

# Multimodal User Interface for QR Code based Indoor Navigation System

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**Abstract**—we are developing a smartphone application system that grasps indoor location information and navigates to a destination by scanning several QR codes in a facility. In this system, it is important to navigate easily to a destination by making scanning QR codes as a trigger. Therefore, we developed a user interface that makes indoor navigation intuitive by displaying text information, augmented reality (AR), and a plane view from information of QR codes scanned with a smart phone. We conducted the evaluation experiment in the campus of Nagasaki University and received favorable evaluation results in terms of functions and services.

**Keywords**—Multimodal user interface, QR code, Indoor navigation system

## I. INTRODUCTION

Since receiving of GPS signals can be difficult in a building, such as a university, hospital or factory, the solution using Wi-Fi or beacons that receive weak radio waves is proposed [1]. However, it requires periodical maintenance such as setting of beacons or replacing batteries. Therefore, we are developing a smartphone application system that grasps indoor location information and navigates to a destination by scanning QR codes in a facility. In this system, it is important to navigate easily to a destination by making scanning QR codes as a trigger. This is because maps of facilities are not in standardized expression, different from regularized navigation in map applications. Therefore, we developed a user interface that makes indoor navigation intuitive by displaying superimposedly text information, augmented reality (AR), and a plane view from information of QR codes scanned with a smart phone. We conducted the evaluation experiment in the campus of Nagasaki University using our developed prototype system and received favorable evaluation results in terms of functions and services.

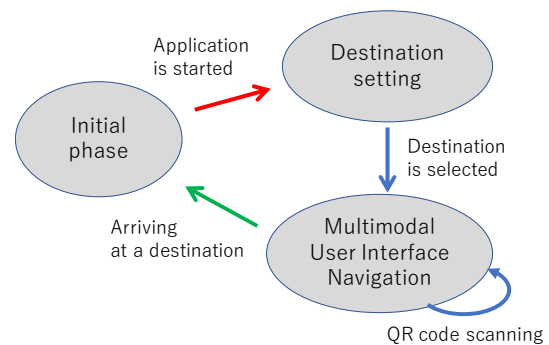


Fig. 1. State transition of QR Code based Indoor Navigation System

## II. RELATED WORK

The study that enables indoor navigation by grasping a present position using a QR code has been conducted [2]. These studies focus not on a user interface for navigation, but on route search. Platforms for indoor navigation with AR have been made into products [3]. Since these are specialized in navigation only with AR, multimodal navigation is not achieved.

## III. MULTIMODAL USER INTERFACE

### A. State transition

Fig.1 shows the state transition of the system. When a dedicated application for a smartphone is started, the initial phase transits into the destination setting phase. Once a destination is set, it enters into the phase of the Multimodal User Interface Navigation. In this phase, a camera becomes available so that it can scan a QR code in a building. Displaying superimposedly text information, AR, and a plain view, which are based on information of QR codes, activates the Multimodal User Interface Navigation. The system repeats navigation by scanning QR codes that are at several main

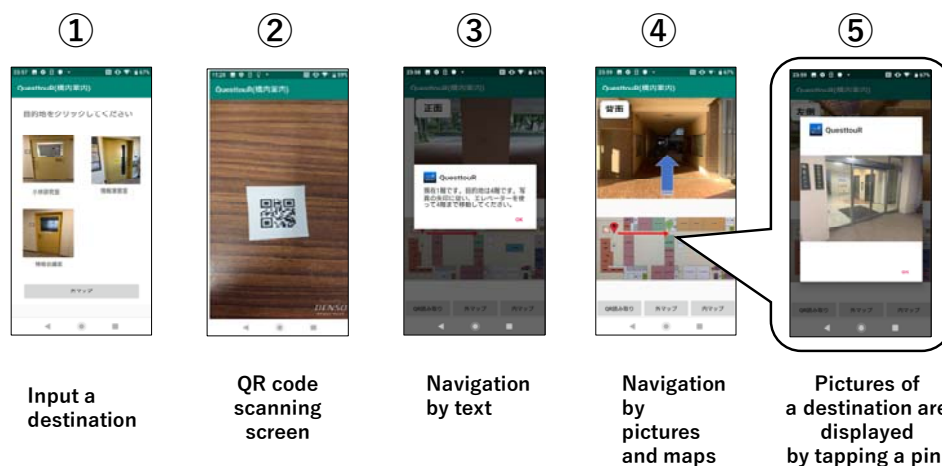


Fig. 2. Multimodal user interface design

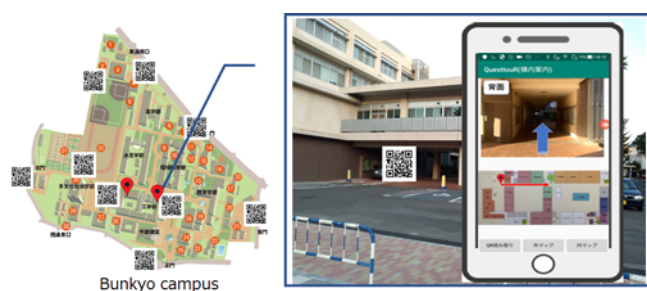


Fig. 3. State transition for QR Code based Indoor Navigation System



Fig. 4. Demonstration of multimodal user interface in Toyama Univ.

points in a building. When you reach at your destination, the phase goes back to the initial phase.

### B. Multimodal User Interface Design

Fig. 2 shows our proposed multimodal user interface design. In the phase of destination setting, a destination is selectable from pictures or names of a point of interest (POI) (①). In the phase of the Multimodal User Interface Navigation, a present position is grasped by scanning a QR code with a QR code scanning screen (②). On the basis of a POI and a present position, the system navigates you to a QR code to be scanned next using text information (③), AR (upper part of ④), and a plain view (lower of ④). On a plain view, the places of QR

codes are marked. Tapping these shows you pictures of where you are at present (⑤). The procedures from ② to ⑤ are repeated until you arrive at a destination.

### C. Evaluation

We conducted a demonstration experiment in Bunkyo Campus, Nagasaki University to evaluate the effectiveness of the Multimodal User Interface Navigation using our developed prototype system (Fig. 3). Furthermore, we gave the demonstration using an actual device and a video at "Student's manufacturing idea contest in Toyama" held in Toyama University on November 30, 2019 (Fig. 4). In the contest, we showed the video of the demonstration held in Bunkyo Campus and won first place out of 28 teams. The judges rated highly the practicality of the user interface for indoor navigation that we demonstrated.

## IV. CONCLUSION

We developed a user interface that makes indoor navigation intuitive by displaying superimposedly text information, augmented reality (AR), and a plane view from information of QR codes scanned with a smart phone. The demonstration experiment at Nagasaki University and the idea contest highly evaluated the practicality of the user interface. For future work, we will deal with problems such as route re-search in putting the system to practical use as an indoor navigation system.

## REFERENCES

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