Location Based Asset Management Application for Railway: AMS-R

Mohd Shoab*, Kamal Jain*, M. Shashi**

* Department of Civil Engineering, Indian Institute of Technology Roorkee.
** Department of Civil Engineering, National Institute of Technology Warangal.

Abstract. Fundamentally asset management for railway infrastructure is about delivering the outputs valued by customers, funding partners and other key stakeholders, in a sustainable way, for the lowest whole life cost. In order to build an efficient asset management system, large amount of data is required in which location of assets plays key role. In current scenario various types of location based services are available, so using the concept of location based services, an efficient and reliable asset management system for railway is developed. In this paper the developed remote device application is presented. The developed application is running on android platform because of cost effectiveness of android devices. Various types of feature can be digitized manually or using inbuilt GPS, in android phone or tablet. Google maps API is used to integrate Google maps services for background maps and geocoding is used to digitize features manually. This paper describe the asset management framework, location based services, use of location based services in asset management system for railway infrastructure and the developed location based asset management application for railway which is used in remote device.

Keywords. Asset management system, location based, android, API, geocoding.

Published in “Proceedings of the 11th International Symposium on Location-Based Services”, edited by Georg Gartner and Haosheng Huang, LBS 2014, 26–28 November 2014, Vienna, Austria.

1. Introduction

Location, which is the most essential context of an object, can be used to provide context aware services to users, which is called location based services (LBS). LBS is the recent concept in which the applications integrates geographic location information with the general notation of services. The concept of LBS presents many challenges in terms of research and industrial concerns. Location services are mainly used in three areas: emergency services, commercial sectors, and military and government industries (Schiller & Voisard 2004).

LBS requires five basic components:

- Service provider's software application.
- A mobile network to transmit data and requests for service.
- A content provider to supply the end user with geo-specific information.
- A positioning component.
- End user's mobile device.

According to law, LBS should be permission based. That means the end user must opt-in to the service in order to use it. In most cases, this means that installing the LBS application and accepting a request to allow the service to know the device's location. From the release of Apple's 3G iPhone and Google's LBS-enabled Android operating system, however, has allowed developers to introduce millions of consumers to LBS (Location Based Services 2014).

In LBS, location based asset management system is an important instance, in which, the type, quality, and positions of massive amount of assets can be managed. Asset management systems are used by many companies to keep track of their field installations and inventories (Cheng & Wei 2009). Asset management involves the balancing of costs, opportunities and risks against the desired performance of assets, to achieve the organizational objectives. Many definitions of asset management being used in different sectors. The most quoted definition of asset management is provided in PAS 55-1 which is as follows:

Systematic and coordinated activities and practices through an organization optimally manage its assets and their associated performance, risk and expenditures over their lifecycle for the purpose of delivering the organization's business objectives (BSI 2008).

Scope of asset management for railway can be categorized in to two categories, which are as follows:

- The physical assets to which the asset management process applies.
- Activities, decisions and processes for the infrastructure.

Physical assets of railway infrastructure consisting the following items:

- Ground area.
- Track.
- Engineering structures: tunnels, bridges, culverts and other overpasses etc.
- Level crossing.
- Superstructures: rails, grooved rails, sleepers, ballast etc.
- Access way for passengers and goods.
- Safety, signaling and telecommunication installations.
- Lighting installations for traffic.
- Electric power plant.

1.1. Asset Management Framework

The asset management framework always consists key components of asset management system, which falls into three categories and shows in figure 1:

