A Study on the Hall-Seat Search System using QR Code and Augmented Reality

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Abstract

There has recently been a growth in diverse integration and utilization of QR codes and augmented reality technologies with smartphones. Therefore, this study aims at designing and configuring a system that identifies concert hall seats using QR codes and augmented reality. When the QR code reader scans the QR code, information on the seat location saved in the database is uploaded. Next, the smartphone that recognized the seat location indicates the final destination with an arrow in the app and guides the user to the seat with another arrow. Such indoor seat finder is expected to help overcome the limited human resources to help users find their seats

Keywords: A*ugmented Reality, QR Code, Indoor Positioning System, App, Database*

1. Introduction

The dependency on smartphones by people has risen drastically due to various functions equipped on them and they have become an essential part for human life. In particular, the capabilities of smartphones have recently become as powerful as those of computers. Thus, there has been a growth in the use of QR codes and AR (augmented reality) technologies using smartphones [1]. With the development of smartphones at amazing speeds, QR codes are now commonly used for finding directions, installing applications, and as a marketing, PR and information provision method for events and products. Furthermore, in 2018, Kakao Pay drew attention with a brand-new alternative called 'No Commission Store QR Payment'. As such, QR codes have become part of our daily lives that not only provide information, but also are used for making payments [2]. Next is augmented reality. AR is one field of VR (virtual reality) and refers to the technology of partially combining a virtual object in a real space or adding information to be displayed in real-time. It combines the real world with virtual experiences. With the release of the smartphone game Pokémon Go in 2016, AR recently attracted huge social attention, along with VR. AR is being applied not only in games, but also increasingly to everyday life [3].

This study aims at using QR codes and AR, which have recently had increased utilization, for seat guidance at concerts. Concerts are usually held in large spaces and have many audiences. But there are only a few guides

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who manage and guide them. When numerous audiences are managed by only a few guides, problems are inevitable. One problem is that workers cannot guide all audiences to their seats. Furthermore, even if they do show them to their seats, the workers cannot manage variables such as the audiences moving or leaving after being seated [4].

Therefore, this study aims at implementing a project where the smartphone can identify and load seating information by scanning the QR code on the ticket and configure AR to guide the audience to their seat, in order to overcome limitations in manpower as mentioned above. This technology can be used efficiently and practically for both the audience and workers.

2. Related Works

2.1 Augmented Reality

Augmented reality refers to a technology that overlaps a virtual object in the real world that the user can see. As it combines the real world with a virtual world with additional information in real time and shows it as a single image, it is also called MR (mixed reality). This is a compound VR system that converges the real environment with a virtual environment. Research and development on this has been conducted mainly by the US and Japan since the late 1990s. AR, which is a concept that supplements the real world with a virtual world, uses a virtual environment produced with computer graphics, but at its core is the real environment. Computer graphics provide additional information needed by the real environment [5].

2.2 Quick Response Code

QR code is a 2D code containing various information in a square grid. For QR codes, up to 7,089 numbers, 4,296 letters, 2,953 binary bytes, and 1,817 Chinese characters can be saved. It has better identification speed, identification rate, and recovery rate compared to general barcodes. While barcodes are mostly used for computation, inventory management, checking products, etc., QR codes are mainly used for marketing, promotion, and PR [2].

2.3 Andriod

Android is a software stack and a mobile operating system that includes operating systems, middleware, user interface, and standard application programs for mobile devices including mobile phones. Android allows developers to write application programs using Java or Kotlin and offers a run-time library that can execute compiled byte codes. Furthermore, it provides an application program interface (API) and various tools needed to develop application programs using Android software development kit (SDK) [6].

2.4 Database

Database refers to the collection of data integrated and managed for the purpose of shared use by many people. It removes redundancy of data items, and structuralizes and saves data to enhance the efficiency of data search and refresh. C. Bachman, who worked for General Electrics at the time, established the concept of database in its contemporary meaning, and created the database management system called IDS in 1963 [7].

