International Journal of Engineering & Technology, 7 (3.33) (2018) 314-318

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

The model of Big Data analysis for MICE using IoT (beacon) and artificial intelligence service (recommendation, interest, and movement)

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Abstract

The aim of this research is to design and construct Smart Exhibition Convention service that utilizes IoT based Big Data. First, we designed the Total Smart MICE platform that can be used from the beginning to the end of the exhibition. In addition, we added support to enhance the competitiveness of objective and valuable reference model-based display tasks (planning, sales, etc.). In addition, we have developed new businesses and smart services utilizing the implications of data analysis. To improve the value of data collection and utilization, we hope that this research model will spread to the platform industry. The results of the study will be an opportunity to transform the paradigm of the exhibition industry to a smart MICE platform.

Keywords: *AI; AI Service; Beacon; Big Data; ICT; MICE; Service Method*

1. Introduction

MICE is an industry that has high value in use for Big Data analytics according to current B2BC trends. Although there have been many attempts to apply various smart IT technologies such as RFID and NFC to MICE, they have been successful due to differences in applications and technology limitations in the offline world. While the activities of visitors, businesses and MICE industry organizers produced an enormous amount of data, there was no basis for collecting, storing and managing such data. Therefore, compared to other industries, the use of IT technology was relatively low in the MICE industry (Table 1). Therefore, there was insufficient support for effective on-site marketing and verification of the results was not sufficient. In addition, the growth and development of convenience services for participants was very slow.

This study analyzes Big Data collected through total smart meetings, incentive travel, convention and MICE platform based on IoT beacon and recommends MICE participating companies. The findings will bring alternative goals to facilitate individual MICE participants and increase the value of MICE using ICT technologies such as Big Data and Beacon. If the results are widely used throughout the dome-tic MICE industry, it will contribute to a virtuous circle of smart MICE. [1, 2, 3].

Data from the exhibition is highly utilized as offline data. The exhibition is a trend toward B2B convergence, and it is a new market in itself. Through connection with surrounding facilities and commercial areas, data generated from exhibitions are highly valuable. The reason for this is that there are a variety of participants such as visitors, participating businesses, buyers and others.

Table 1: Domestic MICE Industry Data

Category	Description
Subject of data collection	The remaining information after the end of the event which lasts for 4-5 days in average: General information on visitors, achievements of the talks (low reliability)
Data utilization	Absence of data utilization: Personal experience or knowhow-dependent planning
Marketing planning	Participating in the event without any quantitative grounds: Inefficient field marketing

The nation's exhibition industry is running out of services. Data collection and utilization are relatively vulnerable. In particular, there are many limitations in obtaining and analyzing real data at the site. Also, there is a lack of marketing support for participating companies or verification of the performance of the exhibition. The convenience service for enhancing the satisfaction level of visitors is also insufficient.

Currently, among the numerous behaviors of the exhibition site, the remaining data is limited to basic information of visitors, and some consultation performances. The participating companies are conducting only inefficient on-site marketing without any basis or plan. Also, during exhibition planning, the staff relies solely on personal experience or know-how. Therefore, the purpose of this study is to use the data from these exhibitions to develop a new marketing strategy.

2. Construction of smart MICE system

Smart MICE is a platform that combines IoT-based and Big Data-based infrastructures such as beacons that were installed in COEX in 2015. The smart MICE platform consists of an intermediate platform consisting of a beacon engine, an exhibition solution, an

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exhibition service app that serves visitors directly, and a back office system operated by an MICE organizer. In addition, infrastructure (e.g., service servers, databases, networks) is already deployed. IoT infrastructure was needed to collect location information of visitors using apps through visitors' apps and servers, and beacons can also be used. Currently, the COEX has about 1,800 seals that are divided into movable and fixed types. For fixtures, the default positioning role is installed in the floor trend. In contrast, mobile beacons are installed in accordance with the cell plans of each booth for detailed positioning at the end of the installation of booths or facility work [7].

