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IMPLEMENTATION OF MOBILE ATTENDANCE APPLICATION USING GEO-FENCE TECHNIQUE

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ABSTRACT

Attendance systems were developed before the mobile device has been introduced to the market. The traditional system and web-based system are accepted method to keep track the attendance of the staff. Some companies introduce a secure and expensive system such as RFID and Thumbprint technology. With the emergence of the GPS enabled device in smart phone, there is a need to introduce a smart phone as a medium to clock in and clock out for staff attendance, especially who work off-site. This paper will discuss the geo-fence technique and its implementation for mobile attendance android based application. The technique is suitable for analysing the location and boundaries of a GPS mobile enabled especially for staffs who are working away from the office or outstation. From the implementation conducted, the application functions well to keep track staff attendance records.

Keywords: GPS, mobile attendance, GEO-fence technique.

INTRODUCTION

Recording secured staff attendance is not an easy task because of authorization issues and limited kiosk for clock in or clock out. Some of the employees are using the thumbprint which is expensive for a company and it cannot be accessed from outside of the office as the device is fixed in the office. Mobile technology makes the attendance management system much easier and cheaper for the employer to record their staff attendance.

The objective of this paper is to show how the implementation of mobile attendance application developed using geo-fence technique to analyse the location of a person using a GPS smart phone. It is a system that was designed to minimise inputs from users. The proposed application was developed on the android platform with GPS and Wifi-3G technologies. To operate the system, users can just tap to the application and the attendance will be recorded into the database. With a single tap, the system will be able to determine details of a particular staff using IMEI number, record an exact location from the GPS with a date and time. This is critical information that is important to store for attendance tracking. The IMEI number and the phone will be verified by the admin to make sure the correctness of the information and legitimate of the device. Apart from that, this paper will show an algorithm to verify the boundary of GPS location using the geo-fence to make a virtual boundary of the particular location.

Figure-1 illustrates an overall view of system where the smart phone detects staff location that has been sent from the satellite. Then, the data will be sent to central computer. All the information will be stored in the database and compare with data that already in database.

This is done to identify the status of attendance that is clock in or clock out. Finally, the administrator and staff can access and update the data in database.

The rest of this paper is organized as follows; Section 2 discusses related work on the technology and the applications. Section 3 presents the design and proposed

algorithm for the mobile attendance application. Section 4 discusses the implementation and the last section concludes the paper.

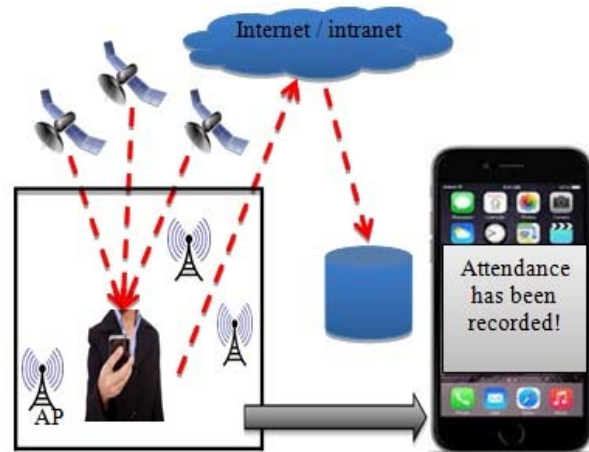


Figure-1. General model of a mobile attendance system using GPS enable device.

RELATED WORK

Tracking with Global Positioning System (GPS)

There are a number of applications that used GPS for tracking. GPS allows an object to be tracked by detecting GPS unit that installed in a device. When a person carries that device, a satellite can detect the GPS location. Nowadays, most of the smart phone already embeds a GPS unit. This section will discuss related technology for tracking systems based on GPS.

Location based queries

Rajachandrasekar *et al.* categorized Location Based Queries (LBQ) into four types as follows [1];



- i) Range queries (RQ)
Range queries enable to retrieve nearby locations within a specified range of the GPS location. Someone with a GPS enabled device can search nearby object using this queries. The application such as a store locator usually used this kind of queries.
- ii) Nearest neighbor queries (NNQ)
For NNQ, the nearest objects return to the specific location based on the queries.
- iii) Navigation queries (NQ)
With NQ, the user with GPS location can be instructed to follow the path to certain destination.
- iv) Geo-fence queries (GFQ)
GFQ enables a user to create virtual boundaries of an area consist a number of coordinates. These coordinate represent the new specific area on the map. With these boundaries, much application can be implemented such as child tracking system and car tracking system.

Mate *et al.* proposed continuous query based for LBQ in their research [8]. While Mon and then proposed hybrid index structure to improve searching for nearest places by reducing time and distribution cost [9]. From the queries discussed, the GFQ is the suitable query to be implemented in this project to keep track the staff attendance.

