 3D contents
Responsive gaming	Pokemon go, Ingress, TimeWarp	Incorporating gamified interactions designed

Yovcheva et al. (2012) also offer valuable reference for future design decisions. They pointed out the major drawbacks of these applications are (1) the structure of information is not clear on AR interface, often resulted in "overloaded and cluttered display". And (2) besides map-based services and communication, further tourism-related functionalities such as m-Commerce, feedback, routing and tour generation are rarely supported in these AR applications.

3.3 Economic Effects and Network

AR technology is expected to have high potential in economic impacts. However, none of the above studied applications incorporate substantial business model. Jung and Han (2014) pointed out several ways that AR can create commercial benefits: because it

provides a new channel and more contact points for a travel product, and the publication of information and marketing is relatively low-cost and flexible. Therefore, they indicate that business has started to implement the technology to encourage customers to make purchase decisions.

The concept of network in economics combined with location-specific context would be appropriate for applying on tourism economy. In economics, the definition of net paradigm refers to the linkages, relevant to market competitiveness, that exist among firms and an array of complementary industries. Becattini et al. (2003) provide a definition that gave more emphasis on the economic benefits: "network refers to the relationships among firms, stakeholders, and other institutions of a region, which generate socioeconomic benefits, as in models of local development."

Asero et al. linked the concept of networks to geographical proximity. Dollinger (1990) regards points of interests (POIs) as nodes, and found that through spatial mobility, the travelers define their reference networks that they build around nodal destinations. The tourism industry is essentially the economic sector with the most inter-organizational networks (Bickerdyke 1996).

In a highly competitive environment, many argue that it's better for small and micro businesses in tourism to form networks and develop strategic cooperation (Asero et al. 2016; Dollinger 1990). The networks cannot be simply based on geographical vicinity; they have to have an electronic infrastructure as well (Ndou and Passiante 2005).

4 AR-Based Virtual Currency Solution

4.1 Service Model and Human-Computer Interaction Design

The applications of AR within the tourism industry are extremely varied and each is designed to satisfy different needs. Yet, in essence, a mobile AR application needs to take into account the particular needs of travelers and the businesses' potential to maintain and manage it. In this research, we proposed an AR-Based Virtual Currency Solution to achieve innovative travel experiences; and we implemented the solution to two models: Non-regional AR Model and Regional AR Model. We hope to encourage cross-store business cooperation by motivating travelers to explore more POIs and purchase more; and this solution would eventually facilitate the growth and sustainability of Business Networks (ref. Fig. 2). The solution includes two core modules as follows:

AR Exploration and Navigation

This research applied the AR technology of camera view on smart phones, which allows the users to explore and browse nearby POIs in 360-degree view thus providing intuitive spatial coordination. We also applied AR navigation technology, which leads the users to their chosen POI with map view and an AR icon layered on the camera view.

In terms of user interface design, for AR Exploration, we created a 360-degree exploring window. Using their smart phones, travelers will be able to browse nearby POIs and their information in all direction on the camera view. The information includes POI names, distance and the number of reviews. The number of review is presented in the number of "sprouts" on a green field (ref. Fig. 3). These reviews can be in forms of

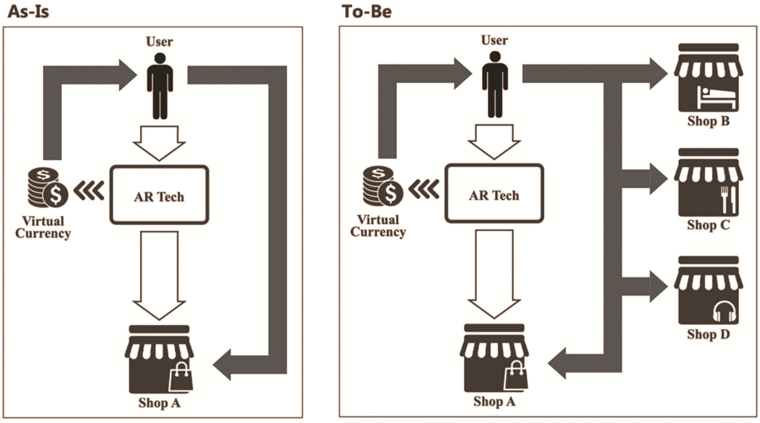


Fig. 2. Service model of AR-Based Virtual Currency Solution

texts, pictures and videos; we believed the number and the quality of these multimedia-based reviews would influence the visit rate of a POI.

