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Development of geofencing system for theft control management

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Abstract
Geofencing technology is a concept in automation that draw challenges to both scientist and engineers in the area of automation system and Grid computing. They have been looking for a way to incorporate this technology for theft management control using a GPS so that object can be easily know from a remote location through email alert. This prompts to design a system with this technology. The methodology used in this research helps to ensure that a thorough study of the present system is effectively carried out, thus helping the research team to completely understand background of the present existing system so as to know how the new system should be structured and the functionalities needed in it to address the seemingly, existing problems discovered. This helps to know if there should be a total over hailing of the existing system or if only improvements should be made. Interview, observation, record consultation is therefore considered as methods used in this research work.

Keywords: Geofencing, GPS, Theft, Management, Control

Introduction
Knowledge about geographical location of a mobile device or indirectly its owner can be of enormous utility. Geo-spatial information is being used in many fields such as computer software, physical security, in addition to location aware marketing and advertisement. In this context, most of the existing technologies focus on identifying the exact location of the user via Global Positioning System (GPS) in outdoor environments. A different view of the location aware computing is to focus on the presence of a user in a virtual perimeter of a given geographical landscape. This second alternative view, which complements the first one is called Geo-fencing and has brought in many benefits and also challenges to the location based computing field(Aalst, 2014)

Geo-fence refers to a virtually fenced geographical area. According to almomani (2011). This concept has been employed to implement various tasks including equipment theft control, transportation path control, asset management and tracking, or automatic house arrest monitoring systems but the system cannot track object using radio frequency identification techniques. Social networks have also brought new ideas and use cases for Location Based Services, including geo-spatial networking. Targeted and location aware marketing and advertisement is also an interesting use case where promotions are sent to potential customers based on the opportunities associated with the geographical location they visit (Almomani, 2011).

Moreover, various techniques are studied in order to improve the robustness and security of such a system. The focus of these studies is develop a geofencing system which will be used in theft controlling management using android phone. The objectives include

1. To develop an automation system that identify theft in a particular geofence region using gps technology
2. To implement a program that identify stolen items in the premises using GPS Geofencing techniques
3. To analyze the importance of geofencing system in theft control

Literature Review
Introduction to Geofencing
A geofence is a virtual perimeter for a real-world geographic area. It can be a radius around a location or a pre-defined set of boundaries. With Plot Researchs you can create Geofences

with a radius of between 50 to 50,000 meters. The process of using a geofence is called geofencing. Geofencing allows you to send notifications to your app users when they are in the vicinity of, for example, your store. This allows you to provide users with information that is highly relevant to them, which helps you to activate your users, drive revenue and leverage customer insights. A geofencing is a virtual barrier program that allow an administrator to set up triggers when a device enter (or exits) the boundaries defined by the administrator so that a text message or email alert can be sent. Geofencing is a technology used to monitor mobile objects (vehicles, persons, containers…), located by GPS. The geographic coordinates of the tracked object are automatically and regularly sent to a control center, via mobile phone networks (Almomani, 2011).

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 below

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 geofencing 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 geofencing perimeter. These coordinates are supplied to the calculation algorithm, along with the inclusive or exclusive nature of the geofencing, which enables the computing of alerts (Jog, 2011).

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 geofencing 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 geofencing.

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

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.

