

## Design of Location Information System using a IoT-based on Sensor

Myung-Jae Lim, Yun-Jin Nam, Young Man Kwon,  
Dong kun Chung and Ki Young Lee  
Department of Medical IT, Eulji University, 13135 Seongnam, Korea

**Abstract:** This study says that design an IoT-based location information service system for the newly silver generation which enjoys cultural life in their leisure time. For this system, the principal technology of the identifying indoor location of the passenger and the guide of the user's indoor destination was explained. Based on the identified location, we proposed methods to provide and collect various information. The number of new silver generation, enjoying exhibitions and art performances is rising. Unlike the previous silver generation, they are capable of utilizing commercial mobile devices such as smartphones, smart watches and etc. Therefore, studies need to be conducted on systems to provide better information and gather better information. Thus, we designed an IoT-based location information service that links their personal device and cultural facilities. For this, we explain the IoT (Internet of Things), QR code beacons and identifying of robot's location by using ultrasonic waves. Then, we suggest using the QR code to visitor's mobile ticket, the wheelchair robot that links with the seat and the indoor navigation using algorithms to guide the path through the maze. Plus, we design systems that will help maintain and supplement the system by gathering user's information or evaluation and guiding benefit or information of the further, future research will be accompanied by the expansion of this system and more accurate indoor positioning of indoor navigation in the interior navigation system.

**Key words:** IoT (Internet of Things), LBS (Location Based Service), Beacon, QR code, mobile tickets, facilities

### INTRODUCTION

Even in the recent economic recession, the demands for exhibitions and performances are increasing consistently (Ryu-Beom, 2017). This reflects the behaviors of the modern people in trying to break away from the boring and tired everyday life to enjoy the so-called 'healing' and there are also elder couples with their children all grown and independent to enjoy their own life by visiting the performance halls and families or friends coming to the affordable performances to enjoy the civilized life. Among many performance halls, the public institutions of the art halls convenient for public access are also planning and providing various performances in accordance to these demands (Jeong-Woo, 2017; An-Sung, 2015).

However, the system in art halls has insufficiencies to accommodate the customers of various age groups. For the performances with the main customers targeted on children or the elders, there were customers in family unit accompanied by children or elder parents but recently there are many cases of the child watching the performance alone or elders attending the performance in

couples or friends. Unlike the young generation who is accustomed to the structure of the performance hall to easily find the their seats through the seating chart on the entrance, children and elders are not accustomed with the performance halls. Therefore, it takes a lot of time to find their seats or may sit in another designated seat. Most of the performances are operated in the reserved seat system, so if the reserved seat is not seated appropriately, there may be great confusion. Currently, Korea has entered the aged society since entering the aging society 17 years ago (Choi-Jae, 2016; Park-Ji, 2016). Thus, the aging population is increasing rapidly and is prospected to be increased consistently which will continue to increase the demand for performances with the senior generation as the main customers. Therefore, three systems are proposed on providing the services based on the location information of the performance hall including the recognition and guidance of the customer seat.

### LITERATURE REVIEW

**IoT (Internet of Things):** The main technologies of IoT are called the 3 major IoT based technologies which

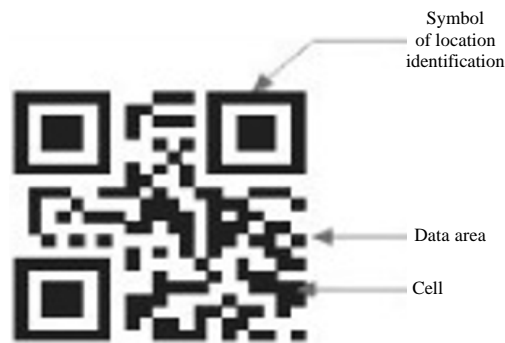


Fig. 1: Composition of QR code

is the sensing technology, wired/wireless and network infrastructure technology and service interface technology. The sensing technology plays the role of collecting the information on the peripheral environment and tangible objects through the physical sensor for processing and management. The wired/wireless communication and network infrastructure technology composes the wired/wireless network through Wi-Fi, 3G/4G/LTE, WPAN, Bluetooth, Ethernet, satellite communication, serial communication, etc. In other words, it refers to all wired/wireless network that can connect or communicate human, object and service. The service interface technology refers to the technology performing the specific function to provide the service between humans, human and object or between objects (Jin-Jo, 2008).

