Staff Outdoor Positioning in Large Area Campus using GPS Enabled Phone, Google Map and Mobile Network

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Abstract – This paper explore the feasibility of using GPS enabled phone to locate staff in a large campus area on a customized campus map.This system provides an alternative approach to locate staff compared to static directory. GPS foot printing enable the system to determine which campus building that the staff is in. The map can be viewed on Internet connected browser via personal computer or mobile device.

Keywords-component: GPS Enabled Phone, Mobile Network, Google map, GPS Foot Printing.

I. INTRODUCTION

In previous work, the use of Google map as Bus tracking platform was implemented using Global Positioning Satellite (GPS) mobile phone as GPS tracking device [1]. Such implementation is not limited to locating vehicle but can be use to locate people as well. However, the issue of privacy arises when it comes to geo locating a person using personal GPS-enabled mobile phone [2]. Anyhow, there are benefits from geo locating mobile phones such as parents tracking their children [3], locating a person in the case of emergency [4],[5], finding location and directions [6] and effective location based marketing [7].

Other than using GPS, there are various methods of mobile phone positioning such as using wireless fidelity (WiFi) [8], GSM Network [9] and Radio Frequency Identification (RFID) [10]. Nevertheless, GPS positioning still remain one of the most cost effective method of outdoor positioning.

II. RELATED WORK

There are some works have been done on campuses for locating position of people around campus using GPS such as visitors is able to self-guide by getting directions from a mobile device [11]. Another work using 3D view virtualization on GPS-enabled personal digital assistant (PDA) that enable user to navigate in the campus [12]. However, such works are limited to provide the user directions and location of buildings on a campus.Other use of GPS in a campus is path planning to identify the optimal path such as shortest route [13].

III. MOTIVATION

There are many large campuses in Malaysia with area of several hundred acres on a single location that comprise of many isolated buildings that makes searching for university staff difficult primarily academic staff for students and visitors. Staff directory is a solution but it cannot provide real-time information of the staff current where about on which building.

Some staff is consistently moving around the campus from one building to another building. Having to solve this by locating the staff on the campus premise will enable people to easily locate the staff.

The scope of this paper covers outdoor positioning using foot printing approach to determine the last location. This can also determine whether the person had just left or entered the building.

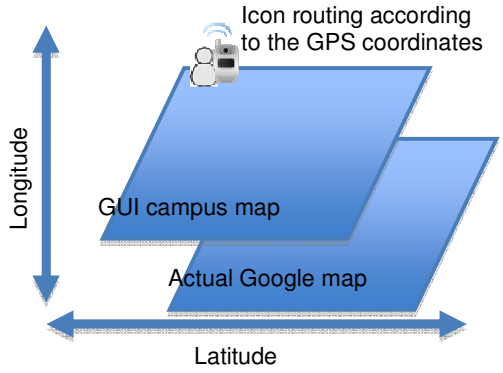

Figure 1. Structure of three main components

IV. PROPOSE SOLUTION

Similar system will be used as in previous work (as shown in figure 2) [13] whereby Google Application Programming Interface (API) use as the underlying platform for the system for positioning. The Google API will provide mapping of the representation icon on the GUI campus map (as illustrated in figure 1) using Latitude and Longitude positioning obtained from the GPS enabled phone.

Figure 2. Left image showing Google map and right image showing GUI map in previous work [13]

A. GPS Enabled Phone

GPS enabled phone use as the GPS tracking device, this device will provide the positioning of the device and represented by a unique icon. The GPS enable phone uses an application to transmit acquired coordinates to the server. This coordinate is uniquely identify using the International Mobile Equipment Identity (IMEI) which is send along with the coordinates to the server.

B. GUI Campus Map

A graphical user interface (GUI) campus map is laid on top of the actual Google map. The GUI campus map is served as an interface for the user. The GUI also permits to view only the location of the staff within the campus. As such, the GUI represents the campus area.

C. Google API

The application uses a custom layer overlaid on the original Google Map where the Google API takes place to position the representation icon on it. The positioning of the icon is based on the actual positioning of the GPS enable phone and is uniquely identified via IMEI number.As such, each icon can be uniquely represented by IMEI number of the GPS enabled phone.

Where the map is viewable on mobile device or computer terminal using an Internet browser that are connected to the web server via Internet or network connection by the user such as students, visitors or other campus staff.

D. GPS Foot Printing

GPS works effectively on outdoorsthat is sufficient to position staff around the campus on the outside. Once the GPS enabled phone lost line of sight with the GPS satellite it will fail to acquire location hence no positioning for the device (see figure 3) so no positioning will be sent to the server. This situation could happen if the GPS enabled phone is in a building. To solve this, GPS foot printing is used to determine the last positioning of the GPS enable phone hence the last location of the staff.

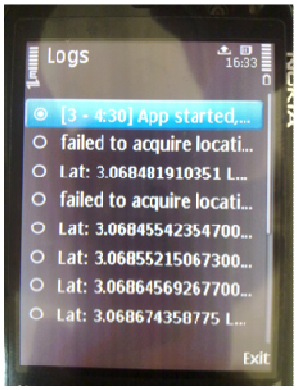

Figure 3: Application in the GPS enabled phone showing its last positioning.

V. SETUP

The GPS enabled phone acquires data transmitted by the GPS satellites and use trilateration to compute the coordinates of the device. The positioning of latitude and longitude is transmitted to

the web server via the Internet using the mobile network connection. Subscription for mobile Internet service is required to use the mobile Internet connection for data transmission between the GPS enabled phone and the web server. The web server will provide the positioning of the staff utilizing the Google API (see figure 4) to place the positioning of the representation an icon on the map.

The GPS application in the phone locates the coordinates of the staff and relays this information on short interval anything between 5 to 30 seconds depending on the preferred setting. Plotting the icons by representing each staff on the GUI is based on GPS coordinates received.

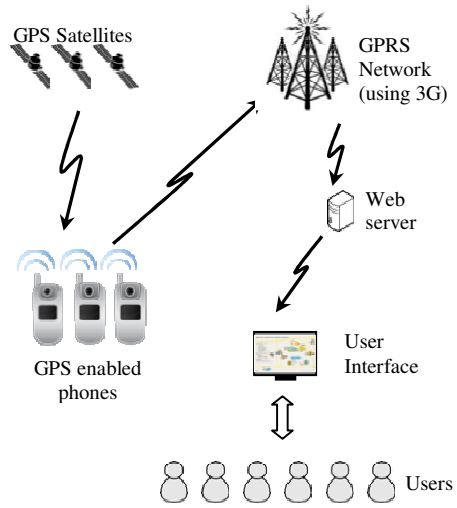

Figure 4. GPS application in the mobile device tracks the coordinates of the buses and relays this information on intervals.

VI. CONCLUSION AND FUTURE WORK

Locating staff on a large campus using GPS enabled phones can be a feasible option compared to a static staff directory.Static staff directory only provides location of their respective offices. By using GPS foot printing, this enable the system to determine the last building entered by the staff. The campus map provides a fixed locating perimeter to locate staff within the campus only.

Data collection is needed for system reliability and usability to determine practicality of the system in large area campus on users perspective.

Future works include implementation of indoor positioning such as locating staff in the building. Integration of indoor positioning using WiFi and GPS integrated mobile phone to determine the exact location of the device in a building[14]. This could achieve by using MAC address on the device when it uses WiFi positioning mode.

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