Review of Related works

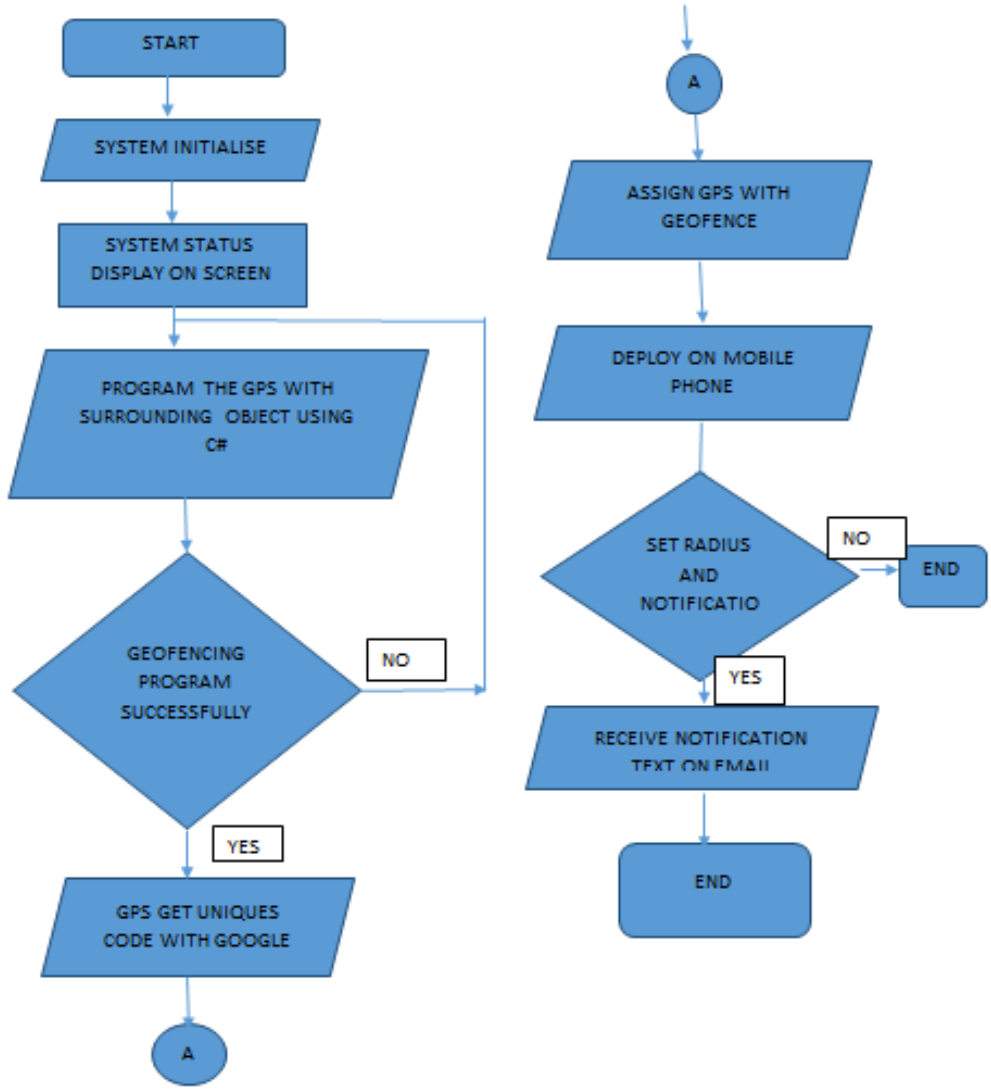
(Fabric et al, 2012)This research deals with geofencing: an innovative technology, based on telematics and satellite positioning. Geofencing enables remote monitoring of geographic areas surrounded by a virtual fence (geofence), and automatic detections when tracked mobile objects enter or exit these areas. The research presents fundamental concepts of geofencing and some applications based on this technique, in the transport & logistics sector. Tracking & tracing systems that are based on global navigation satellite services and include a geofencing feature, could also efficiently contribute to the enforcement of heavy goods vehicles (HGV) regulations: weight and height restrictions on specific routes or tunnels, dangerous goods transports restrictions, restricted access in urban areas.

Sturdevant Rick W**.** (2009) affirmed that the Navtar Global positioning System (GPS) is the firstsatellite navigation system that enabled users to determine precisely their location in three dimensions and time within billionths of a second and grew from a concept into a fully operational system in slightly more than two decades. The widely-used GPS system are the US-based GPS (Global Positioning System) and Russian-based GLOSNASS (Global'naya Navigatsionnaya Sputnikowaya Sistema, Global Navigation Satellite System) satellite positioning systems. By 1972,the U.S. Air Force(USAF) and the U.S. Navy had been studying for several years the possibility of improved satellite-based radio navigation.

The main reasons for GPS development were the need to deliver weapons precisely on target and to reverse the proliferation of navigation systems in the U.S. military.

Petri (2015) in his research Locating and Tracking Assets using GPS, states that "Accurate locating or tracking is required in many fields from navigating for rescuing wounded people in emergency situation to decision-making for striking the target during the military operations. Therefore, the fields of the academic circles and the industries have been interested in locating and tracking objects or people over the years. The study is getting broad for inside as well as outside. Being able to rapidly locate equipment is critical in-building, including hospitals, manufacturing floors and warehouses. To utilize the limited budget and resources more efficiently, it is important to make optimal strategic decision.