**Beacon:** When the smartphone user is within the signal range transmitted by the Beacon, the Beacon terminal transmits specific ID signal. The Bluetooth device in the smartphone receives this signal and the relevant App recognizes the transmitted signal to deliver the signal to the relevant server. The server that receives the signal can identify the information on the user and location and the events and services set for the relevant location are sent to the user's smartphone. When these series of processes are performed quickly, the user can simply enter the specific location but the information of the relevant location is automatically transmitted to the user's smartphone (Anonymous, 2017).

**QR code:** QR stands for 'Quick Response' which means that 'Quick Response' can be received. It is similar to the barcode but in terms of availability and information, QR code is a more advanced code system compared to the existing barcode. The QR code can include not only the internet address (URL) but also information on images, videos, maps, business cards, etc. (Fig. 1).

The biggest advance of the QR code is that a great amount of data/information can be inserted compared to the existing barcode and the short and small shape can still be maintained. Micro-QR code is mostly applied in small spaces such as in electronic components. Also, the QR code has error recovery function, so, the data information can be restored even when the code is partially contaminated or damaged. If the damage/contamination level is serious, restoration of the data may be impossible but the recognition rate is more excellent than the existing barcode. Besides, the shape of the QR code is square to be readable in any direction (Anonymous, 2017).

**Location identification of the robot through ultrasonic waves:** Domestic & Foreign Location Recognition System using Ultrasonic Waves is shown in Table 1.

### COMPOSITION OF THE LOCATION GUIDANCE SYSTEM

To realize the following three systems, the mobile ticket using the mobile phone application must be used and this mobile ticket is used for the sensing of the customer seat information.

**Location guidance system for wheelchair:** The location guidance system attached to wheelchair enables the elders requiring guidance on the seat to be seated on the wheelchair for the sensing of the QR code on the mobile ticket. Then, the system reads the customer seat information from the QR Code to guide to the relevant seat. In the distance between the current location of the user and the seat, the system show the direction of shortest distance. The location identification method using ultrasonic signal is applied in the location identification of the system and for the shortest distance finding method, the system uses the following maze navigation Algorithm 1.

#### Algorithm 1; Application of navigation algorithm:

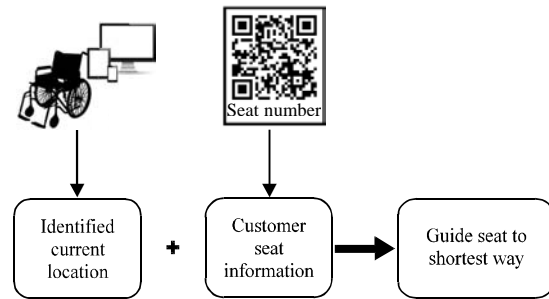
```

path(): //route search
int mcount = 1; mark[1][1]-mcount; //start point
tmp; //StackNode pointer (save pop result)
push(1, 1, 2); //push start point on stack
while (top!=null) //stack is not empty
    tmp=pop(); I=tmp.line; j=tmp.row
    mov=tmp.move+1; //substitute value
while (mov<= 8) //if direction to check remain
    g=i+move[mov][0]; //save line value
    h=j+move[mov][1]; //save row value
if (g = m&h = n) //if arrive at destination
    mark[g][h]-mcount++; //check moved point
    push(i,j,mov); //save moving route at stack
if (maze[g][h] = 0&mark[g][h] = 0) //if there is available to move and have
    never been
    mark[g][h]-mcount++; //check moved point
    push(i, j, mov); //save moving route at stack
    mov=0; I=g; j=h; //change value of I, j, mov to moving point
    mov=tmp+1; //change moving direction
    
```

**Table 1: Domestic and foreign location recognition system using ultrasonic waves (Jin-Jo, 2008)**

Name	Degrees of precision	Methods
iGS-U	Error <10 cm/2°	Transmitter on the ceiling send specific frequency Measuring the distance by receiving specific frequency ultrasonic waves from transmitter Calculate position and azimuth from measured distance value Motion area 10 m
Cricket	1.2×1.2 m, 3~5°	Beacon on the ceiling, send RF signal and ultrasonic wave frequency signal by regular interval Receiver calculate distance using RF and frequency Using triangle calculation with more than 3 distance data, estimate location on space
Active bat	9 cm (95%)	After initialization receivers on the ceiling, call specific transmitter to RF ID Generate call transmitter frequency Receiver save delay time between initialization point to frequency receiving point Using triangle calculation with 3 frequency delay time, estimate location on space Using more than 2 frequency transmitter, detect angle

The system attached to wheelchair is driven in a monitor, so, the current location of the user seated wheelchair and the moving route of the customer including the seat information are shown to the customer in real-time. The monitor not only shows the course but also provides other various services such as the guide on the relevant performance, emergency exit, future performances, cautions during the performance, etc. (Table 1).