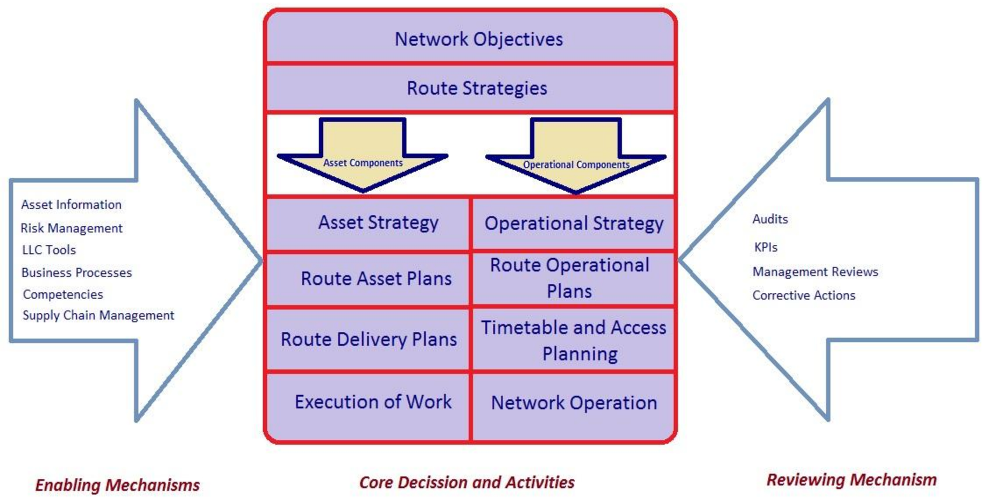

Figure 1 Asset management system framework (UIC, 2010).

1.1.1 Core Activities and Decisions

This is the spine of the asset management framework which defines the decisions and activities that link strategy to the delivery of work, including both work on infrastructure and operation of network.

1.1.2 Enabling Mechanisms

The effectiveness of core activities and decisions is influenced by many support mechanisms like, lifecycle of costing tools, asset information, business processes etc.

1.1.3 Reviewing Mechanisms

To monitor and improve the effectiveness of asset management system, reviewing mechanisms are required. These mechanisms deliver sustainable infrastructure outputs for the level of committed funds. These mechanisms provide continuous feedback for continuous improvement of the asset management system (UIC 2010).

To accomplish the above tasks the most essential part of information about an asset is location. So, this paper proposed a location based asset management application which provide essential information to decision makers about the railway infrastructure. The system has two parts one is central server and second is remote device.

2. Location Based Asset Management System for Railway

Railway organizations have massive amount of assets which have to be managed, reinstall, renovate and maintain properly. To accomplish these tasks an asset management system is required which provide necessary information about desired asset. Location is the key component of asset information. To obtain this location information about an asset and send this information to a central server, an Android based application is developed. The complete system is the combination of two applications one is server side application and second is remote device application. Here in this paper, only remote device application is presented. User can save location information of assets to external storage as well as in central server. If user wants to take photograph of an asset, user need to touch Ok button when alert ask to take picture while saving location information and feature details. The developed application geotag the captured picture of an asset and save it to an appropriate folder. When user touch any marker, line or polygon the related information is displayed in the information window and user can view picture of that asset.

2.1. System Architecture

Architecture of the developed system follows the client-server architecture. The client application is installed into an android based device which transmit location information of an asset to central server. The architecture of the system is illustrated in figure 2:

The client application works in two mode, first is offline and second is online. In offline mode, application doesn't use GPS receiver but in online mode it does. The server application is the combination of database and GIS server.

2.2. Methodology and Development of Remote device Application

Methodology of developed application is illustrated in Figure 3.

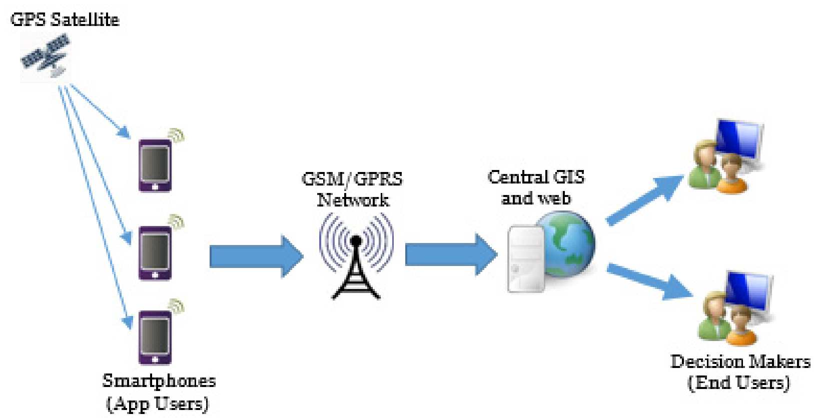

Figure 2 Architecture of location based asset management system for railway.