GEO-fencing

Geo-fencing is a virtual barrier that used the global positioning system (GPS) or radio frequency identification (RFID) to define geographical boundaries. Its function allows an application to trigger when a device crosses a Geo-fence and enters (or exits) the boundaries defined. The alert sent can be an email or SMS. Most of the Geo-fencing applications incorporate with Google Earth that allows us to define boundaries on top of a satellite view of a specific geographical area. Some application defines boundaries by longitude and latitude or through user-created and Web-based maps.

With the alert function, where the location-aware device of a location-based service (LBS) user enters or exits a geo-fence, the device receives a generated notification. This notification might contain information about the location of the device that is suitable to notify parents when the leaves pre-defined areas.

Other applications that used the GPS are as follows;

- Car tracking system [4,5].
- Child tracking system [6]
- Patients tracking system [7]

GEO-fence query

As discuss earlier, to capture the border of a location with multiple coordinate, geo-fence technique is used. With this technique, the human resource department staff will create the area of a working site area using a map such as Google Map. Figure-2 shows the virtual boundary using geo-fence query. With the query, the users can create a virtual boundary of the maps. The coordinate

values of the area will be stored in the database. The system will compare the GPS of the staff that work at the site at the particular time whether they are in the boundary or outside the boundary. The staff can only clock in or clock out within the boundary.

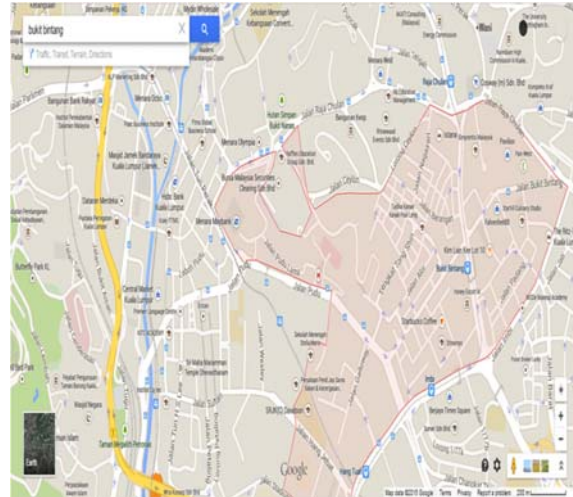


Figure-2. Virtual boundary using geo-fence technology.

There is a real world application that used the technology. Song *et. al.* used the geo-fence technique to extract information of truck loading time and hauling time of a heavy construction operation by simulates the data collected [2]. With this information, the time management of the operations can be monitored.

For the purpose of the attendance system, the input varies in terms of hardware to minimise the input to validate a person. Table-1 is the comparison of other similar projects from [6,7].

Table-1. Summary of system comparison.

Author	Mohd Firdaus Mahyidin [6]	Ruchika <i>et. al.</i> [7]
Project Name	Student Attendance Using RFID System	GPS and GPRS Based Cost Effective Human Tracking System Using Mobile Phones
Technology	Radio frequency Identification (RFID)	Global Positioning System (GPS)
Disadvantages	Student tends to lose or misplace their student card so this system cannot be performed without student card	- Tendencies of failure in transmitting a data packet to server using GPRS are high. -Slow Internet connection when using GPRS



DESIGN AND PROPOSE ALGORITHM FOR MOBILE ATTENDANCE SYSTEM (MAS)

Context diagram for MAS

Figure-3 shows a flow of data and processes within the system. Admin will create a database for staff and map management. From the information provided, the staff can use the application for clock in, clock out, update personal information and check for attendance reports. The process of checking boundary for correct location of each staff will be done automatically by system using data provided by admin.

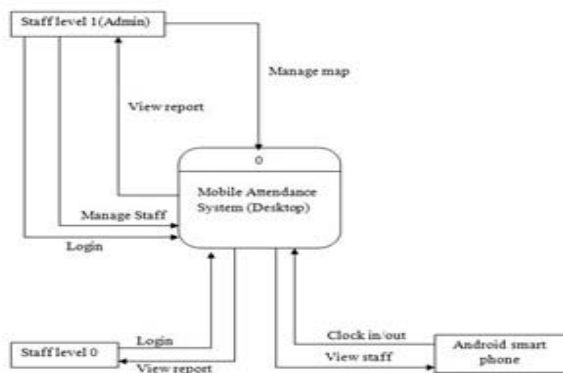


Figure-3. Context diagram for MAS

The propose algorithm for boundary based on GEO-fence technique

The following algorithm will be invoked by two modules, which are clock-in and clock out. The algorithm will automatically check the boundary for each staff based on information provided by admin. The algorithm will be able to recognize the staff in organization and works in different location by a set of GPS locations belong to certain staff. If the staff is out of the boundaries, the system will not allow the staff to be clocked in.

```

Start
1. Login by Staff ( Get the userID and IMEI number)
2. Searching For GPS location
3. Check the boundary of the staff
   3.1 Read GPS coordinates for particular staff
   3.2 CreatePolyLine for the coordinates
   3.3 Get current GPS location for the staff
   • If the staff within the boundaries of PolyLine
     • Send the userID, IMEI Number to clock in and clock out module
     • Save the attendance record into database.
     • Notify the user for successfully clock-in or clock-out processes
   • Else
     • Clock-in and Clock-out process not allowed
     • Go to 2
End
  
```

The implementation of mobile attendance system

Mobile Attendance System by GPS enabled Android smart phone is the system that using GPS location provided by the staff smart phone to get staff current location to enable the user to clock in or clock out their attendance record when the staff is in the valid location. It is suitable to record staff working hours. The system provides ease of management for the administrators to view and track staffs' attendance performance. This system can create virtual boundaries of a company location using geo fence technique so that the system can determine the staff is in valid location or not.