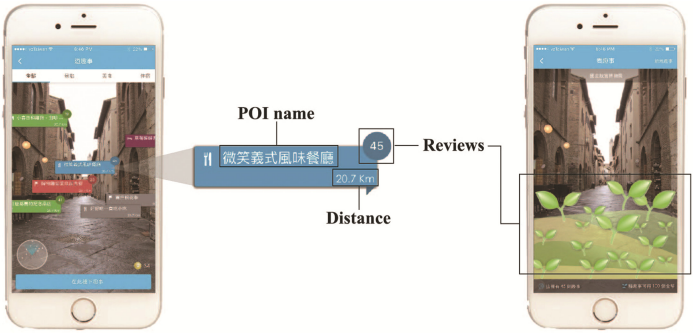


Fig. 3. Mobility interface of AR Exploration

As for AR Navigation, the user interface on mobile devices is consisted of two parts (ref. Fig. 4): the upper screen shows camera view with an icon layered on the intended direction; and the lower screen shows the planned route on the map view. After a traveler chooses a POI that he/she would like to visit, the map view provides the shorted route for the traveler to follow. The traveler can also turn their screens toward different directions to find the AR icon, which marks the direction of the chosen POI. The AR icon is customized according to POI features to accentuate local characteristics. For example, Nanzhuang is a township famous for its spectacular scene of white Tung flower blossoms. Therefore, we designed a Tung flower image as the AR icon, hoping that the connection between user interface and the local POIs can further intrigue travelers, and motivate them to explore the local POIs (Fig. 5).

Fig. 4. Mobility interface of AR Navigation and virtual currency in Non-regional Model

Fig. 5. Mobility interface of AR Navigation and virtual currency in Regional Model

Virtual Currency

The AR Exploration feature mentioned above is an online service mechanism; and the AR Navigation would guide the users to embark on an offline visit, giving opportunities to offline services. One additional feature that we created is Virtual Currency. Our system would award travelers with virtual coins when they perform certain tasks, such as writing a review (ref. Figs. 4 and 6). The virtual coins can be collected and further circulated in different shops by forms of discount coupons.

This research chooses virtual coins to be the operational drive for the AR-Based Virtual Currency Solution, not only because it enhances the novelty in AR technology, but also because it is expected to lead continual travel and consumer behaviors (Bogliolo et al. 2012). The left part of Fig. 2 illustrated that if virtual coins are provides by a shop's own system, they can only be circulated in the particular shop, and the travelers' further purchase would be limited to a single shop. The right part of Fig. 2 shows that our system allows travelers to redeem their virtual coins in different shops, thus encourage travelers to explore more shops.

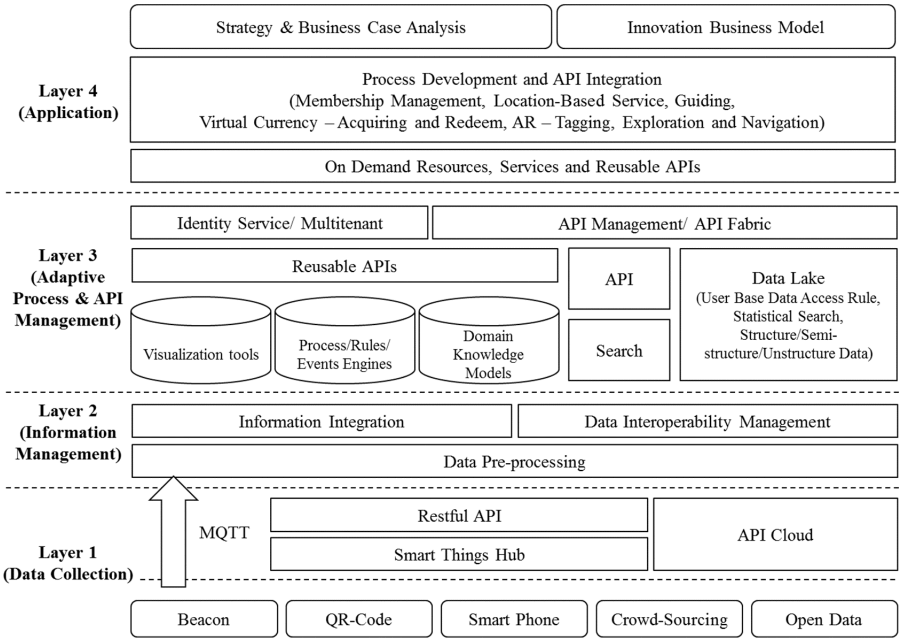


Fig. 6. API-Centric Architecture of AR-Based Virtual Currency Solution

4.2 Architecture and Mechanism Design

In order to realize the AR-Based Virtual Currency Solution in Fig. 2 and to be able to adjust flexibly with different regional features, the project of this research adopts API (Application Programming Interface) for platform development. Through connecting frontend and backend application programs in displaying, transmitting, and through the exchanges and storage of data between servers, users can use web-based applications on iOS and Android Mobile App to communicate fully with the platform.

