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Vehicle Tracking with Geo Fencing on Android Platform

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Abstract:
Geofencing enables remote monitoring of geographic areas surrounded by virtual fence (geofence), and automatic detection when tracked mobile object enter or exit these areas. The paper presents concepts of geofencing and some applications based on this technique, vehicle tracking. The geofence can allows you to set a boundary area where a vehicle is allowed or not allowed to travel. This will alert you if your driver happens to travel across the set boundary. Geofence alerts will warn you when a driver enters or exits their job-site. With a GPS tracker system, you will be able to have a digital time stamp for the arrive time of your drivers, when their work actually begins and when they leave. This means no more pesky time sheets or clocking in. The drivers can just get right down to business. GPS tracking devices coupled with geofence alerts gives your equipment much more security.

Keyword: Global Positioning System, Geofencing, RFID, Latitude, Longitude, Position, Site, Navigation, Vehicle Detection.

I. INTRODUCTION

Geofencing is a common feature found in most commercial fleet tracking systems which allows a fleet manager to define areas in which their vehicles that normally operate. If or when a vehicle strays outside this defined area, the fleet manager is typically notified by a text or email alert and the event are recorded. Tracking & tracing systems that are based on global navigation satellite services and include a geofencing feature. Geofencing is the use of GPS or RFID technology to create a virtual boundary on the map, enabling the software to trigger a notification or response when a mobile device enters or leaves a particular area.

In figure 1, the green area has been geofenced. Vehicles are allowed to move inside this area, but the system has been configured to detect any vehicle exiting the area (e.g. the red vehicle).

A. Tracking & tracing system description

Tracking & tracing systems are mainly composed of four linked segments, which constitute an information chain between tracked mobile objects and the control center. These four segments are: • A spatial segment: signals from Global Navigation Satellites Systems GPS, GLONASS and EGNOS. A telecommunications segment: mobile phone networks or satellite communications for remote areas. An application segment: interface solutions are available on a virtual private network or with a secured connection directly onto the Web. A user segment: comprising both an on-board unit and the control center. Others mobile devices can also be used for monitoring, such as PDA or smart phones.

Figure 2. Tracking & tracing system based on GNSS

II. LITERATURE SURVEY

A. Real time bus monitoring and passenger information system

The Real Time Bus Monitoring and Passenger Information bus tracking device is a standalone system designed to display the real-time location(s) of the buses in Mumbai city. This system will enable the tracking device to obtain GPS data of the bus locations, which it will then transfer it to centralized control unit and depict it by activating LEDs in the approximate geographic positions of the buses on the route map. Specific software will be used to interface the data received to the map. The goal of the Real Time Bus Monitoring and Passenger Information device is to provide a product that pedestrians of Mumbai city can use to

help them decide whether to wait for the bus or walk or use which can be placed at bus sites around Mumbai city.

B. Implementation of a system for localization and positioning of vehicles

The objective of this paper is to describe a system, implemented using GPS and GPS technologies, whereby a command is sent to the system in the form of a SMS by system registered cell phone and the system responds to it by transmitting its current coordinates in the form of latitude and longitude using a reply SMS to same cell phone. The system gives current vehicle location whenever needed with reliable accuracy. The position of the vehicle can be traced on Google / local maps. The paper gives functional, technical description and software implementation for the GPS and GSM/GPRS based vehicle tracking system. Specific software will be used to interface the data received to the map. the goal of the real time bus monitoring and passenger information device is to provide a product that pedestrians of Mumbai city can use to help them decide whether to wait for the bus or walk or use which can be placed at bus sites around Mumbai city.

C. GPS Based Bus Tracking Android Application

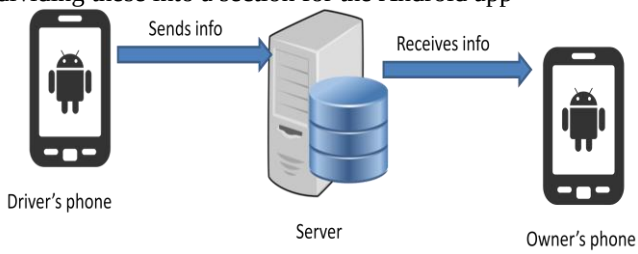
Though vehicle tracking using GPS (Global Position System) has been around for a while, it is only now that certain systems are becoming available to the general public. GPS vehicle tracking is the ultimate fleet management tool. Urban living environment is becoming more and more complex due to manmade chaos. In the rush of modern times when we do not have time to stand and stare, To minimize this chaos and improve modern infrastructural facilities in public transport this Bus Tracking system has been developed. In this system Administrator maintained database information of Buses, Driver and the system user. The Server provides the information of Bus to the User which is transferred via internet to Android Application. Our system will act as bridge. Hence to overcome this difficulty we have come up with the system of Android Application for Bus Schedule System is considered in this study. Second module consisting of capturing the current latitude, longitude and location of the current position of the user using the GPS facility available in mobile Third module includes the facility of security call, if user feels unsecure or any disaster occur, just by pressing a single button user can notify to its closed ones with its current position which usually is common in urban environment. The GPS based low cost intelligent vehicle tracking system can be successfully designed and applied in the urban environment of a developing country like India. This if implemented in a well-planned manner will bring significant revolutionary enhancement in the Indian transportation industry.