As a conclusion, this product can be applied to tracking and recording staff attendance more secure and effective.

Login

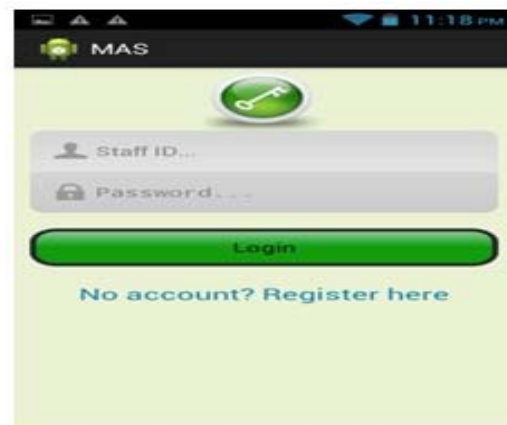


Figure-4. Login screen

Figure-4 shows the main interface for MAS application. Staff must enter their staff id and password for login to the system.

Registration



Figure-5. Screen for registration of a new staff.



Figure-5 shows the registration interface for MAS application. Staff must enter valid staff id and new password and the human resource department will validate the information.

Clock in and Clock out

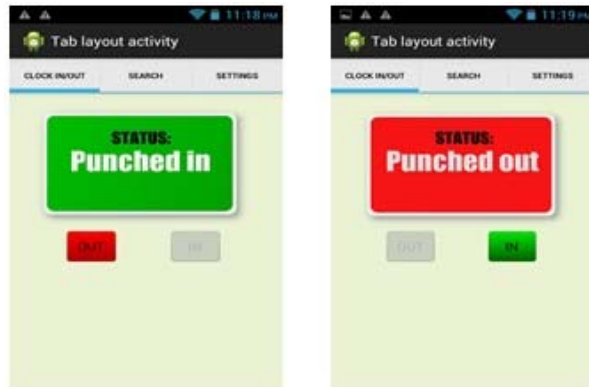


Figure-6. Clock in and clock out.

Figure-6 shows the clock in and clock out interface for MAS applications. Staffs have to click the button to record their attendance. The button will invoke a module (see Section 3.2) to validate the valid location of the staff. If the location is valid (within the boundaries) the staff can be clocked in or clocked out.

Monitoring staff



Figure-7. Screen for monitoring staffs.

Figure-7 shows the screen for monitoring and search for staff in the organisation. The human resource department can generate an attendance report from this information.

Management of a map

In the Figure-8, the human resource department can set boundaries for each staff. When a particular staff has an outstation job, new boundaries have to be set up for

that staff with other details such as date and time. With this feature, the company can monitor their staff anytime and anywhere.

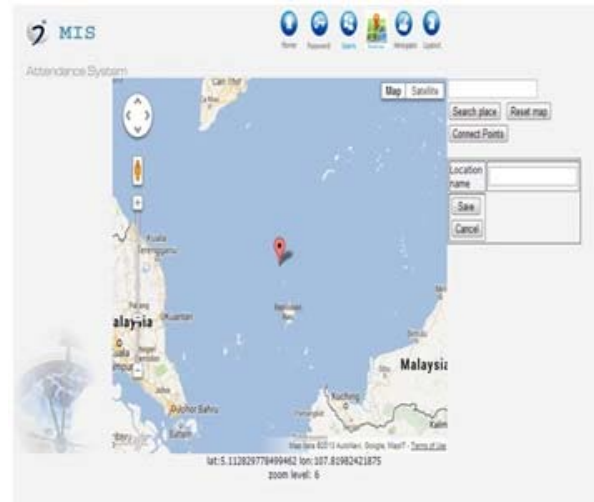


Figure-8. Screen of a map management.

CONCLUSIONS

The Mobile Attendance System (MAS) developed consists of an Android smart phone, GPS technology, Wi-Fi access point and a server. The function of the entire system is very simple. It involves the GPS receiver embedded in a smart phone to get staff location and automate the clock in and clock out attendance in real time by touching a button on the phone. The IMEI number and GPS information for the smart phone is transferred to a database. The system is a possible option for replacing the current attendance methods. From the implementation, the system has successfully tested in real situation outside the building. It helps the process of taking staff attendance efficiently and cost effective when the user is away from office or outstation. MAS is a must-have application for those staffs that value every minute of their working time. The future scope of the app is to develop for other phones as well such as Symbian, Blackberry, and IOS.

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