Methodology



UML Diagram

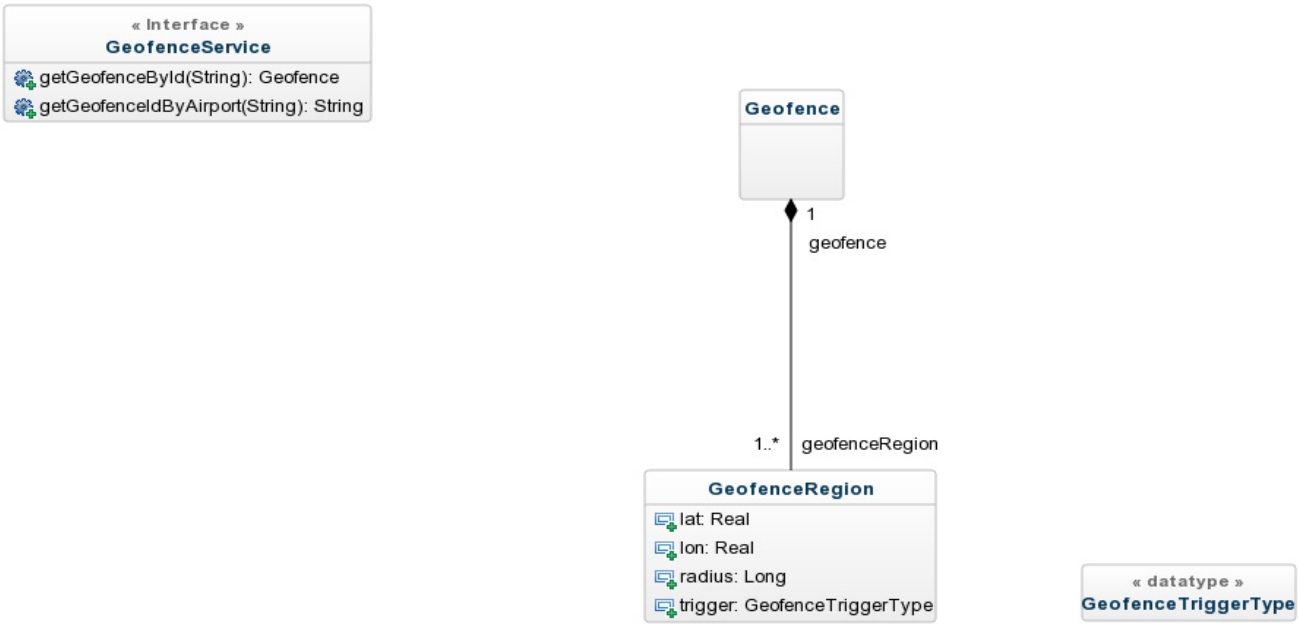


Fig 3.2: UML Diagram

```
#!/bin/sh
basedir=`dirname "$0"`

case `uname` in
    *CYGWIN*) basedir=`cygpath -w "$basedir"`;;
esac

if [ -x "$basedir/node" ]; then
  "$basedir/node"  "$basedir/../bower/bin/bower" "$@"
  ret=$?
else
  node  "$basedir/../bower/bin/bower" "$@"
  ret=$?
fi
exit $ret
```

