Research on WeChat Attendance Technology Based on Geographical Location and iBeacon

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Abstract. In the society today there are many occasions that involve attendance or sign-ins, and applications and technologies are emerging one after another. This paper focuses on the geographical location-based and iBeacon-based micro-attendance technology, and gives a concrete implementation of the two. This paper also improves the micro-attendance technology based on iBeacon. While using iBeacon positioning service, we overcome the shortcomings of “Shake” attendance and greatly optimize the user experience.

1. Introduction

1.1. Overview of Application Background
Attendance or sign-in (hereinafter referred to as attendance) is very common in modern social life, and there are many application scenarios of them. Be it employees’ punching in and out of work, or the student’s class name calling, or product meeting, or reading club, etc., sign-in is needed in all these scenarios. But there are many ways to sign in, and the application levels differ greatly. In terms of ways of operation, there are the traditional punching machines and the now popular fingerprint punching machines, and even paper forms filled by hand. These methods have many disadvantages such as inconvenient use, high cost, low efficiency, scattered information, poor real-time performance, and difficulty in statistical processing [1]. With the increasing popularity of smart phones and the rapid development of mobile internet technology, the attendance system using smart phones, that is, the mobile time attendance system, has gradually emerged in recent years.

Mobile attendance system is a new type of attendance system constructed by mobile phone positioning mechanism, location service, mobile communication network and the Internet [2]. These mobile Internet-based attendance systems of the new generation have broken through the application constraints of traditional punching machines, fingerprint machines and other fixed devices in terms of attendance action and form. They are not limited by the attendance place and attendance time. They have the advantages such as low-cost, convenience, efficiency and standardization[3]. In mobile devices, the APPs require users to download them, which is inconvenient; while the WeChat-based system does not require downloading, and the application is extensive. This article focuses on mobile attendance technology based on mobile phone WeChat, namely micro-attendance technology.
1.2. Overview of WeChat-based Attendance Technology

From the perspective of user demand, the important issues concerning attendance are as follows: whether it is accurate, convenient, and smooth for statistics. Among them accuracy is the primary and basic demand, because ease of use and smoothness of data export are related to the user's experience and are thus acceptable to a certain extent, but the demand for accuracy is compulsory. The so-called accuracy means to ensure that the user should attend in person at the attendance location.

From the perspective of implementation, WeChat-based attendance usually utilizes QR code, geographic location or iBeacon shake. Each of these methods has its own advantages and disadvantages. They can be used alone or in combination to prevent attendance cheating and improve attendance accuracy.

- Method based on generating a QR code with parameters
  This method is mainly to create a temporary QR code, and then release the QR code on the attendance site, and the attendees scan the code to sign in to attendance. The expiration time of the QR code can be set according to needs, generally set to 1 to 5 minutes, in order to prevent the QR code from being photographed and shared to the off-site personnel, but it is difficult to guarantee based on actual experience. The advantage is that the implementation is relatively easy, and the phenomenon of attendance cheating can be partially prevented. The shortcomings are obvious. Since there is no geographical location, there is no prevention from scanning of the QR code in another place.

- Method based on getting the user's geographic interface and Baidu map interface
  The basic principle of this method is: the user enters the Official Account, WeChat automatically uploads the latitude and longitude of the user's geographic location, and the background will compare the user's location with the company's location. If the distance is within the set effective range, the punching is successful.

- Method based on iBeacon WeChat Shake
  This method is mainly used in this scenario: the user shakes with WeChat within a certain range of the iBeacon device. WeChat sends a message. If the message corresponds to a page link such as a check-in form, the user fills in the form and information on the page. Thus the purpose of attendance is met. The iBeacon technology will be described in detail below.

2. Location-based Micro-attendance Technology

2.1. Positioning Technology

At present, the positioning technology adopted by WeChat is GPS (Global Positioning System) and LBS (Location-Based Service). Maybe there will be BDS (Beidou Navigation Satellite System) in the future. [4] GPS positioning is a technique for positioning by satellite. The advantage is that the positioning accuracy is high (the error is within 20 meters). The disadvantage is that the power consumption is large and that the positioning cannot be conducted indoors. LBS positioning is a positioning technology for obtaining location information (geographic coordinates) of mobile terminal users through telecommunication and mobile operators' radio communication networks (such as GSM network and CDMA network). The advantage is low power consumption, which can be located anytime and anywhere. The accuracy is not high (50-200 meters).

