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A WEB-BASED GIS APPLICATION FOR GULSHAN-E-IQBAL UNDERGROUND WATER PIPELINES NETWORK

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ABSTRACT

Typically, a municipal infrastructure requires processing, evaluation and mitigation plans on the basis of some significant spatial data with respect to various rules, factors and constraints. An electronic data management system can be a good solution, but its implementation can be expensive and tedious. These problems needs to be addressed with a web-based GIS applications that can manage, query and envision different noteworthy and upgraded essential data concerning with the Gulshan-e-Iqbal water pipelines network. The possible available paper maps and information of underground pipelines was collected from the Karachi Water and Sewerage Board (KWSB). A geo database was developed using the information of pipelines such as: network type, pipelines diameter, pipelines material, pipelines age, and water sources currently catering the study area. The data was shared onto the application by creating service connection. This application was developed using Adobe Flex builder and Arc GIS viewer for Flex. The results obtained in the application were displayed as GIS maps, tables concisely and widgets/tools – dealing with the data shared on the application. The web-based GIS application presented in this thesis is an improved way to interact with large amount of spatial data, and even asses the risks associated with the current water pipelines network with less technological requirements.

Key Words: GIS, Web-based application, data management, municipality

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* The material presented by the author does not necessarily portray the viewpoint of the editors and the management of the Institute of Business & Technology (IBT)

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1. INTRODUCTION

Karachi being one of the mega cities in the world and the biggest industrial and commercial center of Pakistan, its municipal infrastructure is decaying faster than it's being renewed. Low funding, population growth, poor quality control has led to inferior installations, and inadequate maintenance has an adverse impact on the municipal infrastructure; one of them is the water distribution network. The water distribution networks are the underground pipelines of Karachi, which unfortunately have received little attention from municipal administration. In the past ten years, more than 15 underground water pipelines burst outs have been reported only in Gulshan-e-Iqbal town, one of the largest towns of Karachi, according to KWSB (Karachi Water and Sewerage Board); but due to improper record maintenance, not much information is available with the management on such causes[1]. The water supply problems in Karachi are as complex as is its transmission network. From the beginning, there has always been a gap between the demand and supply in the city due to planning failures, and improper records and data. Today, almost all businesses, government, private organizations and common people around the world are regular users of web-based GIS applications, and use them for different purposes like planning, decision making, and as problem solving techniques. Web-based GIS applications have the capability to combine different types of spatial data (i-e Raster and Vector) into a meaningful shape [2].In view of this situation, it is increasingly become critical to develop an application that have minimum cost, comply with regulations and be acceptable to public[3].

2. PROBLEM STATEMENT

For decades, paper-pen based data collection has been the standard method for collecting and maintaining water distribution/transmission pipelines data by Karachi management. This culture has caused several problems for the water system managers (their planning and engineering staff), and has led them to uncertainties in planning, designing and operating water system to meet customer's demands. Moreover, it also includes data entry errors and the high costs of storage.

3. OBJECTIVES

Therefore, this led to an idea of developing a web-based GIS application in order to improve and systemize the current data management practice of Karachi water management. This new system will assist field engineers and planners with different level of GIS knowledge and potentially save time and energy.
This application will help meet the challenges faced by the Karachi's water management with following goals:

(1) A GIS based solution
(2) A user-friendly environment for pipelines field data
(3) Store a large amount of spatial data
(4) Easy to evaluate and process

(5) Up to date
(6) Development of Geo database of water distribution network

4. STUDY AREA

Figure 1 shows a map of Gulshan-e-Iqbal town, largest town of Karachi is located in the center of the city covering an area of 26 sq. km with 13 union councils. The population of the town is approximately 650,000 as per last census It is located between latitude 25°38'46.92"N 24°44'2.36"N and longitude 66°38'55.50"E 67°35'10.48"E[4][5].

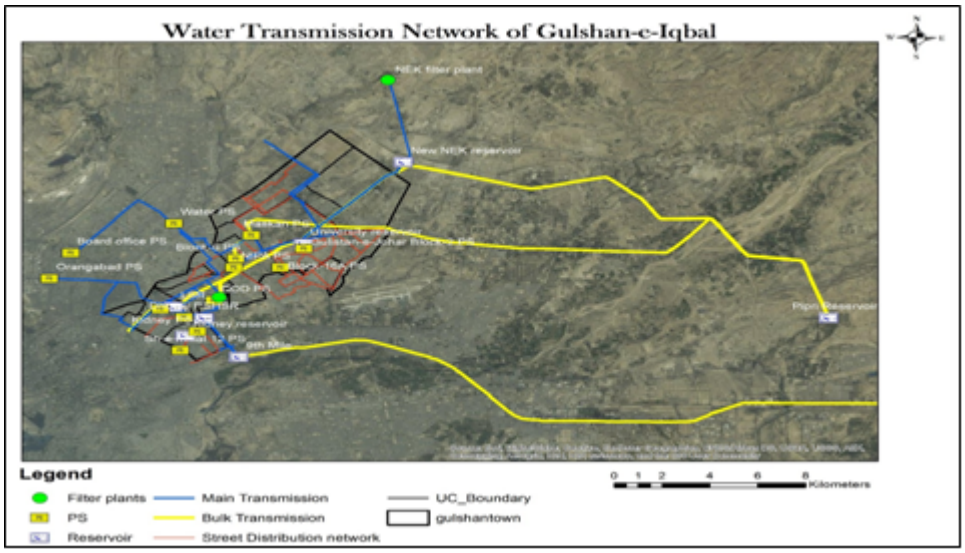

Figure 1: Water Transmission Network of Gulshan-e-Iqbal

From the Figure 1, a water network system of Gulshan-e-Iqbal Town is shown, which is based on three network types.