III. PROBLEM DEFINITION

Difficult to track more vehicles at a time. Sometimes the GPS may fail due to certain reasons and in that case you need to carry a backup map and directions. Driver may cheat the owner by showing fake information i.e. the driver drives the vehicle without informing to the owner. The drivers feel difficult in new places for finding the petrol bulk, hotels, and other locations. We can't find the exact location of the vehicle. We can't get the notification if vehicle is nearest to us. For tracking multiple vehicles we need multiple GPS hardware.

IV. SYSTEM ARCHITECTURE

The Android app's primary purpose is to facilitate the communication of the device's precise geographical location using the geo fencing system. This location is then used in calculations performed by the server. The app frequently sends the coordinates and compass direction to a remote database (Note: Originally, the information was to be transmitted directly to the server but this was decided against). The user can simply turn the transmission of the devices coordinates on and off. The user can specify a unique id number for the particular bus and device. The user can select the current route and trip id. Keeping track of the vehicle information, performing the calculations to estimate arrival times, and hosting the website that displays this information to the user. In System Features, I outline the specific capabilities of the project from the perspectives of both the transit system operators and potential bus riders using the system dividing these into a section for the Android app



A. GPS Tracking Unit

A GPS tracking unit is a device, normally carried by a moving vehicle or person, that uses the Global Positioning System to determine and track its precise location, and hence that of its carrier, at intervals. The recorded location data can be stored within the tracking unit, or it may be transmitted to a central location data base, or Internet-connected computer, using a cellular (GPRS or SMS), radio, or satellite modem embedded in the unit. This allows the asset's location to be displayed against a map backdrop either in real time or when analyzing the track later, using GPS tracking software. Data tracking software is available for smart phones with GPS capability.

B. GPS Tracking unit architecture

A GPS tracker essentially contains a GPS module to receive the GPS signal and calculate the coordinates. For data loggers it contains large memory to store the coordinates, data pushers additionally contains the GSM/GPRS modem to transmit this information to a central computer either via SMS or via GPRS in form of IP packets.

C. Fundamentals

The GPS concept is based on time and the known position of specialized satellites. The satellites carry very stable atomic clocks that are synchronized to each other and to ground clocks. Any drift from true time maintained on the ground is corrected daily. Likewise, the satellite locations are known with great precision. GPS receivers have clocks as well; however, they are not synchronized with true time, and are less stable. GPS satellites continuously transmit their current time and position. A GPS receiver monitors multiple satellites and solves equations to determine the precise position of the receiver and its deviation from true time. At a minimum, four satellites must be in view of the receiver for it to compute four unknown quantities (three position coordinates and clock deviation from satellite time).

D. Mobile Phones with GPS Capability

Due in part to regulations encouraging mobile phone tracking, including E911, the majority of GPS receivers are built into mobile telephones, with varying degrees of coverage and user accessibility. Commercial navigation software is available for most 21st-century Smartphone's as well as some Java-enabled phones that allow them to use an internal or external GPS receiver (in the latter case, connecting via serial or Bluetooth). Some phones using assisted GPS (A-GPS) function poorly when out of range of their carrier's cell towers. Others can navigate worldwide with satellite GPS signals as well as a dedicated portable GPS receiver does, upgrading their operation to A-GPS mode when in range. Still others have a hybrid positioning system that can use other signals when GPS signals are inadequate.

V. GEOFENCING TECHNIQUES

Geofencing can be of benefit in numerous domains and has many functions: the monitoring of mobile assets and people within geographical areas, intrusion detection and protection against theft are examples of use. Various geofencing techniques have been developed to meet different pragmatic needs. The main techniques are presented in this paper, but this list is not exhaustive.