The platform (ref. Fig. 6) is consisted of four layers of subsystems: Data Collection Layer, Information Management Layer, Adaptive Process & API Management Layer and Application Layer. The Data Collection Layer is at the very bottom layer and is designed to collect various real-time and batch data from IoT devices, open data, crowd-sourcing, and external data sources into the platform to achieve syntactic interoperability. The next layer is the Information Management subsystem. The purpose of this system is to achieve semantic and concept interoperability and provide a common data service framework for the platform. The Adaptive Process & API Management Layer is mainly formed by an API management subsystem designed to export all the services with API and provides its monitoring and manage. Since the operation of a business case is governed by various business processes, the design starts from making rules, data and analytics easily reusable, customizable, and can be connected into a business process which itself also needs to be flexibly modifiable. Each step of the business process systematically binds to other services via APIs. In this way, it makes it possible that the business process steps can be mapped to a set of isolated underlying computing services

and infrastructures which supported these APIs. Through open service environments based on an API interface, the Application Layer is supported to define business processes and is much easily customizable since each component used in the module can be easily decomposed into a set of APIs and then recomposed by a flexible business process.

The following paragraphs explain how the project forms different AR service models targeting the special characteristics of non-regional and regional areas through the communication between different APIs and SDKs in the system.

Non-regional AR Service Model

For Non-regional AR Navigation services, the project adopts GPS API to locate users' location and communicate with servers. Servers then send back an amount of (approx. 20) Point of Interests (POIs) closest to users and utilize Wikitude for image registration and present POIs in its corresponding fixed-position in the 360° view on the screen. The system can simultaneously send back POIs' information from the data layer for users to read, including their introduction, hours, related comments and the pictures, content, and tags travelers uploaded in the past. After users chose certain POIs as their destinations, the system will communicate with Google API, initiate Google Navigation and navigate users to their destinations with a double-windowed AR Image Navigation. In order to filter the amount of POIs on the Mobile App screen and customize the rules for defining rewards for arrivals at destinations, the GPS API is designed with a flexible definition of arrival distance. For example, GPS API will locate users when they are approximately one hundred meters away from chosen POIs and communicate with servers to define it as meeting the standard for virtual coins rewards. Servers then trigger corresponding dialogues on APP screen to notify users to confirm the completion of their navigation mission and reward users with virtual coins. Next, the system will document the amounts of coins users receive in each mission into the Coins table and the accumulated amount of coins acquired by individual users into the Users table in database. These records then enable users to use virtual coins to redeem rewards in local shops in their upcoming trips.

Regional AR Service Model

Compared to non-regional AR service model, the application of this study's AR service model in regional area is specialized in its business model of directing travelers to specifically defined travel regions. For instance, the system will send users notification when it locates users within 2–5 km around specifically defined regions through GPS API. After users click to start the regional exploration services, the mobile app will send request to server API and further make a table query to get all regions information in database. API then gets the corresponding ID and related information of that specific region from the data layer. In addition to operating the virtual coins rewarding system with defined location, the system also verifies each regional store's coins-rewarding requirement settings for travelers' behaviors such as check-ins and story writing to enhance the gamification elements in regional exploration. Since all the information are in dynamic control by APIs, changes can be displayed on users' mobile app in real-time

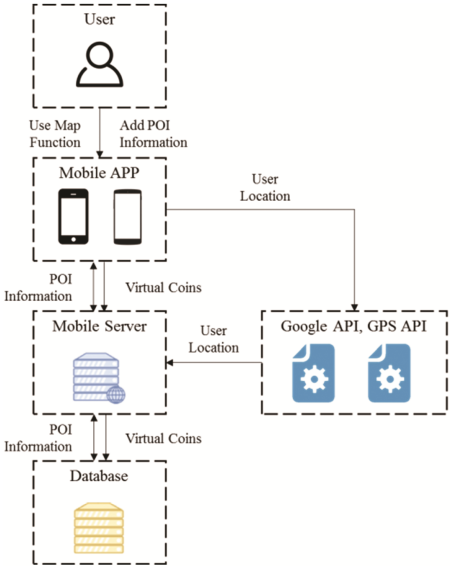


Fig. 7. Interaction of user, app, servers, and APIs database

if any store is added onto or removed from the store list, or changes its setting for rewards requirements.