4.1 Bulk Transmission

This network type pipelines are responsible to supply water to Gulshan-e-Iqbal town in bulk amount. Five 84” inch diameter pipelines are connected with Pipri reservoir and COD filter plant; reported to be 40 years old by KWSB officials. From Pipri reservoir, the town receives the bulk water at COD filter. Then from COD filter plant, water is further supplied through the Main trunks. Another 54” inch diameter pipeline is connected with Haleji filter plant and 9th Mile reservoir. Means, bulk amount of water is supplied to the 9th Mile reservoir, which is further supplied to the town through the Main trunks. This pipeline is reported to be 10 years old. These pipelines are made of PRCC material [6] [7].

4.2 Main Trunks

These pipelines are responsible for supplying water to the union councils of the town. This network type is connected to several pump stations, filter plants and reservoir. These pipelines are of 24”, 33”, 36”, 48”, 54”, 66” and 72” inch diameter. They are

reported to be 30 – 50 years old by KWSB officials and are made of Cast iron, PRCC, and Ductile iron. These pipelines collect water from their respective water sources and then through street distribution pipelines, which are injected in the main trunks, supply this water further to the houses of Gulshan-e-Iqbal [8].

4.3 Street Distribution Network

This network type is responsible to supply water to our homes directly. They are of 10", 12", 15", 18" 24" diameter pipelines, and reported to be 40 – 50 years old by KWSB officials. Their materials are PVC (Polyvinyl chloride) and UPVC (Un-plasticized Polyvinyl Chloride). These pipelines are injected in the main trunks, which collected water from the water sources, and through these street distribution networks water is further supplied to the homes of Gulshan-e-Iqbal town [9].

There are three types of water sources that are catering the Gulshan-e-Iqbal town.

4.4 Pump Stations (PS)

These pump stations are known as the mother feeding stations of the town. Gulistan-e-Johar Block-2 PS, Block-6 PS, Block-16-A PS, Maskan PS, NIPA PS, COD PS, Dhoraji PS, Kidney PS, Al-Hilal PS, Sh-e-millat PS, Water PS. There 11 pump stations currently supplying water to the home. The capacity of these pump stations is 50,000 gallons reported by the KWSB official [10].

4.5 Filter Plants

There are three filter plants catering Gulshan-e-Iqbal COD filter plant, NEK (north east Karachi) filter plant and Haleji filter plant (source of bulk supply to the city). COD filter plant receives water from the Pipri reservoir as the bulk amount and supplied further to the town. NEK (north east Karachi) filter plant supplies water to the New NEK reservoir, and from there it goes to the university reservoir for further supply to the town [11][12].

4.6 Reservoirs

There are seven reservoirs for the town, University reservoir (receives water from New NEK reservoir), Kidney reservoir, 9th Mile (receives bulk water from Haleji filter plant), LSR (Lower service reservoir), HSR (High service reservoir) New NEK reservoir (north east Karachi) receives water from the NEK filter plant, and Pipri reservoir (situated out of the area and supplies bulk water to the town)[13].

5. DATA AND METHODOLOGY

5.1 Overview

The aim of this work is to create a user-friendly web application for Karachi's water management, through which users can gather all possible underground water distribution pipelines data information to make constructive decisions. It became extremely important to develop a web-based GIS application that has state-of-the-art functionality, an attractive look, and user-friendly for the public. This chapter demonstrates about this application which configures a server to distribute information to the end users of

Gulshan-e-Iqbal and its Water Management. Relationship becoming stronger between the internet and GIS, the development of web-based GIS applications is becoming quite simple. Architecture of server/client is set up within Arc GIS Server; all the GIS feature classes, and all of the underground water distribution pipelines data, are uploaded into a geo database. The geo database then plays a role of a storage container for the Arc GIS server to create a web service. This service is then accessed via a URL through which the application will call.

This study created an Adobe Flex application. Flex is more contemporary in its design and interface, in comparison to the default Arc GIS server web application. It was created as a cross-platform and an open source application builder.

5.2 Methodology

The web-based application requires conducting the following steps as shown in Figure **2**:

1. Identifying the problem for the region
2. Data preparation
3. Creating a Geo database
4. Service Connection
5. Application Customization
6. Data Integration

5.2.1 Identifying the Problems for the Region

This step was carried out initially and separately. In this step, the problems associated with the Gulshan-e-Iqbal water management's conventional method of storing large amount of pipelines data were identified. The problems were:

a. Gulshan-e-Iqbal water management is using more than 15 years old paper based maps for planning, repair and replacement work. This culture has caused several problems for the water system managers (their planning and engineering staff).

b. Improper record management. The data is being stored in the form of papers in plastic files and folders, which has caused them problems in storing it. They require more iron closets and more files and folders to store and handle heavy influx of pipelines data.

c. Historical pipelines data is missing along with pipelines incident data for the past 10 years.

