ISBN 978-93-5156-328-0
International Conference of Advance Research and Innovation (ICARI-2014)

# Cross Platform Mobile Gis System For Data Collection Based On Gps And Emerging Gis Technologies

Mohammad Nasim [a,*], Prashant Kumar [b]
Department of Content Software, RMSI Pvt Ltd, Noida, Uttar Pradesh, India
Department of Computer Engineering, Shri Venkateshwara University, Amroha, Uttar Pradesh, India

**Article Info**

Article history:
Received 29 December 2013
Received in revised form
10 January 2014
Accepted 20 January 2014
Available online 1 February 2014

**Keywords**

Android,
Geographical Information System,
LBS, ArcGIS 10.1,
Mobile GIS,
SVG 1.1, HTML5, CSS3,
Phone Gap, JavaScript,
Geocoder, Attribute Editing,
Basemap, Routing, GPS,
Cartography

**Abstract**

This paper presents a new method of dynamically collecting data that is based on the integration of GPS and new emerging GIS technology on a handheld device in cross browser and cross platform. It describes the process of developing a relatively inexpensive data collecting prototype with a low level of interface that enables ordinary users with an average IT knowledge to easily set up survey runs in order to collect, store and analyze spatial and non-spatial data.

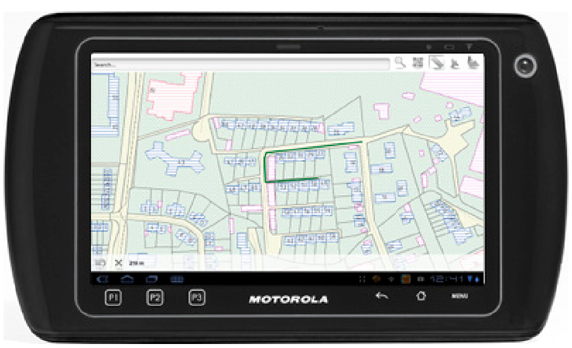


**Fig: 1.** Application UI on Tablet Device

## 1. Introduction

### GIS

A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts.

A GIS helps you answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared.

### LBS

Location-based services (LBS) are a general class of computer program-level services used to include specific controls for location and time data as control features in computer programs. As such LBS is an information service and has a number of uses in social networking today as an entertainment service, which is accessible with mobile devices through the mobile network and which uses information on the geographical position of the mobile device.

### Mobile GIS on Field

Mobile GIS is the combination of GIS software, GPS and mobile computing hardware. It is a group of

**Corresponding Author,**
**E-mail address:** mohammad.siddiqui@rmsi.com

technologies that allows the Enterprise central Data Base to be accessible to field, public user or other remote personnel.

## 2. Problem Statement

a) GIS Surveyors used hard copy plotted maps to indentify and mark feature and attributes. After that they used to digitize the inputs to create vector maps. Process was taking months to months to complete a single small city survey.
b) Large data size: To create vector maps we need the existing land base data and latest satellite high resolution imagery. (It is one of the ways to update the utility map with high resolution data). GIS Surveyors were facing problems to load/manage such data with application in their handheld devices.
c) Portability issue: Stake holders used to setup local offices, hardware resources like PC's, Printers and staff to manage the data collection job and invest huge amount of money.
d) Scalability issue: In traditional system, there was not any system which can manage large volume of work at a greater scale. When o/p data were coming from different sources it was difficult to merge/combine/qc those.
e) Data Security and Access issue: Data once shared to users, it becomes very risky for top management as it gets copied to local PC's and laptops for various works.

## 3. Research Goals and Objectives

There is a growing need for mobile data management systems, which are able to store, manipulate, retrieve, most importantly , manage the large quantities of geo-referenced data that are available today. Should Utility administrators decide to incorporate mobile technology as a tool for mobile data management in the field, it will have to add value to the overall strategic and operational management approach.

In view of the problem statement and research questions, the study will interpret the questions asked and motivate the benefits of using mobile devices in a utility administration environment. The goals and objectives formulated are to:

- Explain and describe the theory behind wireless technology, location-based services (LBS), land administration, and field data management.
- Optimize field data management in utility by using mobile technologies and LBS
- Improve the quality of data management in the field
- Effective and efficient data transfer from the server station to the fieldworker and back
- Facilitate the development of wireless education in utility sector
- Customize mobile GIS software for faster and effective data capturing and management in the field

Describe the use of mobile multimedia as new data collection techniques in the field as a future research

## 4. Research Design and Methodology

### 4. 1. Purpose of the Study

This study will investigate and evaluate the utilization of mobile technology and location-based services for field data management in Utility sector and to facilitate the development of wireless learning in the field. It evaluates whether this new technology can be used for field data management in utility sectors.