3. System Design and Implementation

3.1 System Design

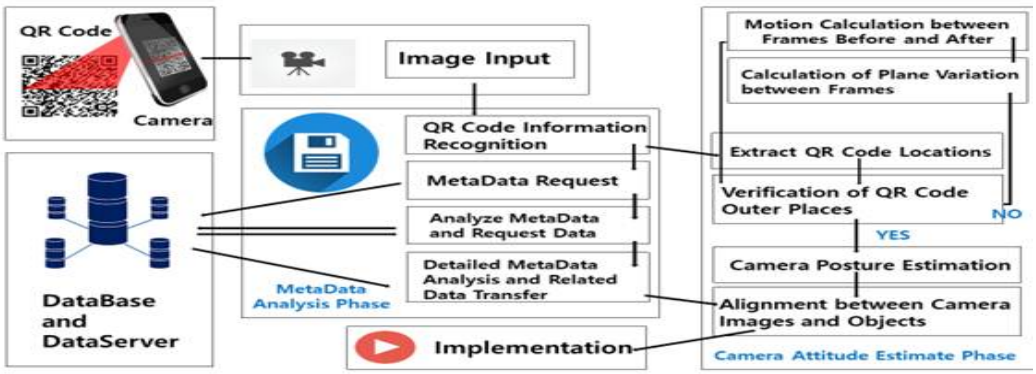

Fig. 1. System Architecture

This study intends to use Android Studio, a program used for developing software, a database for saving seating information and relevant information, and AR that visually displays seating location and directions for finding seats at concerts. By using such seating location search system, users can precisely find their seating location using their smartphones. As there are generally fewer workers compared to audiences, this study proposed a system that can overcome the inevitable problems related to limited human resources. The blueprint of this system is shown in Fig. 1.

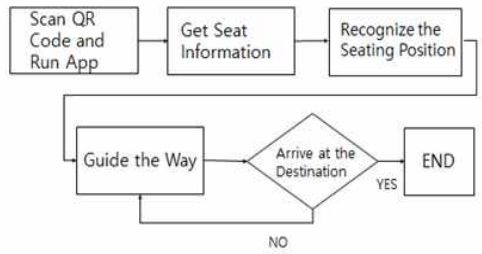

Fig. 2. System Flow

Fig. 2 shows a simplified version of the blueprint in Fig. 1 for a better understanding. First, the locations of seats are obtained to set the coordinates for each seat and this information is saved in the database. Various contents that can be used aside from searching for seating locations can use metadata. The saved data is then loaded into the QR code. When the QR code on the concert ticket is scanned with a QR code reader, the pre-saved seating data is loaded and set as the destination. Once the destination is set, it guides the user to the coordinates of the seating location. An application is used for this process, and AR is used to visualize the seat information. A total of two arrows are displayed in the application, with one arrow showing the final destination and the other arrow showing the direction to the destination. The arrow, or AR, makes it possible to find the exact location of the seat easily and quickly.

3.2 System Implementation

This study aims at developing an application using AR and QR codes. The application was developed based on the Android system, and the database was used to generate data to be displayed in the application.

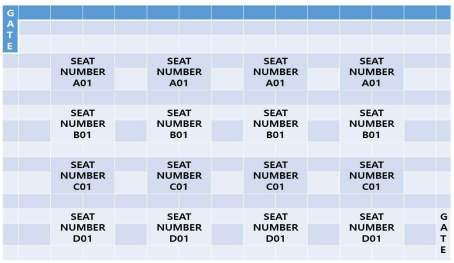

Fig. 3. Seats Map

	COLUMN 01	COLUMN 02	COLUMN 03	COLUMN 04
ROW A	A01 (20,20)	A02 (30,20)	A03 (40,20)	A04 (50,20)
ROW B	B01 (20,30)	B02 (30,30)	B03 (40,30)	B04 (50,30)
ROW C	C01 (20,40)	C02 (30,40)	C03 (40,40)	C04 (50,40)
ROW D	D01 (20,50)	D02 (30,50)	D03 (40,50)	D04 (50,50)

Fig. 4. Coordinating of Seats

The coordinates for each seat have to be set by converting the information of seats into coordinates. To this end, the seating arrangement layout of the concert hall have to be obtained. Through this, the coordinates of each seat can be available. The seating map, or the arrangement map, is shown in Fig. 3, and the resulting outcome is shown in Fig. 4.

Table 1. Table Example

id_seat	location	information
Z00	00,00	GATE
A01	20,20	Seat Number A01
A02	30,20	Seat Number A02
A03	40,20	Seat Number A03
A04	50,20	Seat Number A04
B01	20,30	Seat Number B01
B02	30,30	Seat Number B02
B03	40,30	Seat Number B03
B04	50,30	Seat Number B04
C01	20,40	Seat Number C01
C02	30,40	Seat Number C02
C03	40,40	Seat Number C03
C04	50,40	Seat Number C04
D01	20, 50	Seat Number D01
D02	30, 50	Seat Number D02
D03	40, 50	Seat Number D03
D04	50, 50	Seat Number D04

After converting the information of the seats into coordinates, a table was created to save information related to this in the database. The resulting outcomes are shown in the above Table 1.