5.2.2 Data Preparation

The data for a particular project comes from a several different sources. Some are different in coordinate systems or formats; some of the data is usable as it is, whereas some need additional processing before it can be used.

a. The data used for the said work has been acquired from Karachi Water &

Sewerage Board (KWSB) Gulshan-e-Iqbal office. A service based consumer oriented organization, responsible for storing, managing, and provision of only Gulshan-e-Iqbal area's underground water pipelines data.

b. The data provided by KWSB was in the form of paper maps - were then geographically aligned by using geo referencing tool in Arc Map. Firstly, the paper maps were scanned. Google Earth imagery Quick bird with 0.65m resolution was taken as a reference image to add coordinates in the scanned maps. Before the geo referencing process, projection of scanned maps was defined by using "define projection" tool in Data Management Tools>Projections and Transformation. After defining the projection, four control points were taken for each scanned map from the Google Earth imagery Quick bird, and by clicking the "Add control points" button in the Geo referencing toolbar, one by one the coordinates (collected) were then added. In total nine control points were collected. The control points could then be viewed in the "View Link Table". The total RMS error that came out to be was 0.234. After finishing entering the control points, in the drop down list of geo referencing tab, select "Update Geo referencing" to save the changes made.

c. After acquiring SPOT 4 image, further, this image was used as a base map by keeping the scale of 1:0:06 for the digitization of Gulshan-e-Iqbal underground water transmission/distribution pipelines and creating their connections by plotting filter plants, pumps stations and reservoirs.

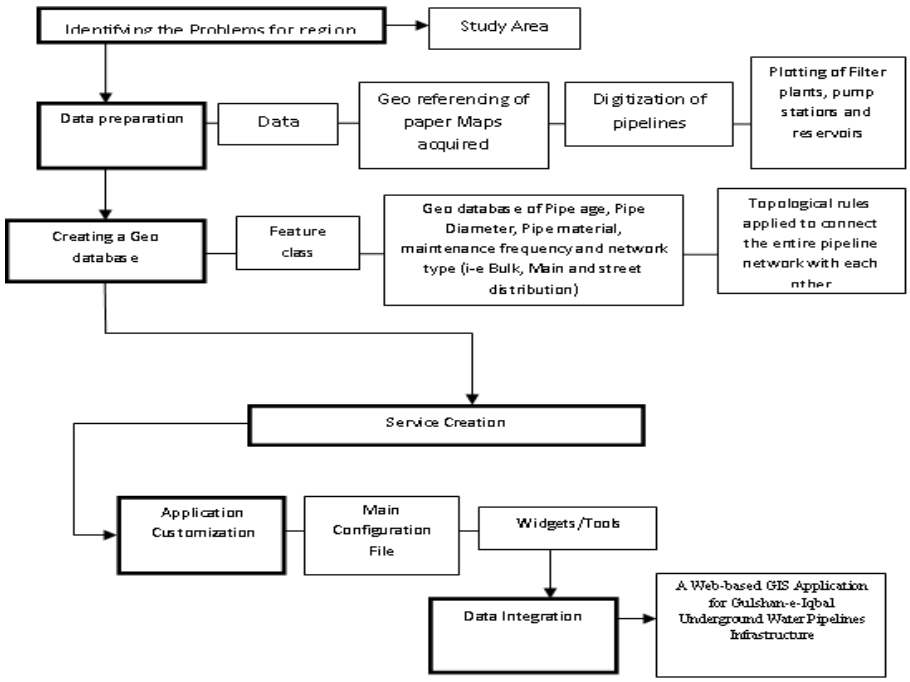

Figure 2: A flowchart showing a sequential process of aforementioned steps for the development of web-based GIS application

5.2.3 Creating a Geo Database

This phase involves the creation of a geo database; consisting possible details associated with the pipelines. Firstly, the feature classes were import in the geo database by using Arc map, which were digitized in the data preparation section after geo referencing of the paper maps. The details provided by the KWSB officials were then inserted such as: pipe age, pipe diameter, and pipe material and network type i-e for the Bulk transmission, Main trunks and street distribution network in the attribute table of digitized pipelines as shown in Figure 3. All the feature classes were inserted in the geo database, and topological rules were then applied to align and connect the entire pipeline network with each other, and with their respective filter plants, pump stations and reservoirs. After running all the topology rules, it displayed the errors that were in the network. Then in the topology toolbar, by clicking the fix topology error tool**,** the errors were then fixed depending on the nature of the error in the entire pipelines network. Once the errors were fixed, the next step was to validate the topology. This is an important step. Validating the topology means to check the features to recognize any infringement of the rules that have been characterized for the topology.

By clicking the Full Extent tool, the pipeline network zoomed to the full extent of the map. Then, same in the topology toolbar, by clicking the validate topology in current extend tool, the whole extent of the pipeline network was validated.