In conclusion, this project's flexible API structure, connection to external Google API and GPS API and the mechanism of virtual coins are key elements to successfully support cross-industry services and business model. First of all, the system guided travelers to specifically defined regions with Google API and GPS API, and acquire the POI-specific rewards requirements information of travelers' behavior such as social media sharing or story-writing (Fig. 7). This enhancement of gamification elements is also strengthened by the usage of IoT technologies such as Beacon and QR Code. This gamification mechanism not only encourage users to interact with regional stores and experience local travels in a profound way, its AR technologies can further inspire users to share service information with more travelers and increase the numbers of our potential service users.

While travelers enjoy the AR services, the system will document the virtual coins travelers obtain in each mission and its overall record of the virtual coins users obtained into different tables of database, which further enhance users' motivation in engaging in travel-related consumer behaviors. This study also aims to form a tourism ecosystem consisted of travelers and stores through the circulation of virtual coins between POI stores and further realize the goal of building an offline business network.

5 Empirical Result

We incorporated virtual currency system to motivate travelers to explore more, and visit more shops in order to stimulate economic prowess in Taiwanese tourism. The design

of the virtual currency redeem system allows users to redeem coins collected in their travels for discounts of merchandises in another shop.

Our experimental project is carried out on both models: Non-regional Model that encompasses normal POIs across Taiwan, and Regional Model that includes selected POIs and designed user interface. In this project, we selected 5 districts, each with different characteristics to charm travelers, to implement regional AR project on. Some districts are bustling shopping districts, some have rich natural resources, and some are quaint, artsy districts. A total of 103 POIs signed up, including local shops, chain stores, popular attractions, restaurants and cafes and bike rentals.

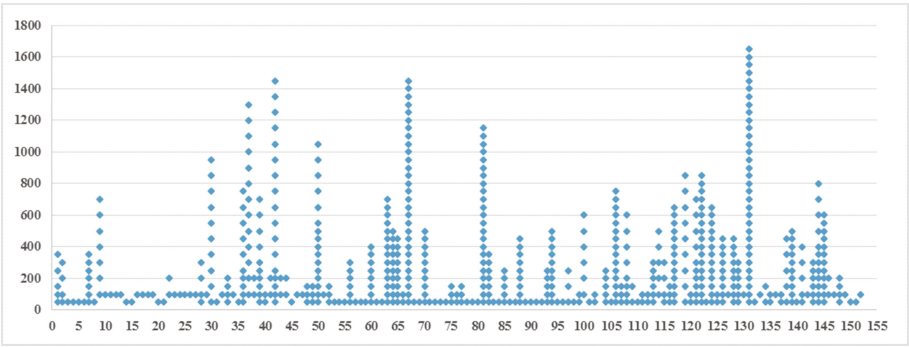
There are 3 ways for travelers to acquire these virtual coins in both models: (1) using the navigation function on AR view, and arriving at the destination POI, (2) scanning QR code or getting the broadcasted notification from participating POIs, and (3) leaving reviews or feedback on POIs. During the period of our experimental project (Oct. 1st 2016 to Dec. 31st 2016), 1,890,330 coins are circulated: Non-regional AR Model attracted 236 visits, contributing to the circulation of 20,450 coins. In comparison, Regional AR Model showed significant effect on attracting visitors, because it attracted 10,645 visits, contributing to the circulation of 1,869,880 coins (ref. Table 2).