2.1. Smart MICE platform

The Smart MICE platform has three parts. The first part is the middle layer consisting of the Beacon Engine, Exhibition Solution, and Analysis Platform. The second part is the exhibition service app, which is used as a direct service delivery channel for visitors. The third part is the back office system in which exhibition organizers and participating companies operate and manage exhibitions. In addition, this platform requires a variety of infrastructure, including servers, DB, and network, to deliver services. In addition, Beacon Device is required as an IoT infrastructure to collect location information of visitors using the app while communicating with visitors and servers. Currently, the Beacon System has 1,800 locations in the COEX exhibition hall as fixed and mobile. Fixed beacon is installed as a basic location determination role in the floor track of exhibition hall, and mobile beacon is installed at the time of each exhibition, and detailed location determination at the time of facility construction. Visitors can download it from the Android iOS App market. The app basically provides services such as access to exhibition information, purchase of exhibition tickets, and registration of admission. In addition, Beacon provides various location-based services by monitoring the location information of visitors. This service carries out Location-based Service (LBS) notification, directions to the showroom, and facility information. The management system of the exhibition organizer will perform overall information registration and management of the contents operation of the exhibition. Statistics can be analyzed after the exhibition is finished in terms of performance management.

2.2. Smart MICE service

Location-based services that can be provided using Beacon are divided into visitors' convenience service, marketing effectiveness service, profit possibility service, action intelligence extent service, and operational efficiency improvement service.

COEX Smart MICE Platform has planned the service by considering factors such as industrial characteristics, commercial value, and business direction in addition to these categories. As a result, final services were derived through Beacon based automatic entry registration service, information provision and convenience functions using the floor map, micro fencing event notification service and IoT data analysis service.

In particular, the Beacon based automatic entry registration service can play a trigger role in securing the most important service user parameters for collecting the user's location information. With this service, you can enter the service without any other offline lines using mobile tickets. It is a service that improves the chronic problem of exhibition management.

The first is location-based services (XP), which are designed to provide convenience and utilize marketing. When the visitors arrive at the exhibition site, the Beacon installed near the entrance will recognize the user and provide the welcome message and various event information in its push form. Depending on the length of stay by location, special benefits or detailed information are also available. A variety of services and content are provided in the right place at the right time to suit the user's preferences. It greatly improves satisfaction level compared to current mobile services. The second is a Big Data analysis service using collected user location information. Leveraging Big Data solutions on platforms, location information for users is collected on site at a near real-time level. The estimated information is provided to the subject of each utilization in the form of statistical analysis, reference model-based data services. Third is the enhanced service for existing work processes. In addition to the area of collecting and analyzing location information and providing access to services, basic mobile services are provided to streamline existing businesses. Again, if location-based services are used in parallel, they can be delivered in a more effective form.

The first function is exhibition schedule and information. The Smart MICE app constantly updates and manages schedules, overview information, and registration details for the exhibition or to be held in the exhibition hall. Just as using the app to select the movies you want to watch in the movie theater, ordinary visitors can purchase tickets by checking information about the exhibitions they want to see in advance through the Smart MICE app. The second function is to register for the exhibition. Previously, entry registration through various channels such as advance registration and on-site purchase was possible in the exhibition hall, but many of them lined up to get a pass or not, and many others entered the survey. Therefore, the queue was always very tired for visitors. Smart MICE offers mobile tickets in a certain location through Beacon. This allows visitors to enter directly from the entrance without waiting. In addition, if entry registration is done via mobile, the data can be obtained from the service activation and the ease of use of data from the underlying parameter using the service app by integrating the previously distributed entry channels. The third function is managing the participant directory. The company information data, previously held separately by participating companies in brochures and catalogs, can be provided on the app in the form of an e-class. In addition to simple information from the participating vendors in the e-catalog in a variety of forms, the products, contact contacts, and each species' content can be used. The fourth reappointment is a recommendation of attention. The algorithm designed through visitors' visit history allows the app to recommend specific booths and areas of interest for that person during the exhibition period. The fifth function is to guide directions to the showroom. If I check the booth that I want to go to in advance among the hundreds of booths in the exhibition hall, I can check the position of the booth that I want to go to by map at the entrance of the exhibition hall. In addition, anyone can conveniently use the shortest route from their current location to a specific location (booth or facility).

3. Research projects

To address the major business challenges facing the MICE industry by holding workshops with MICE planner, the study drew analysis topics, identified analysis conditions and the specifications of available data, and selected data analysis support items. To derive specific analysis topics, the analysis conditions and final details of the subject were shared by the exhibition PM, system developers, and data analysts through prior review. Constraints and split conditions were also discussed with regard to rough modeling. Details of the clear objectives for this are defined from the perspective of user stories to derive the need and insights of MICE managers. In addition, agreements on details have been made or items that are structurally defective during the workshop have been improved. Based on the results of several workshops to derive research projects, this study recommended companies in real time using big data collected from the Beacon of detailed analytical models. Therefore, a final recommendation service designed based on preferences derived through visitor similarity

will be provided to reflect the characteristics of the MICE industry through big data analysis. [6, 8].