3.3 Implementation Results

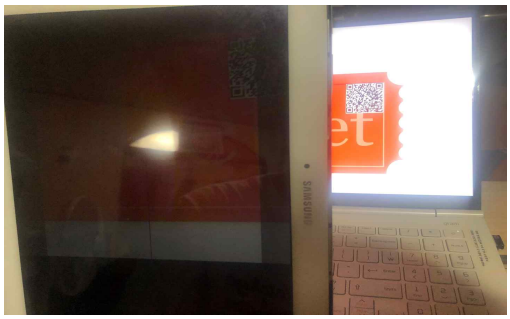

Fig. 5. System Implementation Results 1

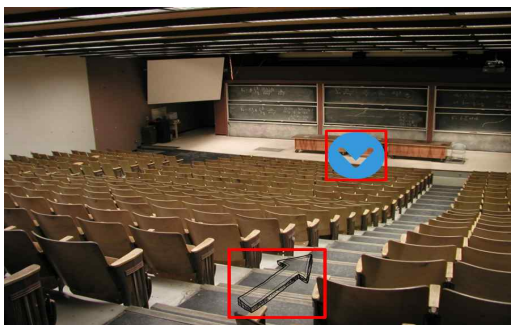

Fig. 6. System Implementation Results 2

The results of the configuration of the system proposed in this study are shown in Fig. 5 to 6. In Fig. 5, the ticket issued at the concert hall have the QR code attached to it. This QR code contains data on the seating coordinates and helps guide users to the seat. Fig. 5 shows the QR code reader that can identify the QR code shown in ticket, and also the process of recognizing the code. Through this process, data saved in the QR code can be loaded.

Fig. 6 shows the results of configuration after the procedures presented in Fig. 5. There are one arrow representing the final destination to show the precise location of the seat and another arrow that guides the user to the seat. These arrows all appear through AR and help the audience to find their seats more easily and conveniently. This is one of the most important factors that can overcome the problems of limited manpower. Therefore, in this project, the location of the seat saved in the database is loaded by scanning the QR code. After identifying the seating location, an arrow appears on the smartphone display and shows the direction to the target seat.

4. Performance Evaluation

The results of the seating information identification performance evaluation are shown in Fig. 7. The performance evaluation was performed to evaluate the accuracy of the seating location identification and guidance pertaining to the seating information identification. The results presented in Fig. 7 show the consistency between the seating location in the application and the actual seating location. The data was measured 100 times each to determine the frequency.

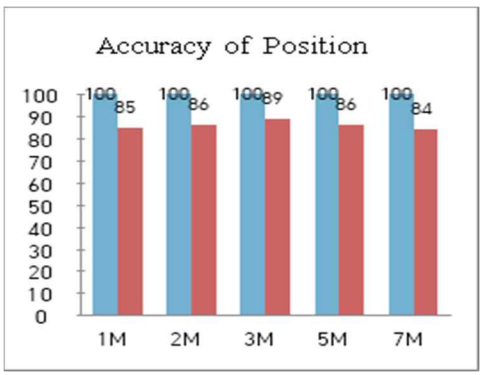

Fig. 7. Performance Evaluation 1

Fig. 7 shows that the locations of seats were measured consistently on average, whether the user was close or far from the seat. This demonstrates that the location of the seat to be guided to by the application and the actual location of the seat were consistent and accurate. In other words, as seen from the chart, it was found that all the measurement values exceeded 40 and there were almost no differences. The below Table 2 shows that the location of the seat that appeared in the application had little error in measurements, when guiding the user to the actual seat. There were some differences, but these were errors due to other electronic devices or electronic wavelengths that had a big impact on the surrounding areas. Therefore, it is evident that on average, it had constant accuracy without significant errors. However, because many people gather at concert halls, there is a high possibility that there may be electronic devices or electronic waves that can affect the application. Therefore, metadata should be used to offset this to not only resolve such issues, but also increase usability by allowing it to save more types of information.

Table 2. Accuracy Error

List / Distance	Times	Error	Error Probability
1M	85	15	0.15
2M	86	14	0.14
3M	89	11	0.11
5M	86	14	0.14
7M	84	16	0.16

5. Conclusion

This study configured a service for guiding the audience to seats at concert halls using AR and QR codes. It was designed and configured to identify the location information of seats using a QR code and display arrows in the app using AR, and for easy guide to seats. It is evident that visitors can find their own seats easily without the help of staff, therefore making it possible to overcome the issue related to limited manpower. This study has some limitations that errors can occur due to strong electronic devices and electronic waves, and the seating location information could be obtained only using the database. These problems will be resolved using metadata in the future.

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