

# Cadastral Business Expansion Using Indoor Spatial Information

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**Keywords:** Indoor Spatial Information, Cadastral, Indoor Reference Point, Indoor Spatial Information Survey.

## SUMMARY

Spatial information industry is growing at 11% per year global market in the \$ 81.2 billion of 2010, is expected to be extended to 2015, \$ 137 billion. And recent trend in the spatial information industry is facing into the indoor space. According to the report of the US Environmental Protection Agency, about 80 percent of the total life is in the indoor space. This means that the economy, social, and cultural activities which has been limited in the outdoor, increasingly moving into the indoor space. In addition, the rapid adoption of smart devices is to knock down the walls of the outdoor space and indoor space by the support of these activities. The Ministry of Land, Infrastructure and Transport announced to build a database of information for indoor spatial information plans to promote the safety and welfare of the people from 2013. To build indoor spatial information is future high-value business. So the ministry of cadastre creates indoor spatial information books that can systematically deal with interior space and the attendant cadastral survey work carried out surveys in order to maintain the indoor spatial information management. The country of the land and the interior space through indoor spatial information books and indoor spatial information survey can be represented by the absolute coordinate system and it is possible to provide various services based on location to the user by the convergence of the various LBS system. The purpose of this study is to describe the core technology for building survey indoor spatial information, operating a system of indoor space and indoor space information books that is the foundation for building indoor space information.

The Republic of Korea announced plans to build an indoor spatial information database to promote the safety and welfare of the people from 2013. The cadastral surveyor worker performs indoor spatial information survey to build indoor spatial information, is future high-value business. Land and indoor space can presented absolute coordinate system through indoor spatial information survey and provide several services which based on location by merged with LBS systems.

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## 1. INTRODUCTION

According to the report of the US Environmental Protection Agency, above 80% of the whole life is placed in the room. This means that the economy, social, and cultural activities, which has been limited in the outdoors, are increasingly moving into the indoor space. In addition, the spread of smart devices can break down the walls of the outdoor space and indoor space being to support these activities. Thus, the importance of indoor spatial industry that still not pioneered filed to the market, has no excess no matter how stressed you it become huge. Therefore, in Korea, through one of the first projects in developing core technologies from '10 biggest Research & Development projects', developing evacuation and disaster situations Indoor 3D indoor navigation service and to take advantage of the 'interior space utilization information service platform'.

The purpose of this study is to describe the indoor spatial surveying of the underlying technology for indoor space information.

## 2. MAIN SUBJECT

### 2.1 Status and need of indoor spatial information

Major changes of the spatial information to bring in our future life are 'the combination of the physical space and virtual space', 'achieve predictable society', 'smart economic construction' and the like. The indoor spatial information that can take advantage of the indoor space occupying most of our daily lives has emerged as a high convergence of IT technology and new blue ocean as a complex with the infinite value creation as a new growth engine industries. Google, Apple, Microsoft and global IT organizations are under intense competition to dominate the interior space information usage market of new products which indoor location information based. Google is the leader in utilizing airport, shopping malls, museums, such as the indoor map service using Google Maps based on Android at the via the smartphone and tablet was launched in 2011, and IT companies in the United States Meridian company in indoor applications, such as to yield the navigation. Indoor space information is being provided to users in the Republic of Korea has been limited so far, indoor evacuation directions. These features might one good examples that utilize the indoor space information has stopped to show simple images or indoor map image yet. Thus, the indoor space information is to provide more precise and reliable information will be building a database with the absolute coordinate system. Into the indoor space to the target based on this navigation system for guiding the optimum path and the monitoring system, the emergency room would be provided to rescue services.