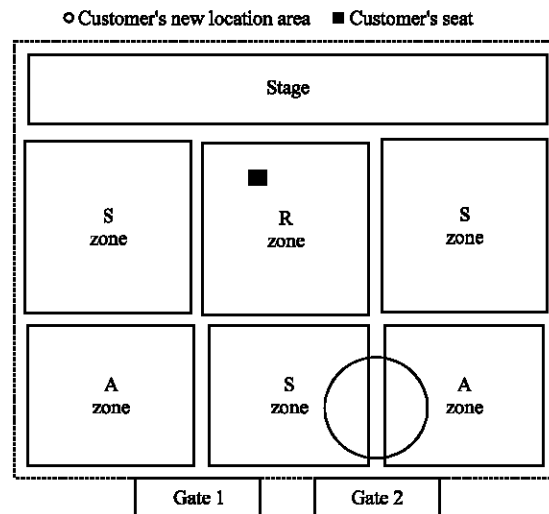
**Fig. 2: Operation of the Seat Guidance System for Wheelchair**

**Location information guide LED:** When the QR code on the mobile ticket is sensed on the robot located inside each gate of the performance hall, the location of the reserved seat is shown on the monitor. At the same time, the robot sends a signal to the relevant seat and the LED is lighted in its unique color on the seat receiving the signal to help easily identify the location. Here, the unique color is different for each robot per gate.

This robot not only helps the customer sit in the reserved seat based on the seat information but also performs the role of evacuating the customers in the case of accidents in the performance hall such as fire. The robots help customers evacuate quickly through the emergency gate by the siren or flashing the light.

**Indoor navigation:** When the mobile phone application is used to sense the mobile ticket for entry this system provides guidance on the route through the mobile phone screen. The beacon is used to identify the zone of the current user (customer) and the current location and seat zone of the customer is shown simultaneously on the screen (Fig. 2 and 3).

The current location of the user (customer) recognized through the beacon signal is indicated in a zone and the customer's seat is displayed in detail in a dot to enable the customer find the seat nearby. As the signal of the beacons nearby is stronger, the color of the zone is shown darker to inform the location. Along with simply showing the location of the seat, there is also a method of push alarm or voice message when the relevant seat becomes close or far.



**Fig. 3: Example of indoor navigation screen**

The application developed for the use of mobile ticket can be utilized diversely. First of all, the location information of the user is utilized to provide the information on other performances in the relevant hall. Along with the contents, price and discount information on other performances, the comments from critics or others on the relevant performance are shown and the user can also write comments on the performance that he or she experienced. The

application is used to exchange and communicate the information. Moreover, reservation is possible directly through the application. The records of use on the user's application can be utilized to recommend performances or perform the function of providing special discount benefits. The information is not limited only to the performances but also information regarding tasty restaurants near the performance hall and attractions can be provided.

### CONCLUSION

By using the mobile ticket in the mobile application, the seat guidance robot by the use of the QR code and the indoor seat guidance navigation based on the beacon were planned. This system of providing guidance on the seat can be used not only inside the performance halls but also in the guidance of relevant theatres in facilities with many movie theatres. Also, this system can be used in facilities with many seats such as movie theatres and baseball stadiums. In the future, the indoor navigation will be composed to not only provide guidance on the zone but also on detailed seat guidance.

### REFERENCES

- An-Sung, I., 2015. Control of mobile robot using smart phone for IoT (Internet of Things). BS Thesis, Chung-Ang University, Seoul, South Korea.
- Anonymous, 2017. Current affairs dictionary. Naver, Seongnam, South Korea. <http://terms.naver.com/entry.nhn?docId=3548848&cid=43667&categoryId=43667>.
- Choi-Jae, H., 2016. Hybrid indoor positioning technology research based on pedestrian dead reckoning, map matching and wireless signal. Master's Thesis, Kwangwoon University, Seoul, South Korea.
- Jeong-Woo, Y., 2017. Old Korean advanced society aged 65 years or older 14% or more over 65 years. Yonhap News Agency, Seoul, South Korea.
- Jin-Jo, C., 2008. Introduction to status awareness system development trends. Ninety System Co., Ltd., Seoul, Korea.
- Park-Ji, H., 2016. Study on the indoor positioning using BLE Beacon. Master Thesis, Kwangwoon University, Seoul, South Korea.
- Ryu-Beom, Y., 2017. Sinhan card increased performance during the recession has also increased. Asia Today, Singapore.