

Improvement of OTIP System using Location Information Based on Smartphone

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Abstract—In the case of the previously developed automatic attendance checking system, such separate devices as RFID reader and fingerprint detector are required. On this account, the initial construction cost will increase and there will be some managerial issues due to mechanical malfunction and illegal attendance. To address such problem, the smartphone based automatic attendance checking system using QR code was proposed. However, this method cannot solve the issue of illegal attendance completely either. This paper proposes a new system that improves the issue of illegal attendance by enhancing the shortcomings of the previous system. The proposed system can reduce the initial construction cost because it does not require additional device when constructing a system using an embedded camera of smartphone. Moreover, it can obtain the effect of preventing illegal attendance by acquiring location information by utilizing both QR code and Beacon.

Keywords— automatic attendance checking system, QR code, LMS, Beacon.

I. INTRODUCTION

AS for the smartphone distribution rate of each country provided by Google, more than 70% of Koreans are using a smartphone. In particular, 98% of those aged between 18 and 24 years old are using a smartphone. 95% of those aged between 25 and 34 years old are using a smartphone. A rapid increase in the number of smartphone users would have a significant impact on the entire internet market. Also, it brought about innovation in the mobile field including mobile game ecosystem and life-centric mobile applications[1]. Smartphone is often used for educational use because it allows us to install and run various applications freely. It also establishes smart classrooms that leverage mobile devices. In a smart classroom, it is necessary to have various educational contents suitable for mobile devices. Moreover, it is also important to have a smart educational environment including electronic board, electronic desk, lecture management system and automatic attendance checking system. However, the old-fashioned paper based attendance sheet is still being used in the schools. This method is very inconvenient because

professors should check attendance of students in their respective class. As a result, lecture time is inevitably reduced.

Some schools are using the automatic attendance checking system. However, the currently available automatic attendance checking system requires additional device such as RFID reader and fingerprint detector. On this account, there are still several managerial issues resulting from higher initial construction cost, mechanical malfunction and illegal attendance. To address the aforementioned problems, the OTIP system(On Time In Place: the automatic attendance checking system using QR code) was developed[2]. The OTIP system does not need to install any additional equipment. Moreover, when professors generate QR code, those students in a corresponding class can undergo attendance check automatically by scanning the generated QR code. Professors are able to verify attendance information at any time through web or app. They are also able to modify the information about students through the administrative mode. However, this system has the limitation that attendance can still be accepted if those students in a class transmit QR code to students who are not physically in a class.

This paper proposes a new system that improves the issues associated with illegal attendance by enhancing the current shortcomings of OTIP system by utilizing Beacon. The proposed system utilizes an embedded camera of smartphone. Thus, it does not require additional device when constructing a system. As a result, it is possible to reduce initial construction cost. Moreover, it is possible to prevent illegal attendance by acquiring location information with the use of both QR code and Beacon.

II. RELATED WORKS

A. Beacon

Beacon refers to a device to transmit certain signals in a non-directional way at a specific frequency in order to inform location data. Beacon gained a lot of attention because Apple unveiled 'iBeacon'. This is based BLE(Bluetooth Low Energy) technologies as an extended version of Bluetooth. BLE has a low amount of power compared to low-frequency sound(can be used for maximum 2 years as a coin battery). Moreover, it is possible to miniaturize. It also has the advantage that it can be installed anywhere as being free of physical environment. Beacon transmits a particular ID when a person having a smartphone comes within one's signal reach distance.

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Smartphone application recognizes such value and transmits it to a server. The server having ID confirms the location. Then, events or service information established in a corresponding location will be transmitted to a smartphone. For Beacon service to operate effectively, OS of user smartphone should be iOS 7.0 or higher and Android 4.3 or higher. Moreover, Bluetooth device should be available and Beacon SDK embedded service app. should be installed in user smartphone [3].

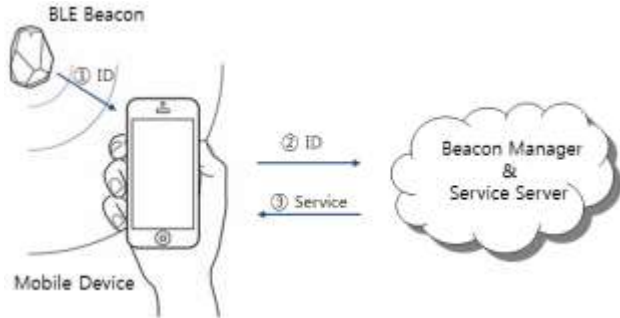


Fig. 1: The operation principle of Beacon [3].

B. The Existing Automatic Attendance Check System

The existing automatic attendance check system utilizes RFID, fingerprint detection, facial recognition and signal transmission technologies. RFID based automatic attendance check system[4] is to collect attendance related data automatically when students place RFID card to a reader installed in a classroom. This system incurs a lot of construction cost. Also, if students lost a smart card, then there will be no way to check student attendance. Furthermore, it is possible to conduct illegal attendance check by lending it to other people. The fingerprint recognition based automatic attendance checking system [5] is to collect attendance related data by recognizing the fingerprints of students. Thus, it is highly reliably. However, it is required to install fingerprint detector. Thus, it incurs a high cost for installation. The facial recognition based attendance checking system[6] is to manage attendance status of a corresponding class automatically by recognizing facial information through self-structuring neural circuit network.

