



Kingdom of Bahrain
Ministry of Municipalities And Agricultural Affairs
Information Systems Directorate



MUNICIPAL GIS



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Ministry of Municipality and Agricultural Affairs (MOMAA), Kingdom of Bahrain responsible for planning, development implementation, cleaning and beautification of the nation. The Information Systems Directorate (ISD) in the Ministry of Municipalities and Agricultural Affairs coordinates the municipalities and directorates by sharing their information, activities and their experience ISD connects all of the municipalities with other ministries and provides a centralized facility to store, analyze, maintain and share the data between the different municipalities. ISD also develops the applications to improve municipal services and staff efficiency

ISD plays a key role in identifying and implementing the new technologies and standard procedures in the municipal services. ISD identified Geographical Information Systems (GIS) as a scientific tool to improve the municipal services. The GIS section is a part of the ISD and was established in 1998 for collecting, formatting, integrating and distributing spatial data to municipalities.

The GIS unit provides the following services to municipalities

1. Collecting and updating the base layers for municipal requirements.
2. Developing the GIS based applications and providing training to the municipal staffs
3. Enforcing the spatial data standards within municipalities
4. Updating and sharing the spatial data within municipalities and other ministries

In the last eleven years, the municipality became the major player in use of GIS technology in Bahrain. Many GIS applications have been developed to improve the performance of municipalities.

Softwares :-

The GIS section has selected ESRI GIS software as the primary GIS tools. The following software are used to develop GIS applications and implement GIS in municipality.



ArcGIS server: A complete and integrated Server GIS used to Distribute maps.



ArcGIS Engine: To create custom GIS Desktop Applications



ArcSDE

ArcSDE: Spatial Database Engine to store and distribute the spatial data.



ArcIMS

ArcIMS: Develop the web based GIS applications.



ArcPad

ArcPad: Provides mapping, GIS, and GPS integration via handheld and mobile devices

ORACLE

Oracle: Relational Database to store the attribute data.

MapObjects : Interface to access the spatial data using development tools



MapObjects

Image server : Image server is software to handle large size imagery data efficiently.

ArcGIS

Microsoft Visual Studio
.Net Framework Development Environment



Visual Studio

Visual Basic
Application development tool.



Microsoft Visual Basic 6.0



BENTLEY



ERDAS IMAGINE

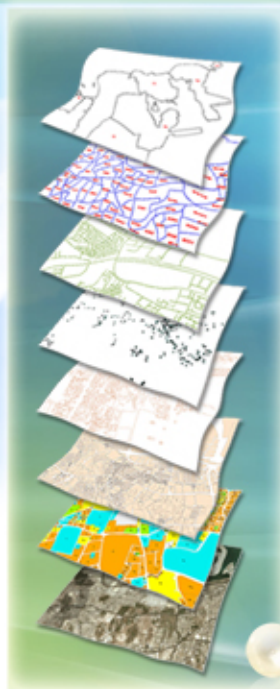
Spatial Database

The strategic business plan for implementing GIS in the municipalities identified the important **base layers** and **thematic layers** to be created or collected for the municipal services.

Based on that, the following spatial information was collected from different sources and formatted to be use in municipal applications. All the data are stored as seamless data in an oracle database using the spatial database engine and it is update daily or frequently depending on the data source whether it's generated from municipality or outside municipality.



Base Layers



Municipal Boundaries : Contains the boundaries of the five municipalities with election circle information.

Block Boundaries : Contains the block boundaries and numbers for 456 blocks in the Kingdom of Bahrain.

Road Centerline : This dataset contains center of roads represented as linear features classified into Highways, Avenues, Roads and Lanes.

Addresses : Point feature that represents Building no., Road no., Block no., usage nature and building type.

Topographic : Provides an inventory of all physical objects such as, buildings, roads, trees, poles etc. It's prepared using survey directorate data

Cadastral : Contains Land parcel boundaries with Parcel Number. It's prepared using survey directorate data

Zoning : This dataset contains zoning regulations for the Kingdom of Bahrain.

Satellite Images : From 1998, satellite imagery collected every year and recently for the year 2009 with resolution 60cm above the ground.