A. Geofenced area

This technique provides automatic monitoring of mobile objects moving around or inside a geofenced area. Alarms are generated when mobiles respectively enter or exit the boundary. The size of the area can range from a few tens of meters to several kilometers. The shape of the geofence can be a simple geometric figure, like square or rectangle, or a more complicated one, like complex polygon.

Coordinates from characteristic points of the shape are necessary to define the geofence perimeter. These coordinates are supplied to the calculation algorithm, along with the inclusive or exclusive nature of the geofence, which enables the computing of alerts.

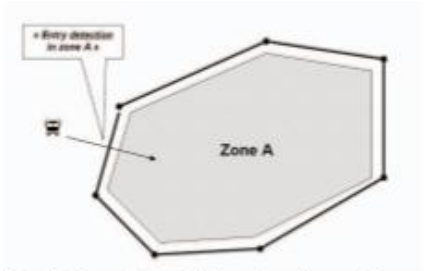


Figure 3. Active geofence (black perimeter) around an area (zone A)

B. Proximity with a point of interest

This technique is intended to detect the proximity of a vehicle in relation to a point of interest (POI). In practice, the geofence is a circle, and the POI is located at the center. The radius is parameterized according to the distance that is regarded as "proximity" to the POI, from a few meters to several tens of kilometers. This method is the simplest way to implement geofencing, because it only needs two parameters, coordinates of the center and value of the radius. The algorithm calculates the distance between the mobile object and the center of the circle. According to whether this distance is lower or higher than the value of the radius, the mobile object will respectively be considered inside or outside the geofence.

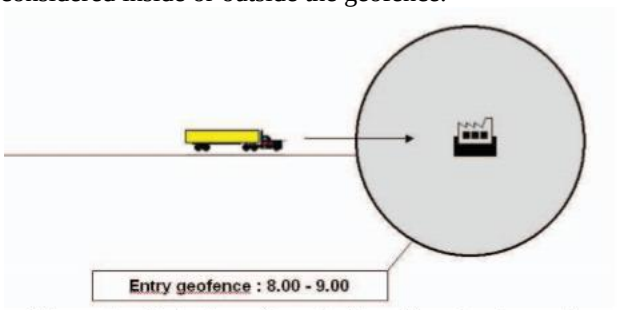


Figure 4. Detection of proximity with a circular geofence

C. Route adherence

This technique relates to the monitoring of a mobile object throughout a journey, from the departure point to the final destination. Geofencing makes it possible to ensure that a vehicle does not deviate from its allocated route. In practice, a route is created with a set of coordinates, and is recorded in the software application before the departure of the vehicle. A set of circular geofences is applied along the entire route, one after the other, as shown in figure 5. If the vehicle deviates from the route, it may cross one of the geofences. Depending on a preset deviation tolerance, an alert is then generated and sent to the control center, with the location where the vehicle has exited the assigned route.

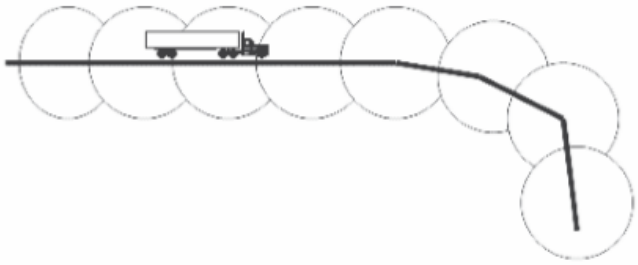


Figure 5. Route adherence control via geofencing

D. Route and schedule adherence

In specific cases, classical geofencing techniques have to be enhanced to meet user requirements. This leads to new functionalities, like route and schedule adherence. This technique is used in particular to follow a mobile object's progression on an assigned route, in relation to a schedule.

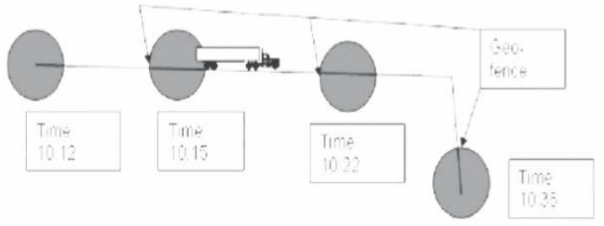


Figure 6. Route and schedule adherence monitoring via geofencing

In figure 6, a pre-planned route has been assigned to a vehicle. The journey along this route is split into stages, which represent a sort of checkpoint. Each one is associated with a time slot for passage, corresponding to where the vehicle has to be at a given moment. Each checkpoint is covered by a circular geofence, associated with a set of coordinates. Throughout the journey, the

system checks if the vehicle has entered the geofence of each checkpoint area at the planed time.