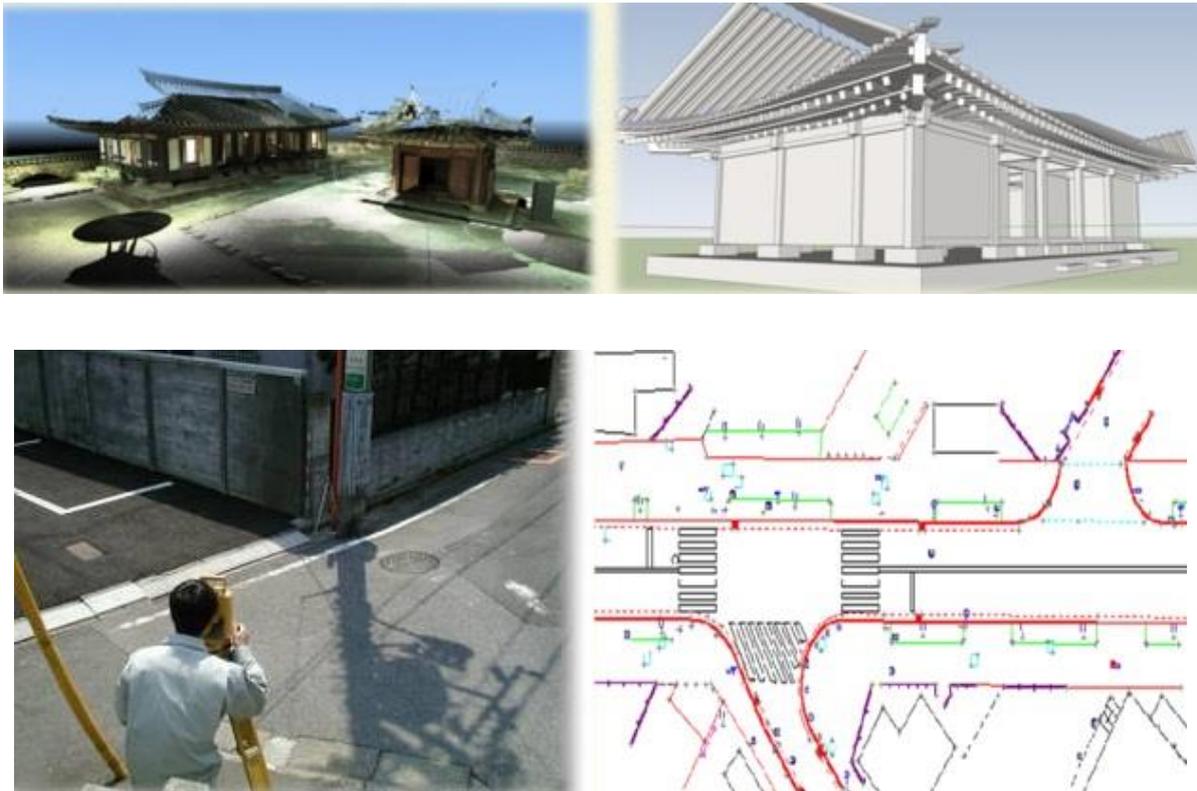


<Figure1. 'StoreView' service by Daum Kakao Corp.>

In addition to an indoor space still collecting data and information by companies because they're having a formal specification or formatted for processing, process the information in a different manner to institutional interior spaces and the situation now is the value of 'integration' and 'simplicity' does not comply with the recent trend that is emerging. And lacking of the absolute coordinate system not give a uniform mutual continuity between the outdoor space and the indoor space and not able to provide a series of information is not separated with respect to the indoor space and the outdoor space to the end user. Service provider for the outdoor space and the indoor space is therefore had to be made independently of each other so far. The purpose of this study is to describe a series of processes to explain the process from the process of collecting data to provide interior space information to the user, and with respect to how to deal with further information data indoor space.

## 2.2 Outline of indoor spatial information survey

The purpose of this study is to describe a series of processes to explain the process from the process of collecting data to provide interior space information to the user, and with respect to how to deal with further information data indoor space. It was a three-dimensional representation of the object in space with a height value dimension (Z axis) from the previous 2D survey, which has been represented as a point and line, through which has been running the model, such as cultural property, facilities and construction sites.



<Figure2. 3-Dimension scanning survey using LiDAR>

3D scanning measurement using the LiDAR has a limit in the time and work required expansion costs incurred for the survey even mention. Because of those reasons, the valuable and important cultural property or very big symbolic objects such as disaster zones have been choose by surveying the target. But it is also limited for future amendments and variety of fields with the survey results are difficult to modify. In order to get the indoor spatial information, I suggest different surveying methods of indoor spatial information.

### 2.3 The way of indoor spatial information survey

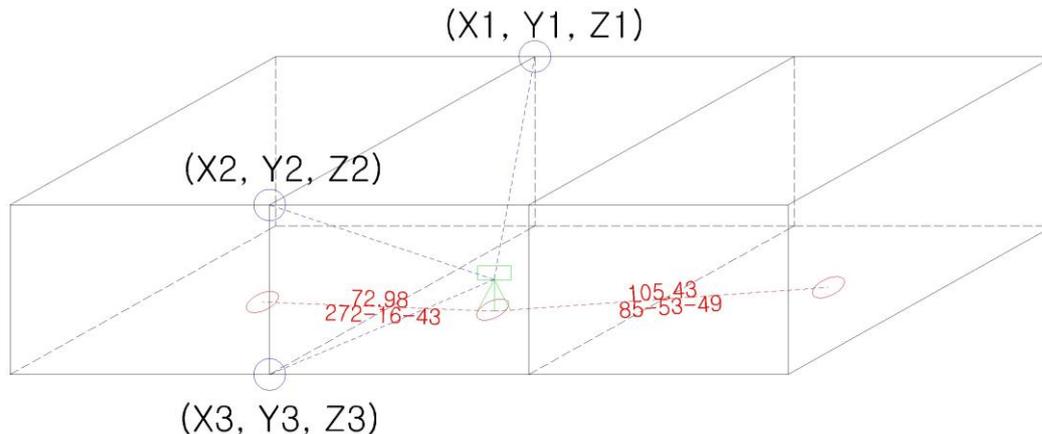
The indoor spatial survey is a survey behavior involved in order to build and utilize the indoor space information. Survey technician may indicate the figure the indoor space and the outdoor space with the same coordinate system through indoor spatial surveying.