Theme Layers

- Municipal Land** :All the lands maintained by municipalities, with details such as land details, ownership and usage even the Title Deeds.
- Advertisement locations** : Shows locations of advertisement boards permitted by municipality with details of their permit number, permission period and contractor details .
- CR location** :Shows location of CR plants with detail, contractor details
- Building Permit**:Shows locations of building permits allowed by municipality with all details.
- Landmarks** :Shows locations of well - known (prominent) buildings and monuments in the kingdom of Bahrain
- Lampposts** :Shows all the locations of lampposts with unique coded and this can be used for lamppost advertisement
- Cemetery** :This dataset contains locations of all cemeteries in Kingdom of Bahrain and thier areas.
- P a r k s** :Shows locations of all of the gardens for the public use and it is stored as polygon features with block numbers.
- Road Types** :Shows all Road types based on usage such as commercial, residential service and industrial with their start and end point descriptions.
- Telephone Call Box**:Shows all the locations of call box telephones that can be used in emergency cases in the Kingdom of Bahrain.
- Services+** These datasets contain service and business establishments such as :- Schools,Hospitals,Hotels, Fire Stations, Banks, Restaurants, Mosques and Maatlams, Post offices, Car services agencies, Car rental Offices,Travel Agencies, Bookshops, Public Libraries, Embassies, Restaurant, Shopping Malls, Supermarkets, Petrol Stations, Fruit and Vegetables Shops,Flower shops,Meat shops,Ministries and Government offices,Property agencies
- Traffic Lights** : Shows locations of all of the Traffic lights in the Kingdom of Bahrain.



GIS Applications

As an Information Systems Directorate (ISD) has a wealth of spatial data that is collected and updated from various sources, Municipal GIS plays the main role in providing municipal users and the public with this spatial data through a useful application that is effective in processing, storing and retrieval daily work.



Map Browsing System (MBS)



The Map Browsing System was developed to enable managers and engineers at municipalities in viewing and handling spatial data in easy way and overcome the difficulties of :-

1. Viewing incompatible data from different resources.
2. Locating particular areas with Topo sheet numbers.

It displays the spatial data layers such as:-Block boundaries, Road networks, Cadastral maps, Addresses, Zoning maps, Commercial roads, Topo sheet maps and Satellite imagery of 60cm resolution above the ground. Also it allows the user to view the images of Bahrain collected on 1998, 2001, 2003, 2005, 2006, 2007 and 2009.

Moreover MBS provides a map navigation tool that allows the user to search for any location by; Address or Parcel number, Road number, Block number or Topo sheet number.

The users have the facilities to :-

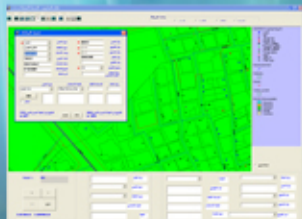
- Add their own shape files to the existing information.
- Create a customized layout easily at any scale.
- Control feature based display (on/off) for both map LEVELS and map FEATURES for DGN topo files.
- Rearrange the order of the layers and display the parcel coordinates and it's area.
- Printing maps at any scale.

Development Environment:

ArcSDE, Oracle, MapObjects and Visual-Basic



Address Management System (ADDMS)



The Address Management System was developed to store, analyze, query and manipulate address data spatially and non-spatially. All of the spatial data are stored in Spatial Database Engine (SDE) and attributes are stored in an Oracle database.

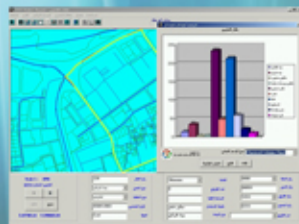
In this application, Block boundary, Road centerline, Building boundary and Cadastral Data are displayed as base layers. Addresses are stored as points, which are located at the entrance of the building. Addresses are represented by different symbols based on the building type.

Landmark locations such as Hotels, Museums, Schools, Hospitals are stored with their description. Address points are stored with the connecting point coordinates with the road centerline, which is useful for effective network analysis.

This environment provides the facility to share the data with users in twelve municipal locations and to update the address layer from different municipalities simultaneously.

Development Environment :

ArcSDE, Oracle, Map objects and Visual Basic



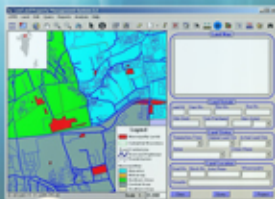
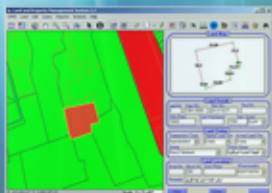
Land and Property Management System (LPMS)

The Land and Property Management System (LPMS) is a fully integrated desktop application for managing lands, projects and properties utilized by Municipalities. It maintains the latest information about lands with greatest level of accuracy, thus making the system an efficient decision making tool for senior management.