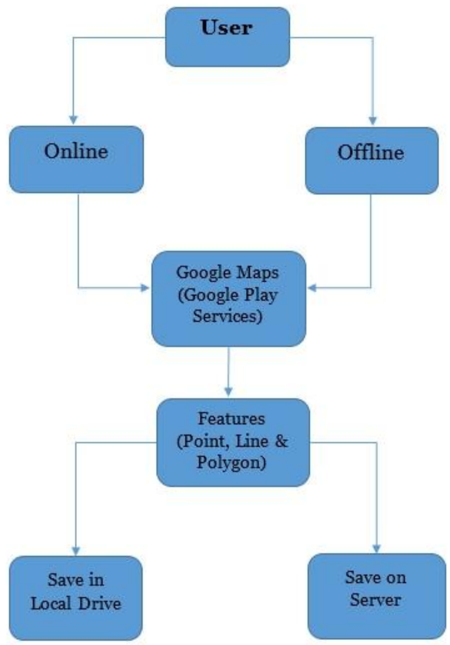

Figure 3 Methodology of developed system

As mention above in section 2.1, the system consists two applications one is client application and another is server application. The client applications is an android based application called AMS-R, which can be installed in any android based device like phone, tablet etc. Eclipse IDE is used to develop the client side application. Eclipse contains a base workspace and an extensible plug-in system for customizing the environment. By means of various plug-ins, Eclipse may also be used to develop applications in various programming languages like: Ada, ABAP, C, C++, COBOL, FORTRAN, Haskell, JavaScript, Lasso, Natural, Perl, PHP, Python, R, Ruby, Scala, Clojure, Groovy, Scheme and Erlang (Eclipse 2014).

AMS-R is configured to run on android versions between 4.1 and 4.4. Google Maps API v2 is used to integrate Google Maps with the developed application. Google Maps API is integrated using google play services. Google play services provide easy access to google services. For this, client libraries are provided by google for each service that let user implement the functionality. The client library contains the interfaces to the individual Google services and allows user to obtain authorization from users to gain access to these services with their credentials (Google Play Services 2014).

The developed application consists three main activities: DashboardActivity, AMSActivity and AMSOfflineActivity, other two activities: CameraActivity and ImageActivity are used to take picture when saving feature details to external storage and view desired picture respectively. Dashboard contains the main configuration functions of the application. User can create new project, open, edit and delete the existing projects. User can also configure project settings, location setting from this activity. After configuring the project user can start collecting data in two modes: Online and Offline. Figure 4a and 4b (refer to appendix) shows the dashboard activity and it's menu.

When user touch the Online mapping button the AMS activity is launched and GPS is enabled, so user can collect assets location information using GPS. The AMS activity is illustrated figure 5 (refer to appendix).

Before taking feature location information user need to select feature from menu and give the attributes to the selected feature like: id, name, feature code, description. After giving attribute information user can collect location information about an asset. Figure 6a and 6b (refer to appendix) shows the menu option and feature details dialog respectively. When user save the asset information by touching save button on menu bar, a dialog popup and ask to capture a picture of the asset. If user touch ok button in take picture dialog, the CameraActivity is launched and take picture of asset and geotag the picture with the asset (See appendix for figure 7a and 7b).

When user touch Offline Mapping button in dashboard activity, the AMS Offline activity is launched. In this activity GPS is disabled so user can collect asset location information by touching the map. User also have to select feature from menu and give attributes like AMS Online activity. Figure 8 (refer to appendix) illustrate the AMS Offline activity.

After completing the data collection, user have to tap on sync option in menu to sync collected data with the server (See appendix for figure 4b).

On the server side MySQL database is used to store data from remote device and PostGIS database is used to store spatial information. PostGIS is a spatial database extender for PostgreSQL object-relational database. It adds support for geographic objects allowing location queries to be run in SQL

(PostGIS 2014). Data from MySQL can be extracted into ascii files and shape files can be generated from these ascii file by using third party applications. These shape files can be uploaded to Post GIS to publish spatial information online. For map service, GeoServer is used which allows user to display users spatial information to the world. Implementing the Web Map Service (WMS) standard, GeoServer can create maps in a variety of output formats. This is a Java-based software server that allows users to view and edit geospatial data. GeoServer allows for great flexibility in map creation and data sharing by using open standards set forth by the Open Geospatial Consortium (OGC) (GeoServer 2014). To publish maps and spatial information over the web Apache is used.