VI. PERSPECTIVES FOR VECHILE TRACKING

A. Monitoring and control of restricted areas

Access restrictions or prohibitions for certain categories of vehicles are implemented on certain road infrastructures (such as tunnels) or around geographical areas (e.g. conurbations). In particular, such regulations are applied to vehicles transporting inflammable or toxic materials, and to excessively high or heavy vehicles. Finally, dangerous routes (for example with steep slopes) are identified and prohibited for coaches and HGVs. Geofencing these regulated zones, infrastructures and routes would enable targeted field data collection, but also a control of entries and the detection of vehicles in infringement. Beyond enforcement purposes, one can also imagine the use of geofencing for the protection of vulnerable sites or areas, with risk prevention in mind. Protection would be provided through the installation of access control to the zone in question. Risks must be detected sufficiently early to make it possible to quickly engage effective measures, the idea being that a detected unauthorized vehicle should not be able to reach the vulnerable site or protected area.

B. Monitoring of motorway corridors

Traffic schemes for cities or conurbations sometimes include recommended routes for HGVs, due to weight or height restrictions. Alternatives routes are also obligatory for hazardous goods vehicles, which must avoid dense urban areas such as town centers. Monitoring of motorway corridors and alternative routes dedicated to this type of transport is therefore essential to ensure that regulations are actually respected. Other categories of heavy vehicles such as coaches are likely to be tracked by satellite in the future.

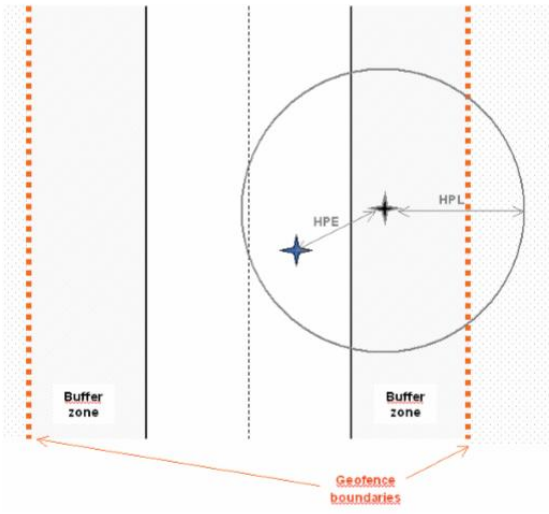


Figure 7. Monitoring of a roadway with geofencing

In this context, geofencing could provide a possible efficient means of monitoring tracked mobiles, by controlling that they actually drive along the dedicated road, and don't exit until the end of the restricted corridor. In figure 7, a geofence is implemented on each side of the roadway (orange lines), considering a buffer area between the pavement and the boundary of the geofence. The mobile is located on the roadway (blue cross), and also inside the horizontal protection level (HPL) around its estimated position (black cross). Considering the estimated position only, the mobile could be considered exiting the roadway, but due to the buffer zone, the geofencing algorithm doesn't trigger the alert. The buffer zone is designed to widen the size of the corridor, and to avoid this kind of false detection. The width of the buffer zone constitutes an adjustable parameter in the geofencing algorithm, which has to be continuously compared with HPL around positions.

C. Service area parking management

Managing service area parking for certain categories of transport (for example dangerous goods vehicles) can be financially difficult to implement, as numerous sites can be concerned. A geofencing system can prove to be an effective solution to this problem. It can contribute to the automatic monitoring of parking areas, by monitoring available spaces, ensuring that designated areas are respected and monitoring the quantity of dangerous goods entering the area. This would help improve the safety of service area users.

VII. CONCLUSION

This paper deals with the concept of geofencing. It presents various applications used in the field of surface transport, and the main control and monitoring techniques based on geofencing. There would appear to be a strong potential for geofencing, as in as far as it can help authorities and infrastructure operators prevent risks, guarantee decisional aid and enable better risk assessment. Firstly, geofencing is a highly flexible technique, because it is not related to a specific means of transport, and can adapt to co-modal transport requirements. Secondly, there is no need for heavy on-site investments (barriers, badge readers, monitoring cameras…). Many emerging applications based on geofencing are also foreseen, such as HGV electronic toll collection, theft protection on public car parks, or statistical data production for studies.

VIII. REFERENCES

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