The LPMS gives the user full control of content and the interface for the Lands supported by details of Projects & Properties. All of the data is stored in Oracle database and Spatial data is accessed through ArcSDE. In this application, information is organized into three levels:-

1. Land information.
2. Project information.
3. Property information.

This application displays the Block boundaries, Road networks, Topo sheets, land parcels and Orthophoto as the base layers. The availability of shops and their details are updated using an oracle based application and the user can view the updates immediately in LPMS.



LPMS allows municipal staff to locate vacant properties easily. The user can also make complex queries about the land and properties both spatially and non-spatially.

Details about the lands including the land cost, land usage, owner and land value are updated and stored in the oracle database which is linked with the graphical data through LPMS. The title deeds of the land were scanned and stored in the server and can be retrieved by LPMS easily.

LPMS has the facilities of :-

- Adding new land and their details in a flexible way.
- Navigational functions with facilities such as map tips and area calculation of land.
- Creating a customized land map at any scale.

Implementation of this application in the Ministry of Finance to manage all of the government land is an evidence of how successful this application is.

Development Environment:
ArcSDE, Oracle, MapObjects and Visual Basic

Advertisement Management System (ADMS)

The Advertisement Management System was developed to manage advertisements locations effectively through combining the spatial and non-spatial information. It is also used to track violated advertisements and check whether they are permitted or not.

In this application, Block boundary, Topo sheets, Road network, Cadastral and Orthophoto are displayed as base layers and the advertisement locations display as point features in the theme layer. In addition to that Lamppost points were added for managing Lamppost advertisements.



The ADMS allows the user to:-

- Execute any type of spatial query or attribute query.
- Display advertisements based on their category, type and location easily.
- View the advertisement photos by clicking on its location.
- Issue the advertisement permit for the new advertisement location.
- To query and view the advertisement permits issued on the specific period
- To make sure the availability of lamppost by adding lamppost advertisements
- Create customized advertisement maps by type.
- Store additional details.

This application is restricted within municipality use through security features system

It helps the user to monitor the pattern of advertisement and location and prepare interpretative reports of advertisements as demand.

Development Environment:

ArcSDE, Oracle, MapObjects and Visual Basic .Net



Non Commercial Advertisement System (NCADS)

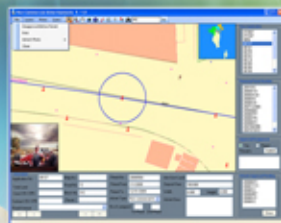


The Non Commercial Advertisement system was developed to manage non commercial advertisements locations with detailed spatial and non spatial information. It is specially designed for Issue / Renewal the permission of only Non Commercial advertisements. In addition to that let the user can accept / modify / reject the artwork based on the permit number.

In this application Block Boundary, Topo Sheets, Road centreline, Cadastral and Orthophoto are displayed as base layers and non commercial advertisement locations display as point features in the theme layer

The NCADS allows the user to:-

- Issue Non Commercial (NC) advertisement permit for the new advertisement location
- To disapprove the approval number before printing the permit by entering application no.
- Facility to Accept/Reject/Modification of Artwork based on the permit number
- To view NC advertisement application attachments (PDF, JGP, DOC, etc)
- Execute any type of spatial query or attribute query.
- View the NC advertisement photos by clicking on its location.
- To query and view the NC advertisement permits issued on the specific period
- Store additional details.



This application is restricted within municipality use through security features system. It helps the user to monitor the pattern of NC advertisement and location and prepare interpretative reports of advertisements as demand.

Development Environment
ArcSDE, Oracle, MapObjects and Visual Basic .Net

Commercial Registration System

The Commercial Registration (CR) version 1.0 is an application with all spatial and non-spatial details of CR in Kingdom of Bahrain. The goal of this application is to improve efficiency of inspectors in municipalities and reduce their field surveys. It also helps management to take better decisions regarding the municipal permission for commercial registration. In future, it will allow the public to view all the commercial registrations through internet in the map which helps the public to start new activities in the area.