The study was conducted on a platform implementation (prototyping method) and on a two-track data analysis. Data collection pretreatments and analyses are performed before and after each prototyping (four times in total) by applying directly derived data to the analysis reference model during platform deployment. The platform is designed to continuously upgrade the system by analyzing the gap analysis of the functional error and demand history and the shortage in planned scenarios with the aim of installing and prototyping fixed beacons in the entire exhibition hall. For data analysis, the timing of data collection, including location information, is linked primarily to the prototyping point focused later. Thus, the analysis scenario is set to simulated in advance, and the analysis scenario is modeled and applied at the time of data collection to supplement the part where the gap occurs.

4. Data analytics

4.1. Analysis model

An analysis model (Figure 1) that calculates similarity of visits based on time spent in booths and recommends companies again has been developed. From the perspective of MICE business analysis, very popular and interested companies will be excluded from the recommendation.

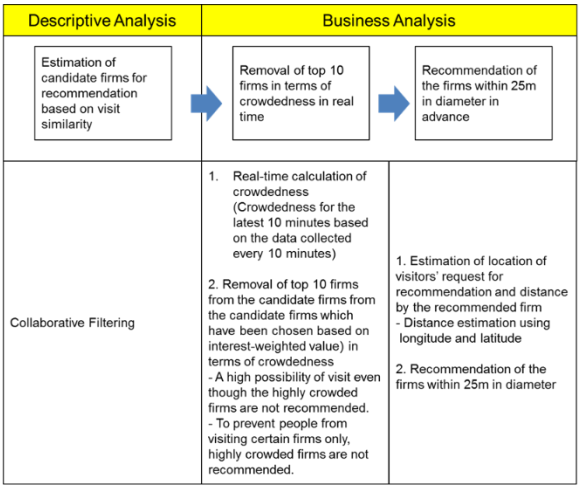

Fig. 1: Data Analytics

However, high-ranking officials were removed in terms of real-time congestion, as visitors were more likely to visit the companies again. The measure aims to recommend an accurate company that removes interference and considers preferences for visitors after attracting more visitors. Also, unlike the online world, which moves by clicking on a mouse, visitors are reluctant to visit distant booths in an offline environment. Therefore, the purpose was to increase the number of visitors by recommending visitors within a certain distance. To filter the company by distance, we have added an analytical procedure designed to use latitude and longitude to estimate distances in advance.

4.2. Analysis model 1: real time recommendation

Model 1 (Figure 2) is to calculate visit similarity based on the business stay time visited by visitors and extract the recommended business.

Collaborative filtering techniques were adopted for research model analysis. Collaborative filtering is an analytical method to estimate a particularly high company in terms of the duration time and relative index among the visiting booths based on the visitor and resident similarity that requested a recommendation (5-point Likert scale).