Table 2. Statistics of virtual coins

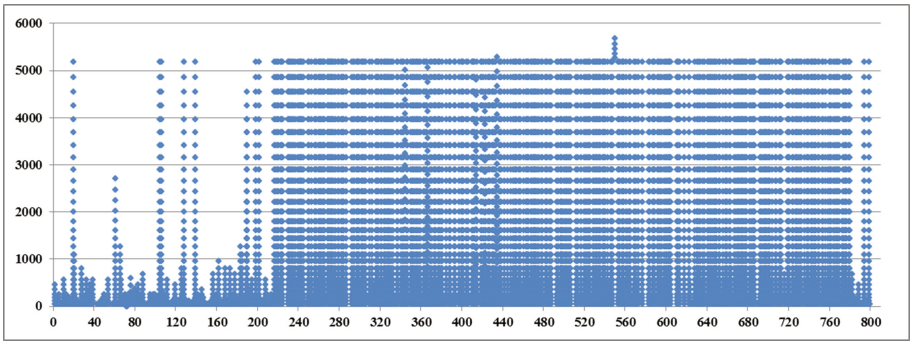
AR Model	Visits generated	Coins redeemed	Max. of visits by traveler
Non-regional	236 visits	20,450 coins	17
Regional	10,645 visits	1,869,880 coins	28

Users will be able to use these coins to redeem rewards such as items in other shops, or 35 NTD discount in local convenient stores. Other redeemable items are periodic, for example, in October, users can choose to donate these virtual coins, and we donate corresponding values to Chinese Children home & Shelter Association, a local orphanage institute. The value of virtual coins circulated equals to 140,000 New Taiwan Dollars (NTD).

We also looked into the behavioral pattern of the travelers' visit to POIs (ref. Fig. 8) and found that the variance of the number of visited POI is higher in Non-regional AR Model (given that the interval of 1 to 33) - most travelers only visit 1 to 2 POIs. Whereas in Regional AR Model, the variance is smaller, and the average of number of visited POI is 20 for a three day trip. This shows that the Regional AR Model is 1.5 times more effective than the Non-regional AR Model. Our assumption is that when travelers are exploring in an undefined environment, they have higher uncertainties for time and space, thus limiting their motivation to explore the next POI. In contrast, Regional AR Model more effectively engages travelers in more extensive travel experiences.



(a) Non-regional AR Model



(b) Regional AR Model

Fig. 8. Circulation of virtual coins

6 Conclusion

New technology has been seen as a way for many businesses in the tourism industry to stay competitive and enhance their marketing campaign in various ways. AR has evolved as the buzzword of modern information technology and is gaining increasing attention in the media as well as through a variety of use cases (Jung and Han 2014). However, although research on AR has been conducted in various fields, the majority of studies focus on technical aspects of AR, while others are tailored to specific applications. Therefore, this research aims to examine the current implementation of AR in the SMB Tourism context that is required to guide the early stages of AR implementation in a purposeful way to enhance both the travelers' experiences and businesses' relationship which are as bellows:

- Intuitive Travel Experience: End-to-end travel includes the course of before, during and after trips. As travelers start a tour, they have to obtain large volume of information from different channels, providers and even industries. It takes efforts and time for travelers to collect and sort out useful information from the large and diverse

information, both before and during trips. Therefore, how to create an intuitive travel experience by providing timely and appropriate information plays an important role in accelerating the organic expansion of "Online to Offline" (O2O).

- Cross-industry ecosystem: O2O is not only crucial for efficient information collection; it also plays a vital role in creating experiences in seamless commerce. All behaviors of travelers are closely tied to the services and products providers. If we see travelers and businesses as a supply and demand chain, how to build an O2O matching platform will be the key to new forms of tourism ecosystem. This platform would customize matchings between travelers and POI, such as attractions, restaurants, accommodations, stores, etc. Eventually, it would help to achieve the organic expansion of O2O services, even improve cross-industry integration and innovation as well as the efficiency of commerce process.

In this research, Regional AR Model is evidenced to be an important vehicle for driving the tourism businesses relationship into a network. The network is a key concept for understanding the relationships linking different POIs that cooperate and interact with each other on the basis of specific relations. In a spatial perspective, these functional links are characterized by the presence of "dominant nodes," which attract an influx of goods and services, people, and information (Asero et al. 2016). And travelers build their own networks around nodal POIs, even if they are geographically distant. Thus, traveler mobility affects the shape, the dimension, and the structure of the networks, where travelers are different in characteristics, trip-related behaviors, and type of holiday chosen.

As POIs are complex dynamic systems, a "smart" system to consolidate the network of POIs can affect and address planning and management actions (Asero et al. 2016). This research confirmed the effect of different AR models on travelers' behaviors through primary research. However, we did not personalize POI suggestions based on individual traveler's behavior. We also did not go as far as customizing distribution rules of the virtual currency based on individual preferences - we standardized the distribution rules for each action. Therefore, future research can further investigate how to optimize POI suggestions and virtual currency distribution based on analyses of traveler's behaviors.

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