Requirements of Mobile GIS application are as mentioned below.

| **Application Requirement Specification** |
|---|
| Mobile Application should provide general search. |
| Mobile Application should provide spatial query by free hand drawing on map to display all landmark locations |
| Show on/off of layers on map. |
| Show detailed information for each landmark. |
| Creating new feature (point, polyline, and polygon) with its attribute. |
| Update/Delete existing feature. |
| The response time for mobile application within seconds. |
| Target platforms – Android, iOS |
| Connected Online Application |
| Routing : get direction from Place A to Place B. |
| Multilingual |

### 4.2 Research Design and Methodology

This study is particularly useful because I as researcher and also the utility administrators lack a clear idea of the outcome and impact of new technology used in the study. Through the exploration one can develop concepts more clearly, develop operational definitions and improve the final research methodology.

## 5. Case Study Architecture

### 5.1 Physical Architecture

Figure 2 depict a high level physical architecture of the system. ArcGIS Server allows you to publish services for visualization, spatial analysis, and spatial data management. Once the services are published, ArcGIS JavaScript API framework can be used to access these services.

Map services offer access to the contents of a map hosted on a server.

Example::http://sampleserver1.arcgisonline.com/ArcGIS/rest/services/Demographics/ESRI_Census_USA/MapServer?f=jsapi

Feature services allow you to execute queries to get features and perform edits that can be applied to the server.

Example::http://sampleserver3.arcgisonline.com/ArcGIS/rest/services/SanFrancisco/311Incidents/FeatureServer/0

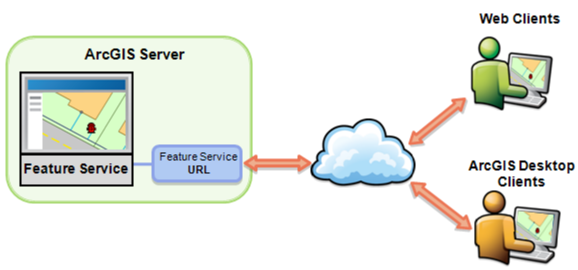


**Fig: 2.** ArcGIS Published Feature Service

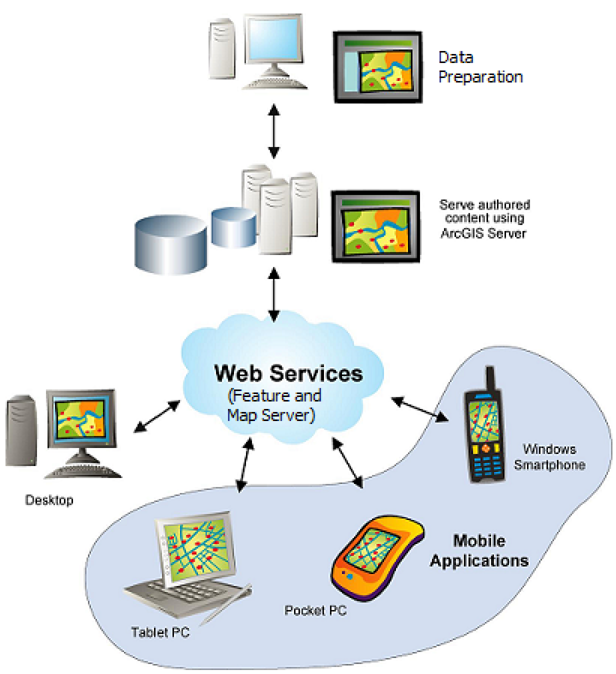


**Fig: 3.** Physical Architecture of the Application

### 5.2. Logical Architecture

Figure 3 depicts the logical flow of the research. It defines the processes that perform functions and the information or data flows that are shared between these processes.

The ArcGIS Server JavaScript API, released with ArcGIS Server 10.x, sits directly on top of Dojo with access to Dojo user interface widgets and all the other benefits of Dojo core through a simple reference in the web application.

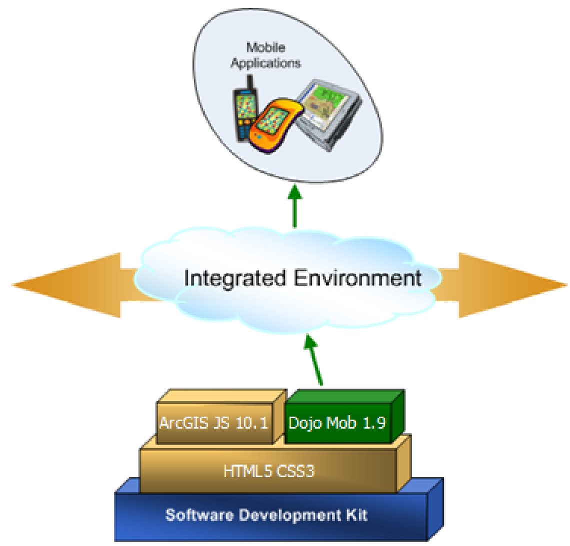


**Fig: 4.** Logical Architecture of the Application

Reference satellite Imagery will be provided by ESRI ArcGIS Javascript Map Object:Basemap type

*map = new Map("map", {*
*center: [-70.6508, 43.1452],*
*zoom: 16,*
*basemap: " satellite"*
*});*
*Basemap types: satellite,topo,oceans,streets etc*

**DOJO MOBILE:** Its libraries have been used to add the following functionality:

- Display spatial information using a Map control
- Display and capture GPS location using native libraries.
- Create new point, line and polygon features as well as update the shape of existing features
- Edit tabular data
- Synchronize changes between mobile devices and the GIS server