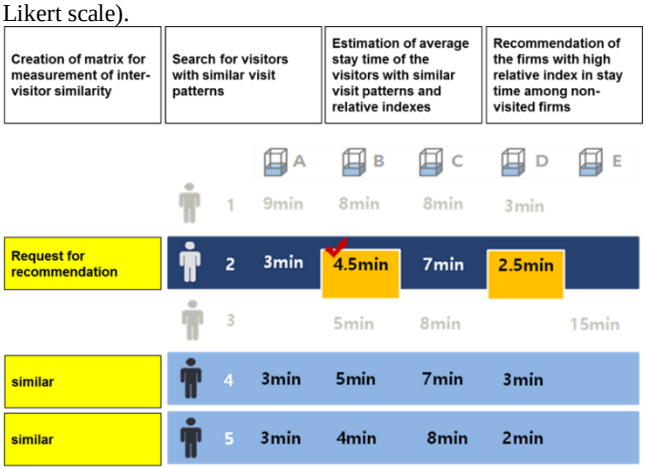

Fig. 2: Interest Index Analysis

Collaborative filtering is a proven technology that is used by many famous companies, such as Amazon, Netflix, and WATCHHA, among a variety of technologies designed to measure similarity. Three specific methods of calculating similarity among these collaborative filtering techniques were considered: cosine, Java and Pearson. The accuracy can be improved by applying the visitor's stay time after switching to preference. Therefore, cosine and Pearson methods were adopted prior to Jaccard confirming visitors' intent to visit. Pearson and Cosine had almost the same result. With Pearson technology, when a company is recommended to calculate its similarity, other companies will be modified whenever people come in and out of the booth. Also, the recommended accuracy is reduced because average dwell time and preferences are applied. Therefore, as a specific analytical-resolution technique for collaborative filtering, the cosine method [4, 5] which enables real-time recommendations based on visit similarity by applying dwell time to preferred indices was then recommended in an open workshop to select analysis topics.

- Hypothesis 1: In terms of accuracy, the user's similarity is higher than the company's visit/visit. Estimates of similarity between visitors/visitors make it difficult to reflect visitors' preferences, resulting in an average duration.

- Hypothesis 2: If visitors prefer the company, they stay long, and visitors stay long at the company they are interested in. If they are not interested, they just pass by or stay very short.

- Hypothesis 3: The visit preference is the same if the preferred index is similar. Because the duration time may vary depending on the preferences of visitors, the relative duration time per visitor is applied and the visit preference index tends to be the same as the corporate preference index.

- Hypothesis 4: Visitors are more likely to visit crowded people than they would otherwise recommend, so they are excluded from recommendations: Visitors are generally aware of great advances in large, large and well-known companies. Therefore, if companies with a large population are recommended, their effectiveness and reliability will be diminished. It is necessary to recommend other companies to prevent visitors from flocking to only one company.

- Hypothesis 5: Since it can affect visitors' intent to visit, people at close distances are recommended first. Therefore, they tend to visit nearby companies instead of distant ones.

Companies that will be recommended as companies with high real-time visit preferences and high real-time congestion achieved through real-time recommended analysis models will be provided with a wide range of useful information from visitors' apps (Figure 3).

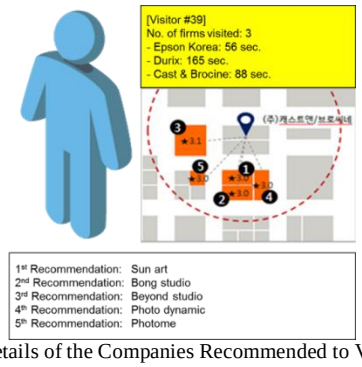

Fig. 3: Details of the Companies Recommended to Visitor #39

Visitors can obtain custom information in real time and access it in an effective way. In addition, the system can prevent people from flocking to only certain booths and encourages them to visit relatively less popular companies. The results from this study are the recommended real-time analysis results. Therefore, there may be restrictions if information from visitors is quickly analyzed and provided, excluding visit preferences by collaborative filtering. Nevertheless, the findings will contribute to the paradigm shift in IoT and MICE industries based on Big Data. Visitors will be able to obtain a variety of content (e.g., MICE information) through the platform and easily find the booth they are interested in. Participants can also measure PR and PR effectiveness with quantified data and analyze visitor (purchaser) interests and behavior patterns to maximize marketing and dispensing effects.

4.3. Analysis model 2: interesting sensing

The following analysis model measured the degree of interest of visitors by calculating the index of interest based on the frequency of visits by visiting visitors, the length of stay time, and the rate of re-vision characters. And the Model 2 is improved with whole interest and individual interests.

This model requires an index that enables an objective evaluation of the extent to which a company receives attention from visitors. Because future prospects can be predicted through the interests of the most important buyers in exhibition business, it is necessary to analyze interest by type of visitors. Conduct text mining to analyze items and items that are likely to be developed in the exhibition for reasons of high interest index.

- Hypothesis 1: The higher the duration, frequency, and number of re-visits of business visits, the more interested the visitors are. Visitors stay for a long time for companies that are highly interested, and if they are not interested, they go too far or too quickly. Visitors visit a company of high interest. Visitors should visit the business of interest more than once. It sees the return visits more than once as the same interest, and its re-vision rate is determined by the number of visitors who visited the company as a whole.

- Hypothesis 2: Time to stay in a business is more important than frequency and number of re-vision characters. The frequency of visits can be affected by factors such as the location of the vendor and events, and the duration time is defined as a more important element in identifying interest than frequency. If you are interested in a business, you may not revisit it if you have a long stay and enough information acquired, so you define the duration time as a more important factor in determining interest than frequency.