Table

pipelines_01

FID	Shape *	OID_	Name	Id	Pipe_Mater	Pipe_Dia	Network_Ty	Pipe_Age
6	Polyline	0	Yellow	0	PRCC	84	Bulk	40
7	Polyline	0	Yellow	0	RCC	54	Bulk	10
8	Polyline	0	Red	0	PVC	15	Distribution	40
9	Polyline	0	Red	0	PVC	18	Distribution	50
10	Polyline	0	Red	0	PVC	18	Distribution	40
11	Polyline	0	Red	0	PVC	18	Distribution	50
12	Polyline	0	Red	0	UPVC	10	Distribution	40
13	Polyline	0	Red	0	UPVC	18	Distribution	40
14	Polyline	0	Red	0	UPVC	18	Distribution	40
15	Polyline	0	Red	0	PVC	12	Distribution	40
16	Polyline	0	Red	0	PVC	15	Distribution	40
17	Polyline	0	Red	0	UPVC	10	Distribution	50
18	Polyline	0	Red	0	PVC	10	Distribution	50
19	Polyline	0	Red	0	PVC	15	Distribution	50
20	Polyline	0	Red	0	PVC	18	Distribution	50
21	Polyline	0	Red	0	UPVC	15	Distribution	50
22	Polyline	0	Red	0	PVC	24	Distribution	50
23	Polyline	0	Red	0	PVC	12	Distribution	50
24	Polyline	0	Red	0	PVC	18	Distribution	40
25	Polyline	0	Red	0	PVC	18	Distribution	40
26	Polyline	0	Red	0	PVC	12	Distribution	40
27	Polyline	0	Red	0	PVC	12	Distribution	40
28	Polyline	0	Red	0	UPVC	18	Distribution	50
29	Polyline	0	Red	0	UPVC	24	Distribution	50
30	Polyline	0	Red	0	UPVC	18	Distribution	50
31	Polyline	0	Red	0	PVC	18	Distribution	50
32	Polyline	0	Red	0	PVC	12	Distribution	50
33	Polyline	0	Red	0	PVC	12	Distribution	50

1 (0 out of 78 Selected)

pipelines_01

Figure 3: Attribute table consisting of all the pipelines information provided by

5.2.4 Service Connection

After all the data preparation and a geo database, the basic phase to start working on the application is: Service Connection. In Arc GIS Flex viewer, Service connection is about adding own developed data to the flex viewer and replacing the sample data provided. Services are created using the GIS Servers in Arc Catalog.

Firstly, a mud file was saved consisting all the shape files of pipelines network type (main trunks, bulk transmission, and street distribution network), water sources (pump stations, filter plants, reservoirs), and Gulshan-e-Iqbal boundary shape file. After that, in the Arc Catalog, in the "GIS Servers" folder, through "Add Arc GIS Servers", a connection was made by selecting to an "Administer GIS Server" option. After clicking it, a Server URL was given along with the user name and password of the administrator for authentication. After the server was added, then by right clicking on the mud file that was made earlier, right clicked on it and selected the "Share as Service" option to publish the GIS data, such as all the pipelines network type shape files and water sources, to make it available on the Arc GIS server. Then in the "Choose a connection", the "Administer GIS Server" connection was selected and a name was given in the service name. Then the Data was transferred on the server.

5.2.5 Application Customization

After service connection is made, application customization phase is started. By default, ESRI has incorporated the Flex Builder 3 capabilities in Arc GIS Flex viewer to develop or customize the application according to the developers need. ESRI has also developed a resource center for the developers from where they can get all the information of Flex viewer such as tutorials, sample data, tools, widgets and even sample codes for users to customize their own web applications for free and without any hassle. There are two phases to customize the application:

a. The first is the customization of the interface's appearance and functionality and

b. The second is the configuration of tools/widgets - the application uses.

c. The customization is done through either XML (extensible markup language). XML has made customization simple for internet applications.

5.2.5.1 Main Configuration File

The Main Configuration File is a gateway to the main interface of the web. In the Flex Viewer package, this file is called configure.xml. The main configuration file can be opened in any text editor program such as Windows Notepad. The file is divided in three sections: the layout section, the map section, and the widget section.

a. The first part of the main configuration file involves the Layout section. This sections deals with setting the title, subtitle, logo, color scheme. These widgets control

the layout of the application, and require very little customization.

b. The second part of the configuration file is map section. This section deals with adding layers to the map. These layers are basically called the Base maps. The base maps call services is developed by Arc GIS Server.

c. The third part of the configuration file is the Widget section. Each selected widget consists of a XML file, which is configured as per the developers need.

5.2.5.2 Widgets/Tools

The Flex Viewer package comes with a wide selection of tools, or widgets by default. These tools or widgets require similar customization steps as the main configuration file. Every widget contains an XML configuration file, consisting of tool/widget functionality. Each tool/widget requires a different amount of editing.

This application was developed using both default and custom designed widgets in the Flex builder 3 as defined below.