#### 2.3.1 Reference Point Survey

In order to perform the indoor spatial information survey, indoor reference point to be embedded in an indoor space. Details of the indoor reference point will be discussed in more detail in the [2. 4. Definition And Use Of The Indoor Reference Point].

### 2.3.2 Detail Survey

Obtain the coordinates of the indoor space through direct observation after installing total station on the pre-installed indoor reference point to. In the manner of performing the conventional measurement point to be added only as three-dimensional coordinate (Z-axis), there is no significant change that this survey method. It is easy to adapt performer in terms of intellectual work is to promote a new business in a big technological change have the advantage of not involving.



<Figure3. Indoor spatial information survey using T/S and indoor reference point>

### 2.3.3 Inspection Survey

Surveying the test agent to determine whether the measurement carried out as to whether the interior space is made properly large survey information from three perspectives.

- ① The indoor reference point been installed correctly.
- ② Has the target building is located right on the drawings.
- ③ The coordinates of the indoor space been acquired correctly.

Indoor reference point inspection survey is a process of verifying the accuracy of the X, Y and Z coordinate. If the indoor spatial coordinates that acquired through the indoor spatial surveying locates outside the building, which is the wrong measure. Thus, by combining the item ② and ③ must go through a verification process the indoor space information survey was made correctly.

### 2.3.4 Significance Of Indoor Spatial Information Survey And Difference From Traditional Surveying Technique

Cadastral worker can record and maintain about variations of the indoor spaces through the indoor spatial survey. 3D surveys have been used to illustrate the existing indoor spatial

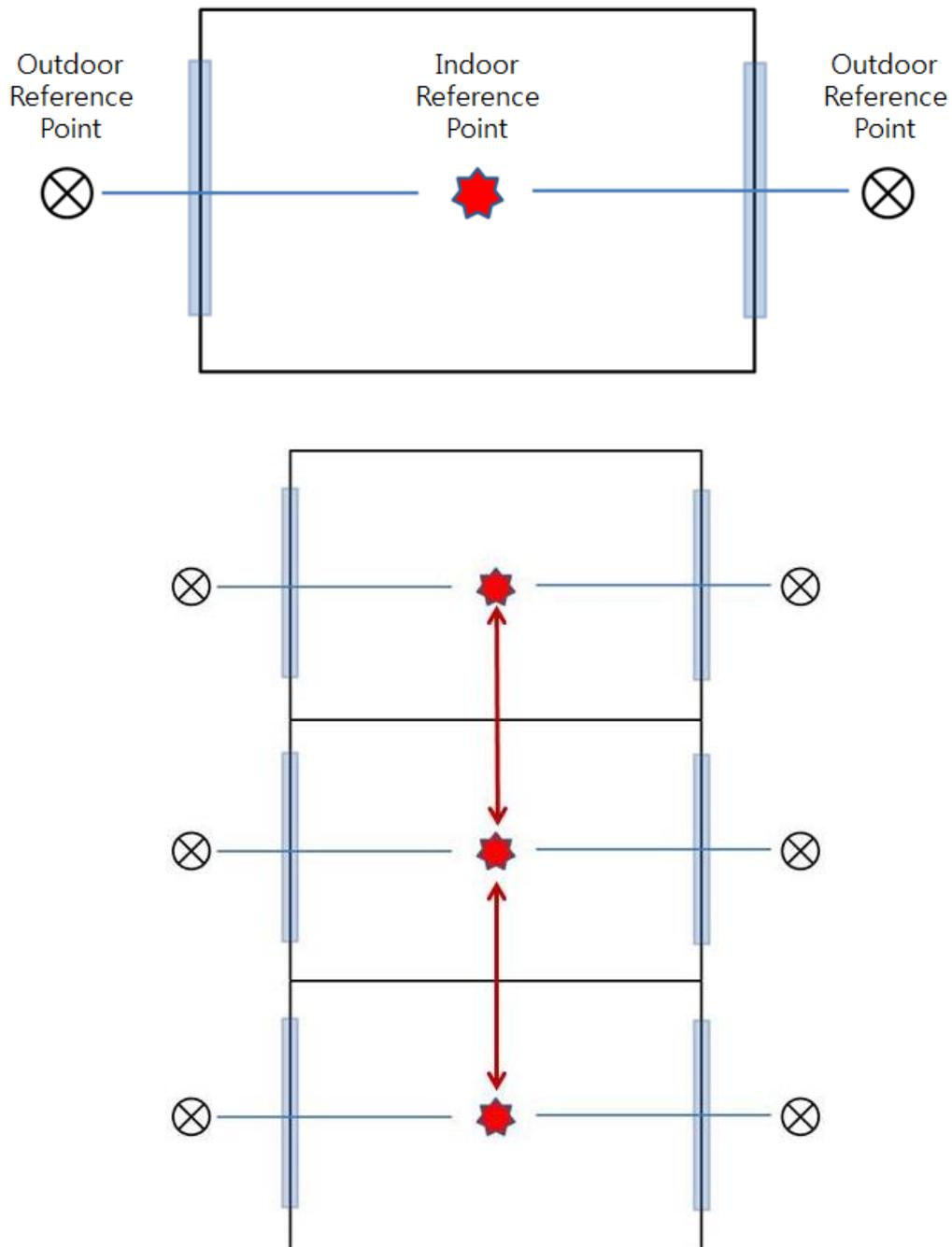
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information is a point to restore the appearance of the visual object. Indoor spatial information survey on the other hand, can be referred to strength that makes it easy to manage the properties of the placed object in connection to outdoor space of the emphasis on the expression of the indoor space to the outdoor space on the same coordinate system.