- Hypothesis 3: Buyers and ordinary visitors have different interests. While buyers visit the business for a clear purpose and stay for a long time, general visitors often visit businesses with a high degree of location impact (entry exit, large businesses).

- Hypothesis 4: The characteristics can be determined from the tags of companies. Using information from their brands, product lines, etc. registered by the companies, the features of the companies that the audience is interested in are identified.

4.4. Analysis model 3: movement track

This model analyzes the main circulation of visitors by exhibition and identifies the companies whose content was relatively good. And the Model 4 is improved with graphic analysis. Graph Analytics is a technique to analyze the characteristics of the connection state and structure between objects taking into account the interaction of objects within a group, and analyzes the number of transfer lines through the order in which the participants visited the company.

Graph Analytics was selected as the method to best understand the connection status and structure between companies considering that there are interactions by company and location. This technique is being used on popular social network sites such as LinkedIn and Facebook. Since visitor movements do not follow the same procedures, they differ from visitor to visitor and are therefore not suitable for process mining.

- Hypothesis 1: Companies that are included in the main circulation of visitors are those that have high influence on exhibitions. True, the visit trend of visitors is understood and the company that influenced the exhibition is derived.

- Hypothesis 2: Companies with high retention times will have good contents. True audiences will stay long if the content is good. Companies that are located in similar locations within major copper lines understand importance of contents through dwell time.

Table 2: Variables of The Visitor and Longitude & Latitude Information (a) - tbl_an_visit (Visitor information)

Column Title	Column ID	Type	Description
Visitors' visit information sequence	visit_seq	integer	Number given for visitors' visit information
MICE sequence	ex_seq	integer	Number given for the MICE
Visitor sequence	user_seq	integer	Number given for the visitor
Fence No.	fc_num	integer	Fence No.
Fence title	fc_name	text	Fence title
Entry time	enter_time	integer	Time of a visitor's visit to the booth (firm)
Exit time	leave_time	integer	Time of a visitor's leave from the booth (firm)
Stay time	stay_time	integer	Time of a visitor's stay in the booth (firm)

Table 3: Variables of The Visitor and Longitude & Latitude Information (b) tbl_an_latlng (Fence Longitude & Latitude Information)

Column Title	Column ID	Type	Description
MICE sequence	ex_seq	integer	Number given for the MICE
Fence No.	fc_num	integer	Fence No.
Fence title	fc_name	text	Fence title
Latitude	lat	double(9, 6)	Latitude by fence
Longitude	lng	double(9, 6)	Longitude by fence

Data were analyzed using a total of 7,302 visits and 119 fence longitude & latitude information. Table 2 and 3 show the specific variables of the visitor and longitude & latitude information. The models are tested by four pilot projects (Figure 4).



Fig. 4: Pilot Projects

5. Conclusion

The results of this analysis show that the major transport lines produced by the execution of the visitors' circulation analysis model can be checked through the website by the exhibition coordinator and used for the placement of the subcontractor in future exhibitions. The competitor may use these results to select locations and sizes for the next participation. The exhibition organizers can find ways to ease the attraction of the exhibition hall by improving the layout of the booths with low-visit locations and business identification.

Visitors who visit the exhibition can automatically enter the exhibition by downloading a mobile ticket from the Smart MICE platform. This is valuable as a revenue model because it allows the budget to be dedicated to the portion that was being done through the existing admission system. As the service is basically implemented as a mobile app service, it can be used as an advertisement platform for those who want to promote products and brands in nearby businesses or exhibitions. Such ads can be provided as a form of coupon push and basic ad exposure on the app as part of location-based service. In addition, statistical information at the exhibition venue enriched by location information is provided in the form of a result analysis report to the participants in a payable format with visitor information at their booth.

Acknowledgement

This work was supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIP). (No.2018-0-00705, Algorithm design and software modeling for judge fake news based on artificial intelligence) This work was Supported by a Korea University Grant in 2015. (1.Mar.2015-28.Feb.2016)

The authors would like to thank project members and agency officers for providing project materials and interviews. This paper was supported by National Information Society Agency, Ministry of Science, ICT and Future Planning, and Hanwha S&C.

This paper was supported by Wonkwang University in 2018.

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