3. Benefits of the Developed Location Based Asset Management System

Location is the most vital information about an object and Location-Based Services (LBS) is a predominant term used to describe applications or services that identify the location of a person or object in order to provide some useful information. So in asset management system, location play a key role. Some benefits of location based asset management system are as follows:

- Location information about an asset can be updated to central server remotely.
- User can view all asset location information in the mobile device.
- Staking is very easy of an asset.
- Real time location synchronization of an asset.
- Cost effective.
- Very less training required.
- User can take pictures of assets.

4. Case Study

4.1. Study Area and Field Work

A field survey was conducted to collect the location information about roads, buildings, bridges, signals etc. The developed AMS-R application is used with Samsung Galaxy Nexus i9250 smartphone, which is running on Android 4.3.3 (Jelly Bean). Railway station at Roorkee and its surrounding was selected as a study area, which is located at 29°51'7.72"N and 77°52'30.01"E. Figure 9(refer to appendix) shows field data collection.

4.2. Results and Discussion

Figure 10a and 10b (refer to appendix) shows the collected railway asset information in the developed application. Figure 10a and 10b illustrates the data collection in online and offline mode respectively. The collected data was upload to a central server by selecting Sync option in menu of Dashboard activity (refer to appendix for figure 4b).

Here in figure 10a and 10b the red markers are signal position, green markers are level crossing and yellow markers are start and end of a bridge and red line shows the road, surrounding the Roorkee railway station in Online mode. In figure 10b, the blue markers shows the point on which the user touch to draw road or boundary (these are node points) after switching the application from Online to Offline mode. The yellow line and polygon shows the road and station respectively in Offline mode.

All the collected assets information is stored in the external storage as well as in central server also. After data collection if user wants to send collected data to central server, user need to select Sync option from menu of dashboard activity otherwise the data remains in the external storage of device.

5. Conclusion

In the context of the asset management system, location information is the most essential part of asset information. Railway have the massive amount of assets so the developed application is the suitable option for collecting location information of an asset. Android smartphones and devices are cost effective due to open source license of this software. So using developed application with Android powered smartphones of devices could be the cost effective solution for asset management system in railway industry. Previous studies shows that horizontal difference between smartphone and dedicated handheld GPS is 1 to 5 meter (Shoab et al. 2012), so where less accuracy is required, the inbuilt GPS receiver of smartphone can be used get asset location information. Offline mapping feature of the developed application make it differ from other location based applications. If a user unable to reach near the asset, user can identify that asset on the background map and digitize manually. This application have the capability bringing field and office activities into collaborative environment that can improve productivity and reduce cost.

References

BSI, P. (2008). 55-1: Asset Management. Part 1: Specification for the Optimized Management of Physical Assets. *British Standards Institution*.

Cheng, C. C., & Wei, X. (2009). *U.S. Patent Application 12/489,991*.

Eclipse (Software). http://en.wikipedia.org/wiki/Eclipse_(software) . Accessed 8 May, 2014.

GeoServer. http://geoserver.org/about/. Accessed 22nd May, 2014.

Google Play Services. http://developer.android.com/google/play-services/index.html. Accessed 18th May, 2014.

Location Based Services (LBS). http://searchnetworking.techtarget.com/definition/location-based-service-LBS. Accessed 1 May, 2014.

PostGIS. http://postgis.net/ . Accessed 22nd May, 2014.

Schiller, J., & Voisard, A. (Eds.). (2004). *Location-based services*. Elsevier.

Shoab, M., Jain, K., Shashi, M. and Haq, M., A. (2012). Comparison between Smartphone GPS and Handheld GPS Location Information Data. *GeoMundus 2012, Conference of Geosciences, Geoinformation and Environment, Lisbon, Portugal*.