## 2.4 Definition And Use Of Indoor Reference Point

In order to surveying location in outdoor space, GPS technology was widely used so far. However, it is difficult to receive position signals from indoor space. So WLAN infrastructure, IMU(inertial measurement unit), Pseudolite, Laser, Sound wave, RFID (Radio Frequency Identification), Bluetooth technology, etc. have been developed for positioning the location of the user in a variety of indoor space have been. Using Wi-Fi signal is the way to construct database for indoor location information in Korea. However, the current in this way is not possible to ensure accuracy with only three to five meters. It would be improve accuracy little bit, but now it is hard to expect improve accuracy of centimeters up to a reality. And the method using the Wi-Fi signal is appropriate as a method to identify the user's current location indoor high accuracy is not required, but may be inappropriate to the database of the accuracy required for the indoor space. And constructing database using a wireless communication network that has a wide range of variables, has the limitation about lack of accuracy. So, I want to provide a measurement method that will yield a numerical accuracy revolutionary than a wireless communication system through introduction of the concept of a reference point in the indoor space has a minimum coordinate value and maximum accuracy. Indoor spatial information with the correct coordinates established through the indoor reference point data will be utilized in a variety of ways by a weapon of precision. A fusion of the RTK survey and backward intersection to this end, we propose a new reference point for installation. RTK survey is simple and has an advantage of obtaining a relatively accurate coordinates in a short time, the indoor place has the disadvantage that reception is not possible. Backward intersection has the advantage of being able to obtain the coordinates of the unknown point in the location of their choice. If you made to improve the system will only be able to provide more efficient and precise results than to use an indoor spatial reference point installation method that combines the RTK survey and backward intersection. This way can get Indoor spatial information relatively superior accuracy than constructing indoor spatial information database using the current Wi-Fi signal using the current Wi-Fi signal has three meters range of accuracy. Installing an indoor reference point by using the RTK survey and rear intersection is as follows. Occupy two points that is visible in the target building or facility, and receives the coordinates of these points using RTK receiver. It should be possible where the satellite signal is received by a veranda, terrace and outdoor space of the surrounding rooftops or destination building. Then, occupy one point that is visible from two points preempted reference point coordinates in the indoor space through the backward intersection preempted by the preemption point is a point on the two visible indoor and outdoor. Three buried indoor reference point that each point can see through and determine the tolerance by measuring the distance between the Cabinet and the three points.