5.2.5.2.1Draw

The first widget in the application is Draw. This widget provides users with basics of sketching, i-e drawing of shapes, and text onto the map display. Just as the user click on this widget, a dialog box appears showing 9 feature creation tools, which are as follows:

- point
- poly-line
- freehand line
- rectangle
- circle
- ellipse
- polygon
- freehand polygon
- text

5.2.5.2.2Edit

The second widget is Edit. This widget has two purposes. First, creating new features and secondly, changes the existing features. With the help of this tool, the management will be able to make amendments or addition in the existing underground water pipelines network, if needed

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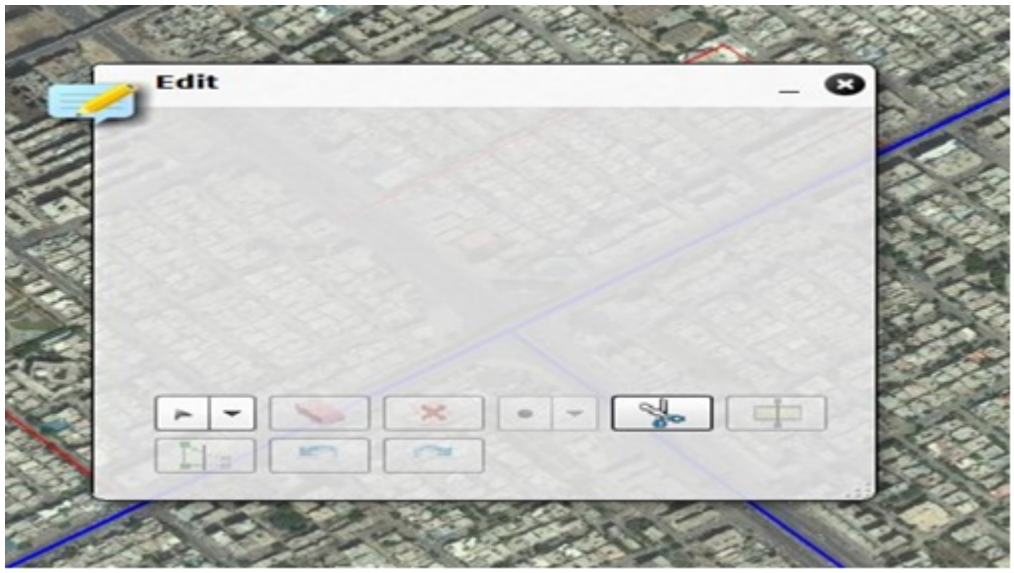

Figure 5**:** Edit widget

5.2.5.2.3 Layers

The third widget is the layer list. This widget shows only the operational layers that were listed in the main configuration file of Arc GIS Viewer for Flex application. The end users have provision to turn the layers on and off as per their requirement. A "network type" layer has been added in this widget; consisting Bulk transmission, Main trunks and street distribution network. Along with the network type, layers of existing filter plants, pumps stations and reservoirs are also added.

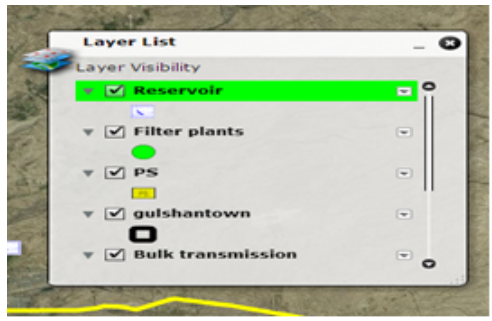

Figure 6: Layer widget

5.2.5.2.4 Legend:

The forth widget is the legend. This widget consists of layers/map symbols. This widget is customized to deliver the meaning of symbols that are used to represent feature on the map display. Further, this widget gets automatically updated with the change in visibility of any of the operational layer.

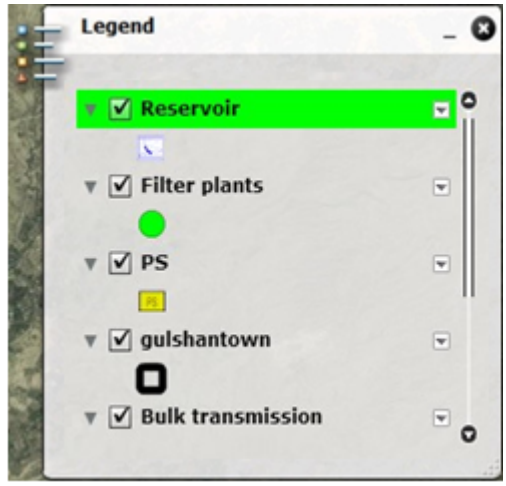

Figure 7: Legend widget

5.2.5.2.5 Locator:

The fifth widget is Locator. This widget will enable the users to find any location on the map in the viewer. The users can locate the pipelines through two ways. Either by entering the address which consists street name, street number and ZIP. Second by entering the coordinate values which are longitude and latitude? Primarily, this widget works with geo coding services from Arc GIS. For geo code service, an address locator is created in Arc GIS for desktop and is then published as a geo code service on Arc GIS server. Once the service is published, end users can then use the geo code service to locate address on a map, after a client application is created for the end users. This will help the management to locate pipelines in minimum time and their connecting stations. Just as the geo code matches, the address is listed under the results tab.