Fig: 5. Conceptual view of the Mobile component architecture

**PHONEGAP:** Complete application would be wrapped using Phonegap framework for both Android and iOS platforms.

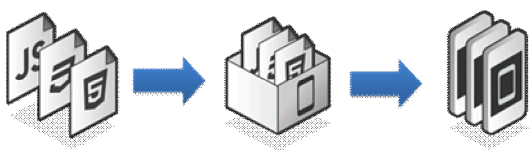

**Fig: 6.** Web Application wrapped with Native Framework can be deployed on multiple Mobile Platforms.

## 6. Technology Used

| Server/API | Purpose |
|---|---|
| **Application Server/Web Server** | |
| IIS + .net Framework 4.5 | Server side implementation as Application Server and hosting web services. |
| **GIS Server** | |
| ArcGIS Server 10.x | Map Server for hosting spatial data and using ArcGIS rest based services for spatial analysis and query as feature server. |
| **Database Server** | |
| Oracle RDBMS/ArcSDE | Storing spatial and non-spatial data. |
| **Client Side Technologies** | |
| ArcGIS JavaScript 10.x Compact API | Light weight ArcGIS JavaScript API to embed Maps and tasks in Web application. Supports HTML5 and SVG. Supports multiple layer type like tiled map service, feature layers, graphics, kml, open street maps, WMS/WMTS, custom layers. Compatible with other JavaScript frameworks like jQuery. Inbuilt widgets for faster development. |
| Scalable Vector Graphics 1.1 | Spatial Statistical Chart Display, icons rendering. |
| Dojo Mobile 1.9 | HTML5 Mobile JavaScript framework. |
| PhoneGap | For enabling access to native mobile operating system functionalities through JavaScript. |
| HTML5/CSS3 : | HTML5/CSS3 is compliant with all the modern browsers like Chrome, Firefox, Safari, and Internet Explorer. Use of HTML5/JavaScript will reduce the need for external plug-in (like Flash, and silverlight), provides better error handling capabilities and is device and OS independent. |

## 7. Conclusion and Benefits

1. No plug-in is required for proposed client side implementation using ArcGIS API for JavaScript where as Silverlight and Flex technologies require plug-in installation on client-side that is on user browsers.
2. ArcGIS API for JavaScript supports HTML 5 which provides platform compatibility and is the future technology that is likely to replace Silverlight and Flex.
3. It provides enhanced security, accessibility and longevity of information, thus providing improved access to data for users.
4. Allow users to easy access to information to support the decision making process and ensure consistent decisions.
5. ArcGIS server optimum configuration to produce best performance.
6. ArcGIS JavaScript API is free with Arc GIS Server.
7. Customizable with little efforts.
8. Low hardware requirement that means it can run on smart phones even.
9. Cost Effective.
10. Large Data Support.
11. Increased Efficiency of Field Data Collection.
12. Minimized Data Entry Time.
13. Reduce Mistakes.
14. Easy Access of GIS Data in the Field, users.

## References

[1] Esri Arcgis JavaScript API 10.1: http://resources.arcgis.com/en/help/main/10.1/index.html#//01540000040n000000
[2] SVGTutorial: http://www.w3schools.com/svg/ http://en.wikipedia.org/wiki/Scalable_Vector_Graphics
[3] Dojo framework: http://demos.dojotoolkit.org/demos/mobileGallery/demo-iphone.html
[4] http://www.microsoft.com/web/platform/server.aspx Professional Microsoft IIS 8 by Ken Schaefer, Jeff Cochran, Scott Forsyth, Dennis Glendenning, Benjamin Perkins -- Wrox Publication
[5] ArcGIS 10.1 for Server:: http://resources.arcgis.com/en/help/main/10.1/index.html#//016w00000036000000
[6] Professional Android 4 application Development by Reto Meier-- Wrox publication Android Cookbook by Android Community Experts -- Oreilly Publication http://developer.android .com /guide/components/index.html
[7] http://webhelp.esri.com/arcgisdesktop/9.3/ index.cfm?TopicName=An_overview_of_geocoding http://www.esri.com/software/arcgis/extensions/networkanalyst
[8] Pro HTML5 and CSS3 Design Patterns by Michael Bowers, Dionysios Synodinos and Victor Sumner – Apress HTML5 Geolocation by Anthony T. Holdener III – Oreilly Professional Mobile Application Development by Jeff McWherter, Scott Gowell -- -- Wrox Publication
[9] Professional Oracle Spatial for Oracle Database 11g by Ravi Kothuri, albert Godfrind and Euro Beinat -- Apress Publication
[10] Beginning PhoneGap by Thomas Myer -- Wrox Publication Beginning PhoneGap by Rohit Ghatol and Yogesh Patel -- Apress Publication PhoneGap Tutorial: http://docs.phonegap.com/en/edge/ guide_platforms_index.md.html
[11] Building Web Applications with SVG by David Dailey, Jon Frost and Domenico Strazzullo -- Microsoft Publicatio