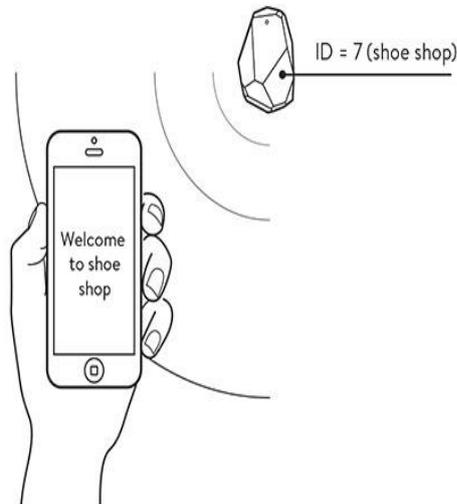


<Figure4. Way to install the indoor reference point>

An indoor installation area is only moved to the indoor from the outside, since the location of the data acquisition method is the same as the existing cadastral survey methods. The reference point coordinate of the indoor(X, Y, Z) may be obtained on the basis of the datum of the indoor space through the indoor space around the measurement information.

## 2.5 Effective Utilization Of Indoor Spatial Information Survey

Apple has unveiled a new technology named 'iBeacon' one of the iOS Software Development Kit Developer Conference in June 2013. 'iBeacon' may be referred to as very accurate GPS that can be used in indoor space easily tell the precise position information to the Bluetooth-based system. The largest core technology of LBS in the indoor space is the user can determine the exact position of less than 5cm in installed area of three or more LBS terminals are. In fact, a mere iBeacon terminal three price \$ 99, according to Apple, and installed the beacon that three terminals and about 2 inches (about 5cm) at 160 feet (about 49m) can detect the distance to. Thus, it is possible to provide indoor location-based services to devices such as smart phone through the associate with LBS terminal devices such as beacons. Through this technology can provide blind people services, such as indoor tour guide. Parts that can be used in the most positive feature of the LBS terminal for indoor spatial information survey is an indoor reference points. When the indoor reference points using the LBS terminal embedded in the indoor space, an absolute reference point with X, Y, and Z coordinate, it is possible to provide a wide range of spatial information to the user to utilize the interior space through the LBS terminal.



<Figure5. iBeacon>

It is critical that have the same absolute coordinate system with the indoor space and the outdoor space. Because the user's location might be connect from the outdoor to the indoor without interruption, even if the user enters into the indoor space from the outdoor space. For example, let's say that building a national museum management system. The museum has exhibits, but also there are also indoor and outdoor exhibits. The system includes its area zoned for each exhibit a range of coordinates and the user enters an area of a predetermined range of the respective exhibits to give coordinates to provide information of the exhibit to the user's terminal. When using this integrated system, the user will be able to receive any information about the museum and the like even when the outdoor displays and the choosing

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indoor exhibits, based on their location device is provided which exhibits in the country. If each of the museums building indoor spatial information data each one has a different coordinate system you can't receive this integrated service. Shows the indoor and outdoor space as an absolute coordinate system it can be seen equals with current flow that growing worth about 'integration' and 'simplification'. Indoor spatial information through indoor spatial information provides large indoor space such as subway, shopping malls, institutions and airports and facilities will be able to provide more accurate information made. Indoor map has shown a diagram based on a schematic drafting for a meantime, it is possible to provide to the user due to the accurate coordinate based on indoor reference point. Each facility, the passage becomes available through an absolute coordinate system, indoor facility guidance and indoor evacuation guidance can be facilitated and become more accurate.

## **2.6 Examples Of Utilization about Indoor Spatial Information Survey**

Constructed data through the indoor spatial information survey may be applied in various fields, using the user's 'current location'. To hear some of the examples are applicable in the real world,

- ① Subway indoor spatial information applications. Various exit information, and toilet, information centers and underground stores location information gives provides the basis of the current location of the user.
- ② Airport indoor spatial information applications. So that a user can look up the reservation-based ticket to the ticketing and immigration section of the path and around the facilities before boarding an aircraft of various types, such as duty-free path to the current user's location to provide the user's smartphone.
- ③ Built tourist information system. Register nationally integrated tourist attractions, and provides a wealth of information on tourist attractions through their location for tourists.

## **3. CONCLUSION**

We learn necessary of indoor spatial information survey for building indoor spatial information database with this future vision of the indoor spatial information industry through this study. Indoor spatial information through the indoor spatial information survey by cadastral worker can integrated at the national level it is possible to manage and use. Indoor spatial information survey can construct a database having absolute coordinate system through indoor reference point with LBS technology and can be provided to the user. This means that the spatial information that is not constrained in that the user can easily take place. Indoor spatial information database built by the installation of the indoor reference point is possible to implement accurate enough for some improvement over the system. However, specific system improvement plans and ways of prior occupation of installation about indoor reference points available for various types of indoor structure and maintenance way better future studies will need to be accompanied by a deep depth.

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## BIOGRAPHICAL NOTES

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