

Mapping of Sewerage System of Aurangabad City using GIS Software

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ABSTRACT: Indian cities transforming themselves to smart city. In every aspect these cities authority try to implant device based system like computer, sensor. However no one thinks of assets buried in ground. Still paper maps, tabular data and sketches are used to maintain the sewerage system. Once pipeline is buried no one able to trace it. Due to which new constructions accidentally damage pipes. Even due to lack of proper data municipal people unable to manage sewerage system. So to overcome these limitations mapping of sewerage system is necessary. GIS based mapping helps to locate sewerage network and also allow building database of it. The paper discusses the mapping using QGIS and the benefits of it to maintain.

KEYWORDS: Mapping, QGIS, GPS, Manhole, Sewer line.

I. INTRODUCTION

Sewerage system is an important asset of city [1]. The combination of underground pipeline sewers receives and drains sanitary water away from city to the destination like sewer treatment plant. An urban sewerage network is web of pipes. The lines of the sewer network running within buildings are connected to the network of that group or block of buildings through special sewer outlets [2]. These pipes are buried in ground due to which unable to find location. Only paper based maps are available which only depict overall system. Location is the most important information in sewerage network. With the help of GIS our data can better visualize and can keep track on the performance of utility data [3]. Digitizing these maps to obtain location based maps [4]. GPS is helpful for building location based mapping and utility management [5]. Accurate data of location, size and depth of sewer line is necessary to do so mapping is the best way [6].

II. RELATED WORK

Urban areas are served with various utilities which help in better living standards of inhabitants by providing appropriate services. In case this infrastructure fails to meet these basic objectives, the result will turn endanger the wellbeing and life of inhabitants. The Municipal departments have relied on Paper data for years.

Sewer Utility Management Center in Municipal Corporation Greater Mumbai used High End GNSS and Digitized Base map with GIS Software in sewer network design and analysis processes, in establishing network analysis tool enables identification of flow direction, selection of best route and/ or best location of pumps, determination of service area etc. In addition GPS and GIS provide user-friendly working environment and powerful tools for mapping and display of results [7].

Technological developments in imaging and vision technology, geoinformatics, computer graphics and augmented reality (AR) are promising more and more capabilities not only in visualizing the real world but also in spatial data acquisition and management. Recent years showed a strong trend towards handheld devices such as Ultra Mobile PCs, PDAs or even smart phones, since these devices are already equipped with sensors necessary for AR. Furthermore, mobile GIS extends geographic information systems from the office to the field by incorporating the before mentioned technologies. Mobile GIS enables workers for on-site capturing, storing, manipulating, analyzing and displaying of

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geospatial data and therefore provides clear benefits for mobile workforces. Current trends of mobile field systems are dominated by quality and completeness control in the field, seamless dataflow between office and field and vice versa, no redundancies in data and workflows. With the approach of providing the entire geo-database in the field, mobile workforces can react on changing conditions too. Moreover, for improved efficiency, paper plans are increasingly replaced by notebook computers taken to the field to directly consult the GIS. Just like the paper plan, the GIS uses two-dimensional models to represent the geographic data. There is also a certain trend observable towards 3D GIS trying to eliminate shortcomings resulting from two-dimensional representations of objects. 3D GIS databases contain 3D data structure representing both the geometry and topology of the 3D shapes, and allowing 3D spatial analysis [8]. The cost of laying a sewerage system is appreciably high compared to the water supply system. It involves a large cost with need for daily maintenance, and the operational cost is one of the major expenditures. In respect of this view, many research works are being done to design a cost effective sewerage network with the given constraints and guidelines. These difficult problems can be solved by using the computer software package SewerGEMS V8i. Computer software package SewerGEMS V8i helps to design sanitary sewer network. SewerGEMS is an extremely efficient tool for laying out a storm or sanitary sewer network. It is easy to prepare a schematic or scaled model and let SewerGEMS take care of the link-node connectivity. In constructing the network there is no need to be concerned with assigning labels to pipes and nodes, because the software assigns labels automatically. A schematic drawing is one in which pipe lengths are entered manually, in the user defined length field. In a scaled drawing, pipe lengths are automatically calculated from the position of the pipes bends and start and stop nodes in the drawing pane. SewerGEMS V8i has different operating modes available. These are micro-station mode, ArcGIS mode and AutoCAD mode.

oMicro-station Mode

Micro-station mode lets user create and model your network directly within primary drafting environment.