Figure 8: Pipelines area can be located by simply entering the area's address

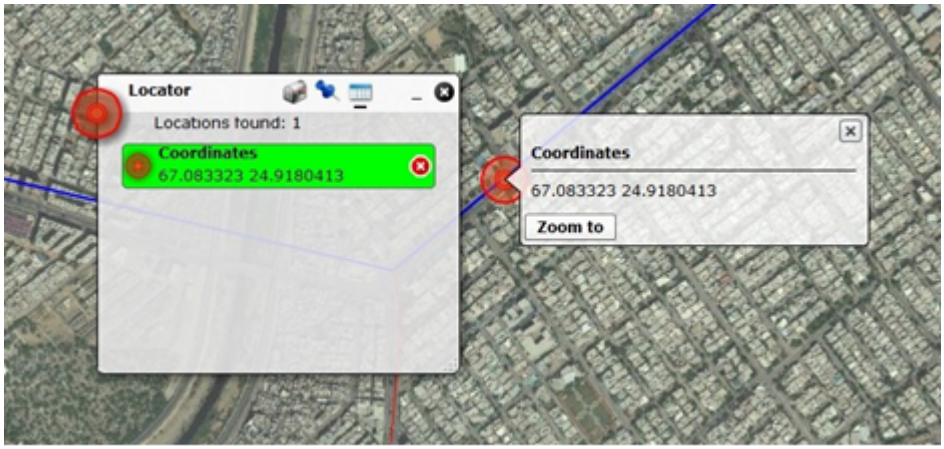

Figure 9: by entering coordinate values

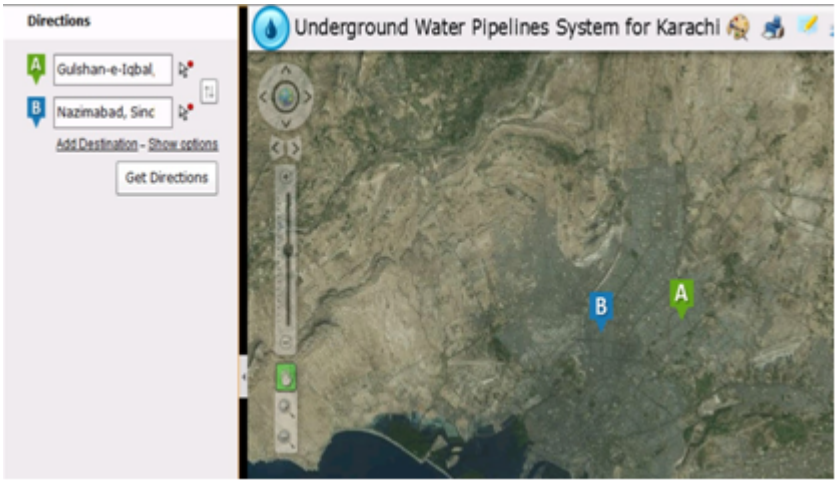

Figure 10: Two marks A and B are placed on the map, but it could not get the direction details

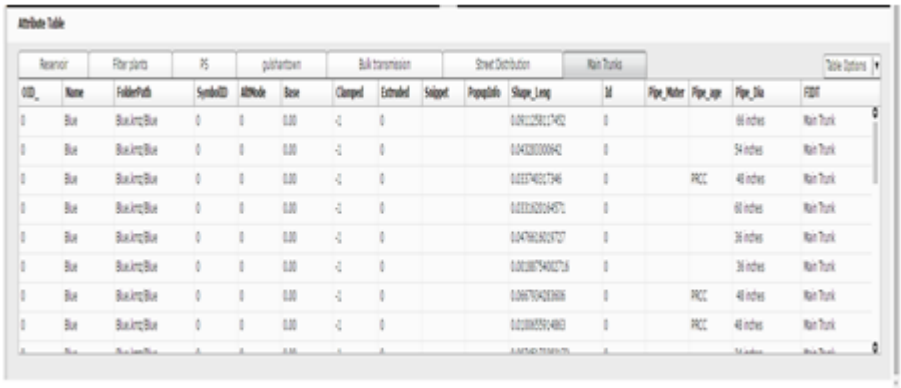

Figure 11: All the feature layers information is displayed in tabular form

5.2.5.2.6 Direction Widget Tag

The Direction widget provides an efficient way to calculate direction between two or more locations. This widget uses a least-cost path method for finding a route between two or more locations. It's a pre-configured tag. In order to work with this widget tag, the users require an Arc GIS online organization subscription. For that, a valid username and password is needed in order to work with the Arc GIS online network analysis services.

5.2.5.2.7Attribute Widget Tag

The second widget tag is the Attribute table widget. All the feature layers information is displayed in a tabular form. The Karachi water management will only have the rights to edit the records within the attribute table. Just as the application loads, this widget checks for the visible layers and fills it with the layer features' fields separately. Further, the layer features can be selected, deselected and even zoomed-in.

5.2.5.2.8 Data Integration

After all the data preparation and creation of geo database and a service connection, all the data that was prepared in the Arc map was then integrated on the application. The data integrated in the Arc GIS Viewer for Flex was as the "Operational Layers". In the Arc GIS viewer for flex, the "Arc GIS Server" option displayed the Server URL - which was established through "Administer GIS Server" appeared in its drop down list and detected all the pipelines network type, and water sources layers. All the data was then displayed on the satellite imagery and open street network.