The bi-directional lecture system called Clicker[7] allows for automatic attendance check and also allows professors and students to have Q&A session. However, it requires additional personal Clicker. Thus, it incurs additional cost. OTIP system[2] is the method to check attendance by using QR code. Students conduct attendance check by placing generated QR code onto their smartphone after installing a relevant application. Therefore, it is not required to purchase additional device for attendance checking. As a result, it has the advantage that the installation cost is very low. However, this system can be illegally misused if those students in a class transmit QR code to students not physically in a class.

This paper proposes a new system that improves the issues of illegal attendance by enhancing the aforementioned problems of OTIP system by utilizing Beacon.

III. IMPROVEMENT OF THE OTIP SYSTEM

The configuration of automatic attendance checking system proposed in this paper is as shown in Figure 2. First, QR code generator generates QR code corresponding to each subject at the server if professors select QR code generation menu by using a mobile device or PC. Herein, such information as subject information, QR code recognition start time and termination time and QR code generation time will be saved in QR code. In particular, it is possible to pre-assign QR code valid period in order to prevent reuse of QR code. Upon completion of this valid period, a new QR code will be re-generated.

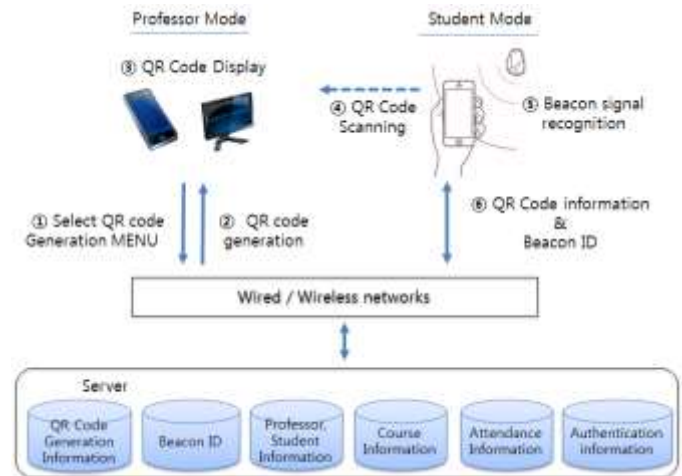


Fig. 2: Flowchart of improved OTIP system

Herein, student attendance is checked when they scan QR code using their smartphone and the information of their smartphone is transmitted to the server. The features of the system proposed in this paper are as follows. First, it is to check student attendance using QR code. Thus, attendance is checked automatically when students recognizes QR code with their smartphone after installing the relevant app onto their smartphone. On this account, they do not need to purchase additional detector for attendance checking. That is to say, there is no additional cost for installation. Second, there is a low possibility of proxy attendance because their attendance is accepted with their smartphone.

QR code generation is conducted by professors at the server. Professors are able to select a medium such as smartphone, printer and monitor in order to express generated QR code. QR code detector recognizes QR code generated by QR code generator. After then, the acquired information and personal identification information are sent to the server after acquiring the information containing QR code. The server processes transmitted data and updates DB. After then, results will be updated in accordance with the situation of professors and students in order to renew the screen of each user. However, QR code image taken within QR code valid period is transmitted to students(absentees) outside a classroom. If those students outside a classroom scan this QR code, then their attendance will be accepted. To solve such problem, this

paper improves the existing system by adding a function for students to receive Beacon signal at the same time as scanning QR code by utilizing a smartphone. That is to say, only attendance of those students who scanned valid QR code while recognizing Beacon signals in a classroom shall be accepted.

IV. CONCLUSION

The system proposed in this paper performs attendance management by one-stop economically by utilizing the camera and Bluetooth function of a smartphone owned by students without any additional device. As a result of applying the proposed system to the actual classes, it was proved that the proposed system could be used for simultaneous(10,000 people/180 seconds) and real time(100ms) attendance checking of a large number of students. It utilizes smartphone number, QR code and Beacon ID information that are in a lecture room. Thus, it has an excellent effect of preventing proxy attendance compared to the other electronic attendance checking method using student ID cards. Moreover, it is able to detect those early leavers during class because it continues to check whether students are still present in a classroom by utilizing the communication function of a smartphone and Beacon.

To verify the performance of this system, it was tested in a classroom by using Android phone and iPhone. On that account, the apps installed on each device were monitored to find out how they would recognize Beacon after placing the Beacon gradually far from the two devices that had installed the same app. As a result of the experiment, iPhone's Beacon signal intensity(RSSI: Received Signal Strength Indicator) had decreased slowly in reverse proportion with distance from Beacon. In contrast, Android phone's signal jumped at a particular distance and also its correlation between distance and signal intensity was substantially unstable. The future task is to develop the automatic attendance checking system that can operate without any error albeit the aforementioned unstable signal.

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