This gives access to all of Micro-stations drafting and presentation tools, while still enabling you to perform Bentley SewerGEMS V8i modeling tasks like editing, solving, and data management. This relationship between Bentley SewerGEMS V8i and Micro-station enables extremely detailed and accurate mapping of model features, and provides the full array of output and presentation features available in Micro-station. This facility provides the most flexibility and the highest degree of compatibility with other CAD-based applications and drawing data maintained at any organization.

oArcGIS Mode

ArcGIS mode lets user create and model network directly in ArcMap.

oAuto CAD Mode

AutoCAD mode lets user create and model network directly within primary drafting environment. This gives access to all of AutoCAD's drafting and presentation tools, while still enabling you to perform Bentley SewerGEMS V8i modeling tasks like editing, solving, and data management [9]. Islampur is a town in Sangli dist.; Maharashtra, India. Author design a system for sewerage network using GIS. Authors consider 35 years of data to design and predict population. They consider following factors to the case study population, rate of water supply, slope/gradient, peak factor, velocity, pipe size, depth of cover, manholes. Each point was taken at 30 m interval on straight path and at every change in connection point. GIS was used to generate a map [10]. Amber Naz and Dr. Saad Malik with the help of KWSB develop a web based application for water pipeline network. They acquired data from KWSB and used Arc GIS flex viewer for building application. ESRI provides information of flex from tutorials, sample data. They have created database of pipeline and then it is used in application to get mapped network. They provided edit widgets to manipulate mapping according to requirement [11].

III. IMPLEMENTATION AND RESULT

Implementation work divided in 4 parts

- Data Collection
- Database Development
- Creation of map
- Maintenance

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➤ Data Collection

Data collection is done by the surveying and capturing images of each manhole. Surveying is performing for obtaining actual map coordinates of each point on sewerage network. Printed maps obtained from municipal corporation makes surveying task easy to locate network of sewer lines. This enables us to map accurate location on map. The database is combination of co-ordinate location and attribute. The attributes for manhole and pipeline are depending on their properties and required information. And co-ordinates are taken from GPS enabled smartphone by visiting each location fig 01 and 02 shows entries of table.

3	75.315855	19.862479	2 metal	0.5
4	75.315962	19.862179	3 metal	0.5
5	75.315914	19.861813	4 metal	0.7
6	75.316751	19.861687	5 metal	0.4
7	75.317027	19.86166	6 metal	0.7
8	75.317572	19.861528	7 metal	0.6
9	75.315678	19.860777	8 metal	0.6
10	75.315592	19.860091	9 metal	0.5
11	75.315008	19.860661	10 concrete	0.6
12	75.314214	19.861513	11 concrete	0.5
13	75.313779	19.861977	12 concrete	0.6
14	75.316016	19.859964	13 metal	0.6
15	75.316268	19.859939	14 concrete	0.7
16	75.316781	19.859879	15 metal	0.7
17	75.316472	19.860835	16 metal	0.7
18	75.316327	19.860903	17 concrete	0.7
19	75.316164	19.860931	18 metal	0.5
20	75.316923	19.860595	19 metal	0.6
21	75.31747	19.859775	20 concrete	0.4
22	75.317709	19.85974	21 concrete	0.9
23	75.318264	19.859694	22 concrete	0.7
24	75.318776	19.859634	23 metal	0.8

Figure 01

Figure 01 contains latitude and longitude along with attribute information of manhole.