6. RESULTS

The basic elements of the application mostly contain view, zoom, distance measuring, change base maps, and altering of the pipelines and the information associated with it. Users can find any specific features by attribute table. Figure 4 demonstrates the begin page of the application. From this page, users can click tools/widgets to get to the data. It contains a few clickable menus, like, as direction widget control tab, attribute table control tab as to whether they be on display when the application starts or not, and print widget. The results include:

The integration of Gulshan-e-Iqbal pipelines network with the GIS web-based application; developed by using Adobe Flex Builder 3, and Arc GIS Viewer for Flex, gave a user-friendly web interface with easy to use tools. Precisely, it displayed information related to the pipelines network and the source of water supply that are currently catering the area. The water utility managers can identify all their information without having to look through different reports and documents. But due to limited amount of data provided by the KWSB officials, the analysis part could not be incorporated. Such as, query tools or visualization tools. The Flex application structure gives an absolute language, application administrations, parts, and information integration that help developers to quickly manufacture applications for web. It produced an easy to use web-application for underground water pipelines, as indicated by the users need even with the limited amount of data.

The application displays base maps with basic layers of network type pipelines, watersources. Also, functionality, and search options. Basic functionality of the application includes map zooming and panning, identify, measurement, layer control, and map printing. Just as the application is started, it zooms straight to the Karachi city. This is very important. By this the users do not have to drag the map all the way to the study area. This would even save their time. The widgets are displayed on the title bar. Base map widget is displayed in the upper right corner through which base map can be changed as per the user's requirement. If the user would like to view their pipelines infrastructure on different base maps, they can do it by using the base map widget.

The tools/widgets are developed according to the limited data provided by the KWSB's officials. This is a very important part of the application that how the data is presented through the tools/widgets. The tools/widgets in this application worked on the limited data of the network type pipelines (street distribution network, bulk transmission and main trunks) and water supply sources (filter plants, pump stations and reservoir). This data is called the operational layers. These operational layers are the dynamic layers – means, changes can be made any time in the information. If KWSB had provided more possible data of the pipelines network, more tools/widgets would have been added.

The application provides a simple and direct geo database for analyzing and as well as even manage historical pipelines data. Administrators or developers will only have the right to make changes in the geo database. Such as adding new pipelines, new filter plants, delete objects or make modifications in the attribute table. Users can just search the piece of information and data that is open for them. One of them is the attribute table.

Attribute tool holds a key importance in any mapping software or GIS web-based application. It contains all the information of layers that are on display on the map. In this application, all the information in operational layers is displayed in multiple tabs. Besides displaying tabular information of feature layers, the features can be selected, de-selected and even zoomed too. All these functions are in the table options dropdown combo box located in the upper right corner of the widget. When the web application starts, the Attribute Table widget checks for any layer features and populates the widget with the information contained in the layer.

With the help of print widget, the analyzed and visualized information will then be printed in any image format for asset allocation, financial planning, and determining condition assessment methods on a network level. This is a value added feature. Those printed maps could further be shared with other utilities

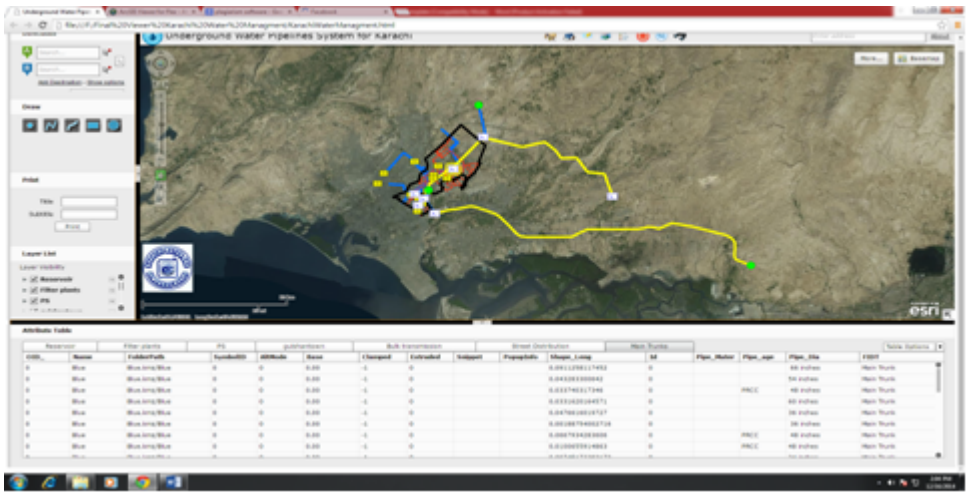

Figure 12**:** The complete look of application

CONCLUSION AND DISCUSSION

Currently, there is no such system in the Karachi Water Management that is being practiced to integrate large amount of pipelines data with a web-interface. This manuscript illustrates the need of the development of a web-based GIS application for Gulshan-e-Iqbal water management to change the time consuming conventional method and switch to a cost effective, time saving, and geospatial enabled method of handling and storing large amount of pipelines data. The web-based GIS application presented in this thesis is an improved way to interact with large amount of spatial data, and even asses the risks associated with the current water pipelines network with less technological requirements. The application is developed using both Adobe Flex builder and Arc GIS viewer for Flex. Such web-based environment will enable the Karachi water management engineers with different level of knowledge of GIS, to investigate and compare results, and also to plan their rehabilitation works accordingly The underground water transmission/distribution system application can also have a role as one of the component of SDSS (Spatial Decision Support System), to provide all possible underground water pipelines information to the stakeholders. Moreover, a suitable and effective instrument for spreading incorporated spatial data with map information must be appropriately prepared into the same direction framework and same projection; and the database must be composed and populated before being distributed on the site.