UIC. (2010). Guidelines for the Application of Asset Management in Railway Infrastructure Organizations. www.uic.org. ISBN: 978-2-7461-1878-2

APPENDIX

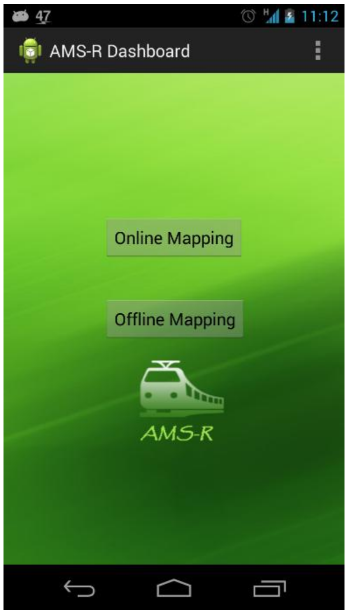

Figure 4 (a) Dashboard activity.

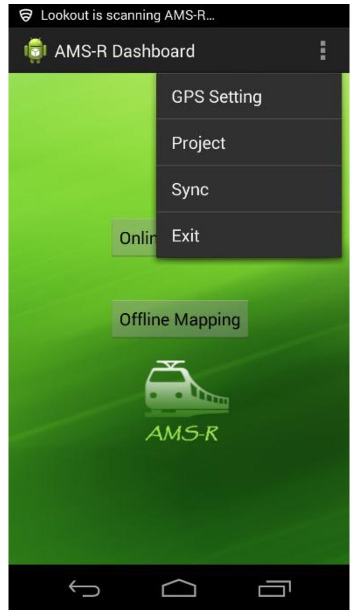

Figure 4 (b) Dashboard with it's menu

Figure 5 AMS online activity

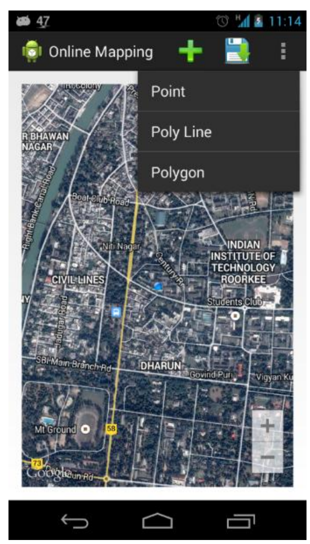

Figure 6 (a) AMS online activity with menu

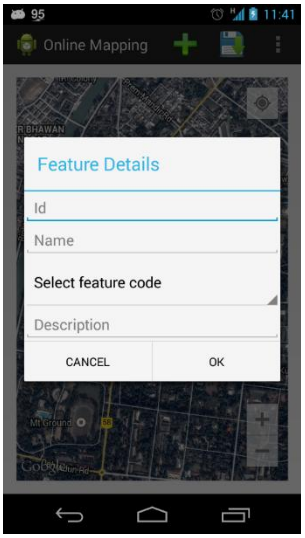

Figure 6 (b) AMS online activity with feature details