WeChat uses the interface provided by various map software (Baidu map, Gaode map, etc.) to obtain the geographic coordinates using the getLocation function.
2.2. Implementation of Micro-attendance Technology Based on Geographic Location

```java
private const double EARTH_RADIUS = 6378137;

/// <summary>
/// Calculate the positions of two points and return the distance between them, the unit being meters
/// This formula is provided by Google and has an error smaller than 0.2 meters
/// </summary>
/// <param name="lat1">Latitude of the first point</param>
/// <param name="lng1">Longitude of the first point</param>
/// <param name="lat2">Latitude of the second point</param>
/// <param name="lng2">Longitude of the second point</param>
/// <returns></returns>
public static double GetDistance(double lat1, double lng1, double lat2, double lng2)
{
    double radLat1 = Rad(lat1);
    double radLat2 = Rad(lat2);
    double radLng1 = Rad(lng1);
    double radLng2 = Rad(lng2);
    double a = radLat1 - radLat2;
    double b = radLng1 - radLng2;
    double s = 2 * Math.Asin(Math.Sqrt(Math.Pow(Math.Sin(a / 2), 2)
        + Math.Cos(radLat1) * Math.Cos(radLat2) * Math.Pow(Math.Sin(b / 2), 2))) * EARTH_RADIUS;
    return s;
}
```

Figure 1. Method for calculating distance

In the H5 interface of WeChat, the geographical location information can be obtained by directly calling the `getLocation` function. In order to complete the location-based attendance, we need to configure the attendance origin first, and then configure a range of attendance. It is recommended that the value be more than 50 meters. According to the actual application test, if the value is lower than 50 meters, attendance cannot be performed correctly on some mobile phones.

Then, the user opens the page and reports the geographical location information of the location to the server, and the attendance system calculates the distance from the reporting point to the origin of the attendance through the spherical distance calculation function. At the same time, the attendance location and distance are entered into the database for big data analysis. Figure 1 shows the calculation of the distance between two points on the Earth.

3. Micro-attendance Technology Based on iBeacon

3.1. iBeacon Technology

According to Baidu Encyclopedia, iBeacon is a new feature on the mobile device OS (iOS7) released by Apple in September 2013. The way it works is that a device equipped with Bluetooth low energy (BLE) communication uses BLE technology to send its own unique ID signal, and the application that receives the ID signal takes some action according to the signal [5]. More specifically, the working principle is: the iBeacon device uses the BLE technology to send its own unique signal to the surroundings, then the mobile device operating system locates and receives and interprets it, and feeds back signals to all application software APPs waiting for the iBeacon signal, and then sends the UUID, Major, Minor and other information. The APP that receives the signal first confirms the UUID, and if the confirmation is a signal sent to itself, it is processed according to the combination of Major and Minor [3].

3.2. Implementation of Micro-attendance Based on iBeacon

This method needs applying to WeChat for the access to “Shake” nearby in the first place. Application for the iBeacon device on WeChat is shown in Figure 2. After the application is completed, the service account can obtain the corresponding interface. The user turns on the Bluetooth and uses the WeChat...
Shake function. The WeChat server sends the iBeacon information that the WeChat gets to the service server. The service server then determines whether the WeChat server pushes the webpage to the user according to the business logic. The user must also turn on the Bluetooth of the phone so that the WeChat Shake can be used normally. This is the usual practice of micro-attendance using WeChat shake.

In the case where the precise location is not required for the geographical location, such as meeting check-in, class attendance, etc., the user’s shaking of the device can be directly regarded as a criterion. Due to the maximum range of iBeacon transmission, the standard signal is about 70 meters and the remote signal is up to 450 meters. [5] So if there are multiple classrooms in class at the same time, or if there are multiple conferences at the same time, using iBeacon for attendance will cause WeChat to shake out multiple messages, which will easily confuse users.

To overcome this shortcoming, it is necessary to improve the method. First, when creating an activity, the activity is mapped to an iBeacon; then the user scans the QR code of the activity to perform an activity check-in attendance; after the page is submitted, the system background calculates the distance between the current mobile phone and the set iBeacon, so as to determine whether the attendance is within the appropriate range. The implementation principle of the new method is shown in Figure 3. The new method has changed the traditional way that needs to “shake”, instead the user no longer needs to shake the phone; at the same time, the new method overcomes the proximity while simultaneously binding the activity with the specific iBeacon. There are multiple iBeacon signals, which users do not need to choose among. In fact, users do not need to know the existence of iBeacon, which saves the trouble of choice and is easier and faster to use.
4. **Comparison and Summary of Two Micro-attendance Techniques**

From the point of view of the emergence of technology, geographical location technology appears relatively earlier, system stability is high, and more mature. From a perspective of cost, development costs are low and no hardware investment is required. The disadvantage is that it is easy to cheat.

The iBeacon technology is relatively new, but because its most basic function is positioning, the technology is more suitable for attendance. But the development will be more difficult. For the micro-attendance of iBeacon, this paper gives two methods, one is the “Shake” method, and the other is the method of improving that. The new method is more convenient and the user experience is good. Table 1 compares location-based services and iBeacon-based attendance methods.

|                     | Geolocation attendance | iBeacon attendance |
|---------------------|------------------------|--------------------|
| Development investment | low                    | relatively high    |
| Hardware investment  | no                     | yes                |
| Signal dependence   | GPS                    | bluetooth          |
| Positioning accuracy | 50 meters              | 10 meters (three-point positioning) within 60 meters (one device) |
| Cheating difficulty  | low                    | relatively high    |

5. **References**

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