(75.316780 19.859878, 75.317469 19.859775)	200 HDPE	1.2	0.7 main sewer_line
(75.317469 19.859775, 75.317708 19.859739)	200 HDPE	1.2	0.7 main sewer_line
(75.317708 19.859739, 75.318263 19.859694)	200 HDPE	1.2	5.2 main sewer_line
(75.318263 19.859694, 75.318776 19.859633)	200 HDPE	1.2	5.2 main sewer_line
(75.318776 19.859633, 75.319207 19.859565)	200 HDPE	1.2	5.2 main sewer_line
(75.319207 19.859565, 75.319701 19.859535)	200 HDPE	1.2	5 main sewer_line
(75.316472 19.860834, 75.316268 19.859939)	200 HDPE	1.2	5 main sewer_line
(75.316327 19.860902, 75.316472 19.860834)	200 HDPE	1.2	5.2 main sewer_line
(75.316163 19.860930, 75.316327 19.860902)	200 HDPE	1.2	5.3 main sewer_line
(75.316922 19.860595, 75.316780 19.859878)	200 HDPE	1.2	5.7 main sewer_line
(75.317046 19.861165, 75.316922 19.860595)	200 HDPE	1.2	0.7 main sewer_line
(75.319934 19.860004, 75.319701 19.859535)	200 HDPE	1.2	0.7 main sewer_line
(75.320184 19.861127, 75.319934 19.860004)	200 HDPE	1.2	5.2 main sewer_line
(75.320184 19.861127, 75.320307 19.861669)	200 HDPE	1.2	5.2 main sewer_line
(75.320449 19.862196, 75.320307 19.861669)	200 HDPE	1.2	5.2 main sewer_line
(75.316815 19.863380, 75.316439 19.862923)	200 HDPE	1.2	5 main sewer_line
(75.316815 19.863380, 75.318081 19.863087)	200 HDPE	1.2	5 main sewer_line
(75.318081 19.863087, 75.319186 19.862915)	200 HDPE	1.2	5.2 main sewer_line
(75.319186 19.862915, 75.320559 19.862610)	200 HDPE	1.2	5.4 main sewer_line
(75.320559 19.862610, 75.321933 19.862502)	200 HDPE	1.2	5 main sewer_line
(75.321933 19.862502, 75.323327 19.862381)	200 HDPE	1.2	5.2 main sewer_line
(75.319701 19.859535, 75.320506 19.859384)	200 HDPE	1.2	5.2 main sewer_line

Figure 02

Figure 02 contains WKT along with attribute information of Mainline

➤ Creation of Map

The database created is used to create layers of map using QGIS. The database is in the form of CSV which is added as layer to QGIS. This will give us precise data about sewer network along with details. QGIS provide different options to create layer like styling, labeling, attribute edit, visible layer selection and also allow adding layer from web map servers. These details will helpful for construction workers and people to acquire locations of underground infrastructure. Figure 03 shows the mapping of sewer network of Aurangabad City.

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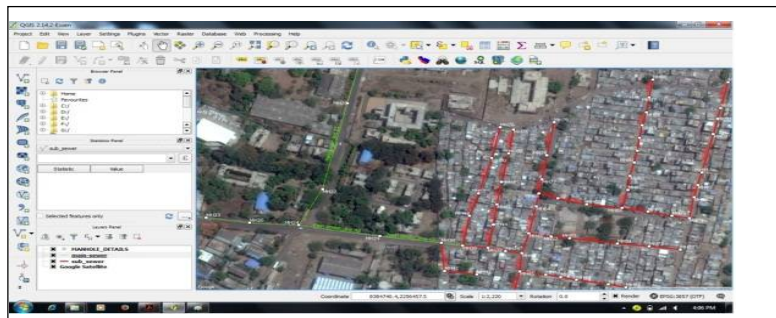
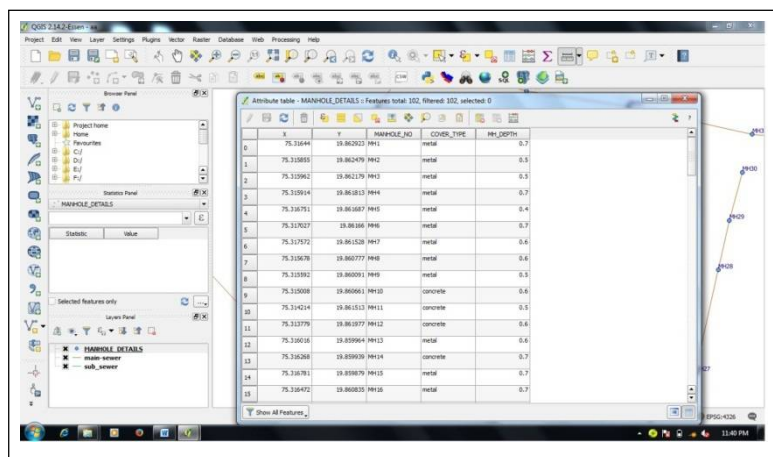