Important features

- Simple attribute query for (CR, block, address, road, area, municipality, parcel)
- Complex attribute query for CR by combining these attributes(Road number, Block number, Road name, Area name, Municipality name, Zoning type, Activity group type, Activity type, Registration or expiry period, Owner nationality, Commercial road validity). Example: find CR for selling sandwiches activity within Salmayia that are owned by Bahrainis.
- Identify spatial data (CR, block, road, address, parcel, zoning)
- Spatial query for CR of certain attributes or approved activities on Road segment, within polygon, rectangle and circle
- Buffering tool to find CR of certain attributes within distance.
- Printing general and specific maps (CR, block, road, address, parcel, area, municipality) of different sizes and layouts
- Generates Different types of reports and charts
- Facility to export result of query for CR to a shape file
- View Satellite imagery for different years
- View map tips
- View dynamic legend

Development Environment
ArcSDE, Oracle, MapObjects and Visual Basic .Net

Building Permit System (BPS)

Municipality is responsible to issue the building permits in Bahrain and use the GIS technology extensively to make decision about the building permits. Using this application, the public can view the building regulation of the parcel from the interactive map and also can view all the details about the area. This System has been designed to validate the project location details in order to speed up the process of issuing building permit. It is used by the engineering offices to search the particular plots and the zoning type. In this application, the Block Boundary, Topo Sheets, Road Network, Cadastral and Aerial Images.

This application is based on two modules

1. Desktop BPS
2. Online BPS



This application also allows the planners to study the urbanisation and new development in any area.

Development Environment:

ArcSDE, Oracle, ArcIMS, MapObjects and Visual Basic .Net



Online BPS allows the user to query a particular plot by parcel number and also by block number. It also helps to make automate the business process by the zoning details and validation against Civil aviation restricted area layer.



Planning Management Information System (PMIS)

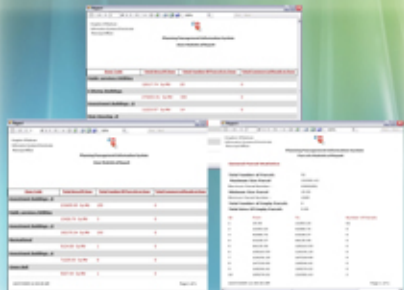
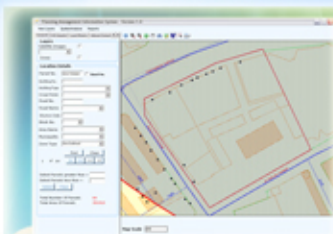


The Planning Management Information System was developed to produce the information required for planners very often and help to interpret the existing spatial data. MOMAA is responsible for planning and development in Kingdom of Bahrain and it requires many information about the kingdom such as Lands, services, utilities and demographic details in its planning process. As all these details are scattered with many ministries and in different formats, the planning process become difficult task and increased the process duration.

PMIS is a GIS application which provides the facility to access different format data from different sources for the planners. Also it has customized tools to carry spatial analysis of lands based on their location, size, usage and block level statistics and also spatial analysis for public services.

It also helps the planners to compare the current situation with future plan which drafted as part of Bahrain 2030 vision. It has many tools to provide the details about commercial shops, land marks, commercial roads, Advertisement locations, building permits, irrigation channels and vegetation mapping analyses at any area in the kingdom.

Planners also can get statistical reports of Blocks, Parcels and Zones doing spatial analysis.



Furthermore they can access archive of satellite imagerys from 1989 till 2009 and they can print instant and detailed maps. Most importantly, the planners have access to up-to-date data, since the application access the data from centralized database.

Development Environment:
ArcSDE, Oracle, MapObjects and Visual Basic .Net

Mobile Violation Tracking System (MobVTS)



The Mobile Violation Tracking System (MobVTS) is a mobile based application that helps Survey Inspectors to track violated advertisements or Buildings against the municipal permission and to issue the violation notice to the violator in the field.

It made the paper less survey possible for the municipal surveyors by providing all the information in their mobile device. It also reduce the time consuming in the field to record and update the violation.

This system consist of the following three Modules:

1. Mobile Violation Tracking System
 - Mobile based Map browsing system which shows permitted services and enable the user to enter the violation with limited entries.
2. Mobile PC Update Module
 - Synchronize the data from mobile device to Municipal database.
3. Violation & Complaints System
 - It is a centralized application to track all types of violations.