Test and Implementation

Test

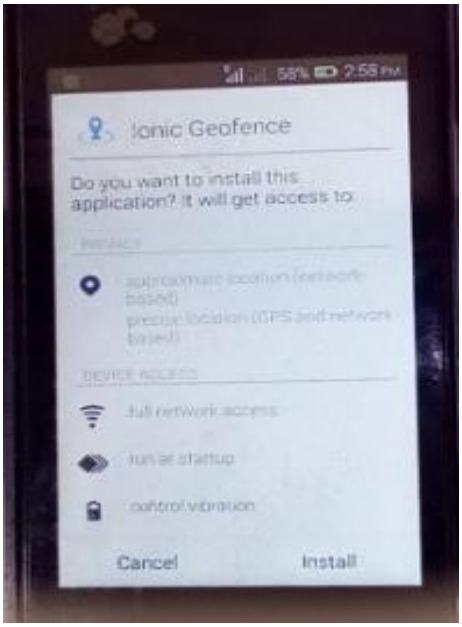


Fig 4.1: installation of the developed geofencing application

Input Requirement

Fig 4.2: setting of GPS location

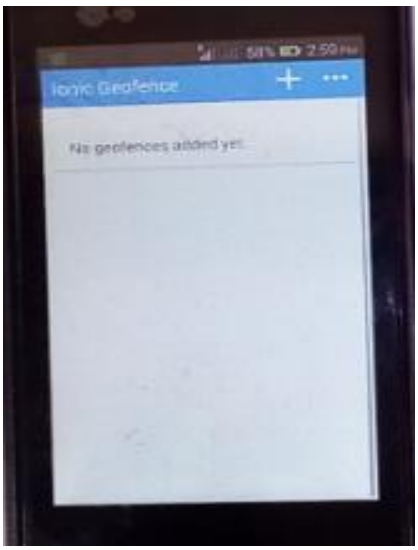


Fig 4.3: Seting of GPS with Fence

Fig 4.4: Seting of the Radius/Distance of theft

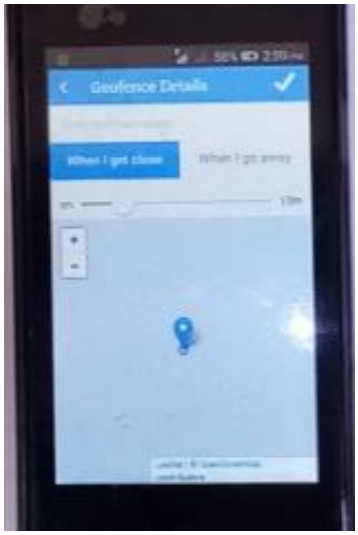


Fig 4.5: Configuration of the Region (Inbound/Outbound)

Output Requirement

Fig 4.6: GPS output

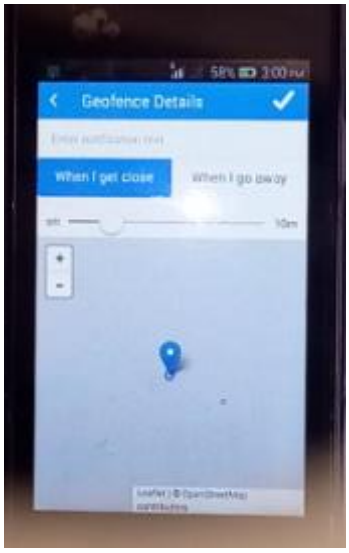


Fig 4.7: Boundary Output

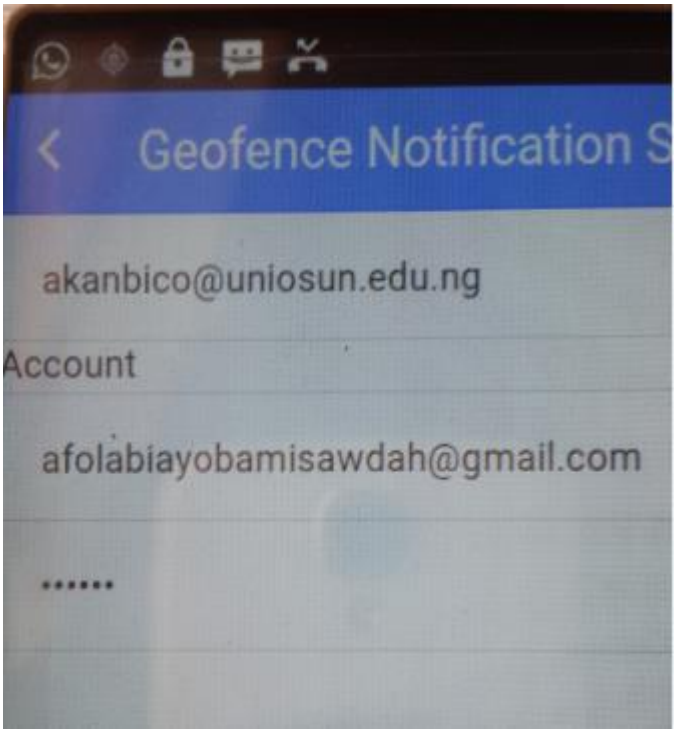


Fig 4.8: Email Notification

Discussion of Result

Fig 4.1 is the procedure for installation of the developed geofencing application on the android phone devices. The application was compiled in apk format using ionic geofencing software and installed on the android phone. Once the user click on install, the application will start the installation. The fig 4.2 to 4.4 above is the settings of the GPS location, Radius and the Fence. The global positioning system which is the longitude and latitude of a particular place was set. This will prompt the ionic geofencing to connect to the GPS location and set the regions of the particular environment. Figure 4.5 above indicates the region configuration to either inbound region or outbound region. The region will indicates the geofencing boundaries and this will be determine by either indoor /outdoor theft. Fig 4.6, 4.7 and 4.8 indicates that the geographical region of a particular place is noted and the region is identided by the ionic geofence by getting the longitude and latitude ,

then display it in map format. The notification involves the username of the authorized person sending the message and the password. The email address box is the textbox where the notification will be send.

Conclusion and Recommendation

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.

Recommendation

Lastly, future applications based on geofencing should benefit from satellite navigation services, where great improvements are also expected in location precision, and By providing better accuracy and improved confidence in mobile positioning to integrity mechanisms, these systems will lead to more efficient geofencing applications

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