BENEFITS TO THE UTILITY

a. The proposed Web-based GIS application can be beneficial for the Karachi's water management in a way that at least pipeline incident response time becomes quick and time saving.

b. If the response time is quick, this will lead the management to a fast repair, or replacement – based on the type of an incident.

c. Budget is an essential part for any utility. To develop an efficient budget, the utility officials need to review their financial situation and make changes based on what they make and spend. With the help of this proposed application, the water management officials can plan and use the allocated budget more efficiently.

d. Most of the utility departments of Karachi do not possess information regarding the infrastructure of other utilities. This leads to unplanned excavation, thus, causing damage to other utility network. The proposed application can bring to the cognizance of the third party planning and prevent from further damage to KWSB pipelines.

RECOMMENDATIONS FOR FUTURE WORK

Future work will require more improvements and including more tools/widgets. To fulfill numerous clients with diverse needs, future work will need to concentrate on giving clients distinctive perspectives in light of their client rights. More importantly, to make the application more helpful, more lawful and arranging data, for example, pipelines depth, new installations of pipelines, water flow direction, new undertakings began by KWSB should be gathered, and integrated. However, future work can be done to better understand this study.

a. Technology changes and improves itself constantly. With this concept comes the possibility of changing this application's functionality and performance. A pipeline break and robbery identification are the real issues in the city. Safety of these pipelines incorporates visual examinations, defensive coatings and other insurance frameworks. Therefore, a pipeline monitoring system can be created to allow for detection of flow leaks in pipeline. The monitoring system can be integrated within this GIS web-application to give accurate alarms on pipelines tampering/breaching. This will detect the leak than conventional flow metering, enabling quick recovery before huge scale ecological harm and perilous conditions win.

b. Advance querying for risk assessment can also be performed through this application using pipelines characteristics such as pipeline age, pipelines diameter, pipelines material, pipelines maintenance frequency etc. Thus, the risky pipelines will be marked with red lines for their own, and public information.

c. Photos of the area, news articles, notices such as out of order, leakage of pipelines or under construction, would give the application more outreach for the public users. Through such information it will be help full for the public users to take alternative driving routes or not to visit that particular area for some time about which has been up dated by the KWSB officials.

d. Field engineers can also collect offline data on sites from their smart phones or android. Later, they can synchronize it with this application through internet connection. And, the geo database keep gets updated.

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REFERENCE

[1] Khan, Abdul Sattar, ", PC surges household, (2012), pp.54-57.

[2] Abel, D. et al, "An exploration of GIS architectures for Internet environments", Computers, Environment and Urban Systems, (1998), pp.7-23.

[3] Alesheikh, A., Helali, H. & Behroz, H, "Web GIS: Technologies and Its Applications", Symposium on Geospatial Theory, Processing and Applications, (2002), pp.23- 25.

[4] C.T. Yang, L. Ye , J. Yu, "A Framework of WEB-GIS for Urban Drainage Network System", College of Information and Electronic Engineering, Zhejiang University of Science and Technology, Hangzhou, China,(2006),pp.35-41.

[5] Hossack, I. et al, "A GIS and Web-based decision support tool for the management of urban soils", Cybernetics and Systems,(2004), pp.499-509.

[6] Jin-Yong Choi, Bernard A. Engel and Richard L. Farnsworth, "Web-based GIS and spatial decision support system for watershed management", Journal of Hydro informatics, (2005), p. 165-174.

[7] Keng-Pin Chang, "The Design of A Web-based Geographic Information System for Community Participation", Master's Thesis, University at Buffalo Department of Geography, (1997), pp.150-161.

[8] L. H. Cuia , W. C. Zhangb, S. J. Xub., "The WebGIS based Jiangsu Oilfield Management System Implemented with a Spatio-Temporal Data Model", The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Beijing, (2008),pp.15-19.

[9] Lan, H.X. et al, "A web-based GIS for managing and assessing landslide data for the town of Peace River, Canada", Nat. Hazards Earth Syst. Sci., (2009), pp.1433-1443.

[10]Liu, ZH, A Novoselsky, and V Arora," XML Data Management in Object Relational Database Systems." Applications and Structures in XML, (2010), pp. 18-46.

[11] McLane Environmental LLC, "The Benefits of Web-Based Map Deployment in Environmental Consulting Project Work", Web mapping white paper, (2000), pp.1-13 .

[12] Michael Blinn, "Creation of a Spatial Decision Support System as a Risk Assessment Tool Based on Kentucky Tornado Climatology", Western Kentucky University, (2012), pp. 1-91.

[13] Tafuri, A.N. and A. Selvakumar, "Wastewater collection system infrastructure research needs in the USA". Urban Water, (2002), pp. 21-29.

[14] Varun Raj Sekar, ,"Web-based and Geospatially enabled Tool for Water and Wastewater Pipeline Infrastructure Risk Management", Virginia Polytechnic Institute and State University, (2006), pp. 1-78.