Figure 03: Mapping of Sewerage network



ID	MANHOLE_ID	COVERS	TYPE	MH_DEPTH
0	75.31644	18.862523 / 1911	metal	0.7
1	75.31685	18.862479 / 1912	metal	0.5
2	75.31692	18.862179 / 1912	metal	0.5
3	75.31694	18.862513 / 1914	metal	0.7
4	75.31671	18.862467 / 1915	metal	0.4
5	75.31707	18.86246 / 1916	metal	0.7
6	75.317572	18.862520 / 1917	metal	0.4
7	75.31678	18.862777 / 1918	metal	0.4
8	75.31692	18.862093 / 1919	metal	0.5
9	75.31608	18.862063 / 19110	concrete	0.4
10	75.314214	18.862513 / 19111	concrete	0.5
11	75.31779	18.862777 / 19112	concrete	0.4
12	75.316016	18.859964 / 19113	metal	0.4
13	75.316288	18.859930 / 19114	concrete	0.7
14	75.316781	18.859879 / 19115	metal	0.7
15	75.316472	18.862523 / 19116	metal	0.7

Figure 04: Attribute Table of layer

Above figure 04 contains attribute information is shown for layer of network. QGIS give facility to export created layers for further process.

➤ Maintenance

Indian cities are developing faster and the need for sewerage network increases. All the cities have their existing sewerage network but no one knows where exactly it is. Due to which digging for new construction, laying new pipe, laying fiber optic cables or electric cables causes damage to the existing infrastructure buried underground. We are at the first stage of transformation towards smart city so we don't have ideal developed infrastructure to maintain these type of infrastructure. So there need to share the information of it to people. So that they will aware of it. Figure 05 shows map to share with some required functionality.

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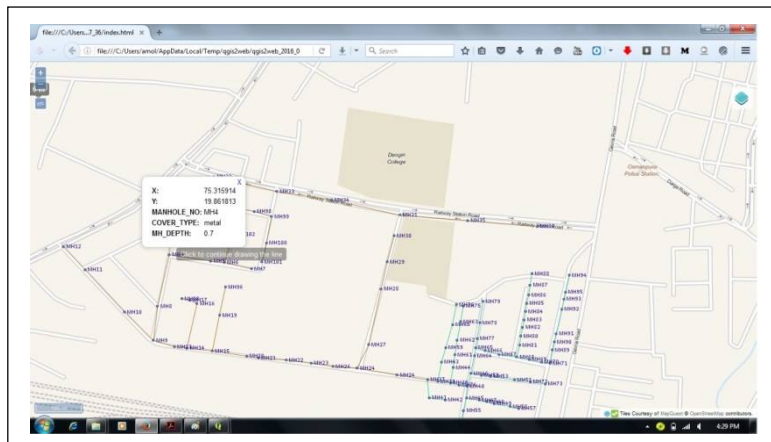


Figure 05: map to share

IV. CONCLUSION

The Sewerage system is one of main asset of city. It helps to draw out sanitary water out of the city towards sewer treatment plants. As all we know our sewerage systems were developed with the development of city. Most of the municipal corporations don't have proper way to keep data of assets like Sewerage network. Due to which maintaining of it is difficult. Damages caused by excavation increases budget of maintenance. Creation of map and share them via portal is the solution for present state.

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