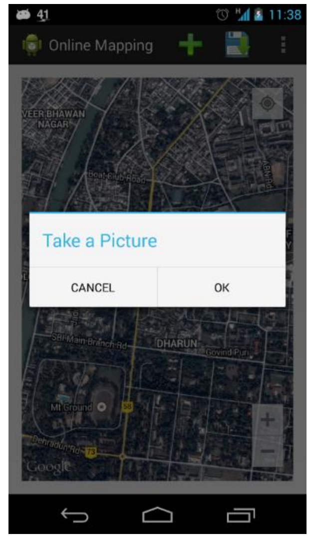

Figure 7(a) Take Picture dialog when saving asset information

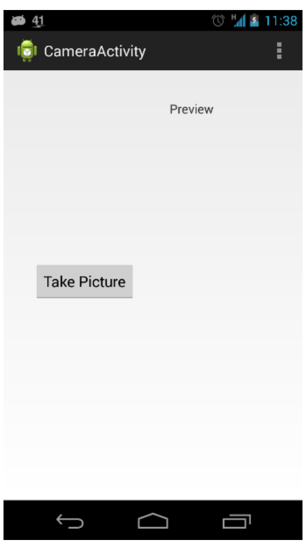

Figure 7 (b) camera activity for taking pictures

Figure 8 AMS offline activity

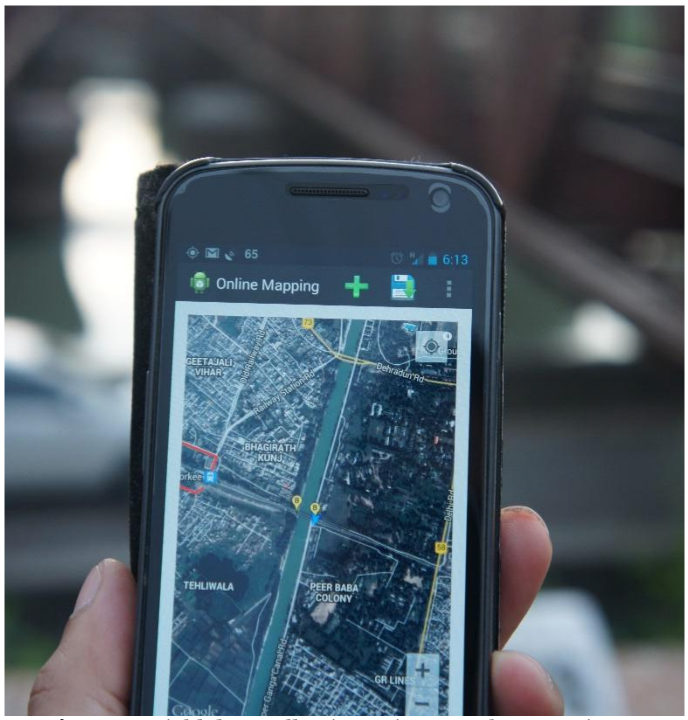

Figure 9 Field data collection using Google Nexus i9250

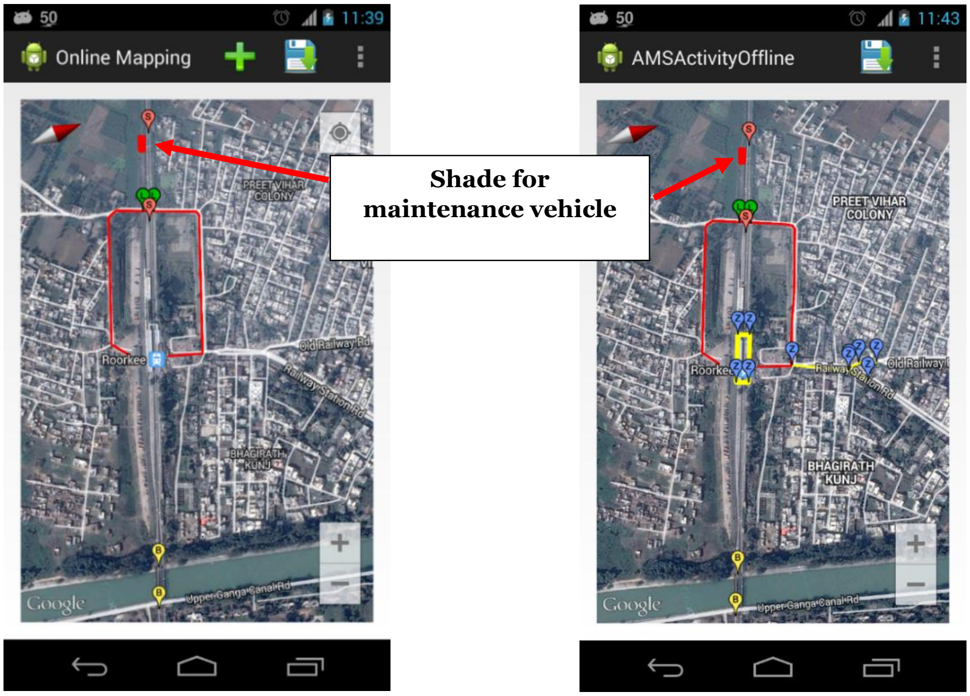

Figure 10 (a) collected railway asset information in online mode

Figure 10(b) collected railway asset information in offline mode