This system will give up-to-date information and maintained accurate data in the centralized database.

This system will helps the managers and users to easily view the location of the address / Advertisement / Permitted Buildings on an advanced map display and satellite image based map display

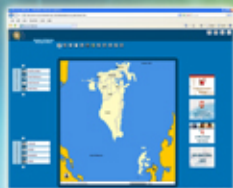
Development Environment
 ArcSDE, Oracle, ArcPad Application Builder, MapObjects, Visual Basic.Net
 and Bluetooth SDK

Discover Bahrain

Discover Bahrain is a web based GIS application. This system is user friendly for its easy access for address data of Bahrain.

Discover Bahrain was developed to provide the geographical scenario of Bahrain to the public and also to help the public to understand their location with zoning information and availability of commercial roads.

The application is available on the website www.mun.gov.bh

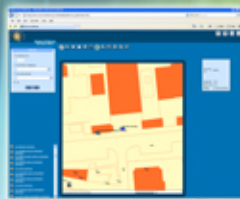


The application provides the following facilities :-

- View the latest satellite images of Bahrain.
- Executing of queries based on address, road and area of the kingdom of Bahrain.
- View of complete list of well known and important locations of Bahrain that are categorized into Schools, Hospitals, Hotels, Mosques, Parks and Tourist location by simply clicking the list.
- View of zoning maps that's contain building regulation for the land.
- View of commercial road map to help business people select suitable places for their business.

Using the location tool, the user can prepare a location map with the detailed address and it can be Printed for a customized report.

Development Environment:
ArcSDE, ArcIMS



User Training and Support

User Training

Municipal staffs provided with hand on training on all municipal GIS application about the usage and importance of the application in providing the service to the public.

Online support

Users can access online support for any municipal GIS applications queries or technical problems.



ISD Achievement among Kingdom of Bahrain:



- **ISD** received the "Best Achievement in GIS Award" for its contributions towards municipal GIS in 2000 and 2003 from the Environment System Research Institute (ESRI).
- **ISD** presented the Municipal GIS application at GIS conferences held in Bahrain on 2000, 2004 and in Dubai on 2002.
- **ISD** presented the municipal web applications in world IT organized by United Nation in 2005 at Tunisia.

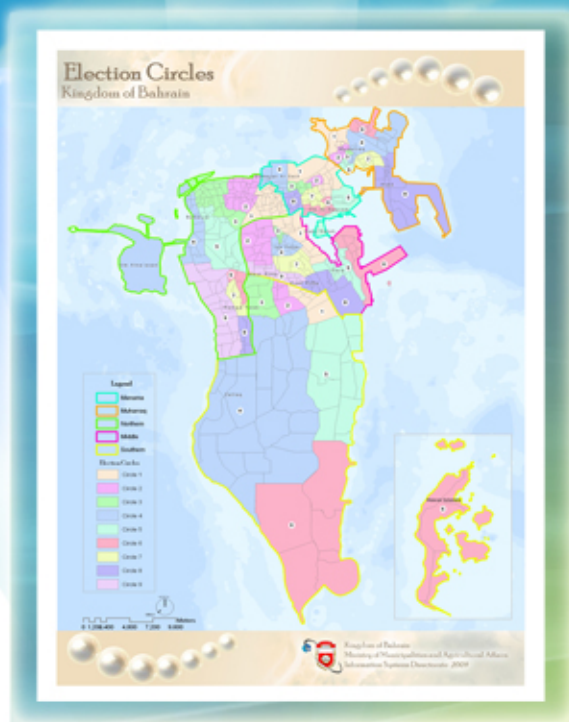


- **ISD** conducts the "GIS Day" regularly to increase the awareness of GIS among municipal staff and Bahrain school children.

- **ISD** has shared expertise and spatial information with the following ministries in the Kingdom of Bahrain:-

1. Survey and Land Registration Bureau
2. Ministry of Interior
3. National Guards
4. Ministry of Education
5. Ministry of Works
6. Jaffria Awqaf Directorate

Sample Maps prepared by GIS unit



Sample Maps prepared by GIS unit



Satellite Enhancements in ISD, Kingdom of Bahrain

Satellite Image 1998



Satellite Image 2009



Satellite Image 2001



Satellite Image 2007



Satellite Image 2005



Satellite Image 2003





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