

Development of Open Source GIS Based Field Service Management software for Pharmaceutical Industries

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Abstract: Managing human resources in today's dynamic environment is an essential function as well as important. Pharmaceutical Companies have medical representatives to present their product in the market. The growth of these pharmaceutical companies is depending on the presentation of the product by medical representative to the doctor/ Clinics. In a previous time, most of these companies managed their employee's information through paper processing. Paper based processing has several limitations hence a Field Service Management Software (FSMS) has been developed for digital information recording and processing. Through this FSMS, a Manager can store, manage and track employee's information in near real time. This paper presents a FSMS on West part of Ahmadabad, Gujarat which was developed using free and open source software (FOSS4G). This system has a study related data like hospital, clinic, and Pharmaceutical company location, roads in the study area and ward boundary. In this system, a manager can get the live information about all employees on their screen using GPS system. Furthermore, the manager can also store and manage all details of the employees. This application considerably reduces paperwork and save one's precious time apart from being very convenient.

Keywords: WebGIS, GPS System, FSMS, FOSS4G, GIS, Open source technology

I. INTRODUCTION

Human resource is always of immense support of any developing company. The FSMS is developed for managing medical representative digitally and accurately. Monitoring of employee performance in an organization stands as an integral aspect and segment of organizational growth and development. Managers are expected to monitor the performance of employees to boost organizational growth and achieve organization's goals[11]. There can be several reasons for which we may feel the need to keep track of our employees based on their daily location. Thus, location information devices can be used to track employees and their assigned tasks. Location information device tracking system is a common approach to get employee location information in real-time[3]. The FSMS is developed with Geographic Information System (GIS) and web-GIS technologies. GIS is the computer-based information system used to digitally represent and analyze the geospatial data[4]. With the help of GIS, FSMS is able to provide information about the roads, road types, hospital locations, traffic information, and time to reach particular locations. This system is used to track all employees in real time with the use of GPS systems. It also makes easy to integrate data and locate all employees in one system [2].

Field service management software is mainly designed to manage hundreds of employees in a single account. The system enables live tracking of all representatives in a

single screen to the manager and past history of employee movement can also be accessed. Field service management software also allows a manger to retrieve total distance travelled in working hours with the details of a particular employee, time on field, and time taken for a task.

In this study free and open source software for GIS (FOSS4G) like GeoServer, PostGIS, Open layers were used. For visualization, monitoring and store geospatial data such as path, location of hospital, present and previous location data. If any organizations need to monitor their employees in one screen, the location information device can collect data of location of particular employee and send it back to the manager application. This field service management software also provides a sequence route for going to the target/destination. This tracking system has road, hospital and clinic data for tracking the location of MR of Pharmaceutical Company. It gives a shortest path for the representative and gives live information of the representative to the manager [6].

A. OBJECTIVES

The main objective of this study is to develop Field service management software using free and open source software in order to improve management of employees through solving the routing problems and store information of employees digitally. Specific objectives include:

- Assignment of plain routes/ jurisdiction or coverage area to medical representatives

- Track location of medical representatives in near real time
- Tracking of total distance covered by a medical representative
- Map based scheduling of visits to doctors/clinics/hospital/medical store and audit every activity by location and time stamp
- Provision of driving directions to medical representatives for his/her scheduled visits.

B. STUDY AREA

The field service management software (FSMS) is developed for Ahmedabad city in Gujarat centered at 23.0225° N, 72.5714° E. Ahmedabad district is divided into, western and eastern parts. The city is located on the banks of the Sabarmati River and it has 6 zones for administrative purpose: central, east, west, New West, north, south. Each zone is further split into wards. Ahmedabad has a total 48 wards West zone further divided into 2 parts: west zone and new west zone. The west zone has a total of 10 wards and new west zone has 10 wards. (Source: AMC). Ahmedabad has been selected as one of the hundred Indian cities to be developed as a smart city under government of India's flagship Smart Cities Mission. The altitude of the Ahmedabad city is 174 ft above sea level. It covers an area of 464 km². In 2011 Census of India, Ahmedabad had a population of 5,633,927, making it the fifth most populous city in India. [1]. Figure 1 shows the study area.

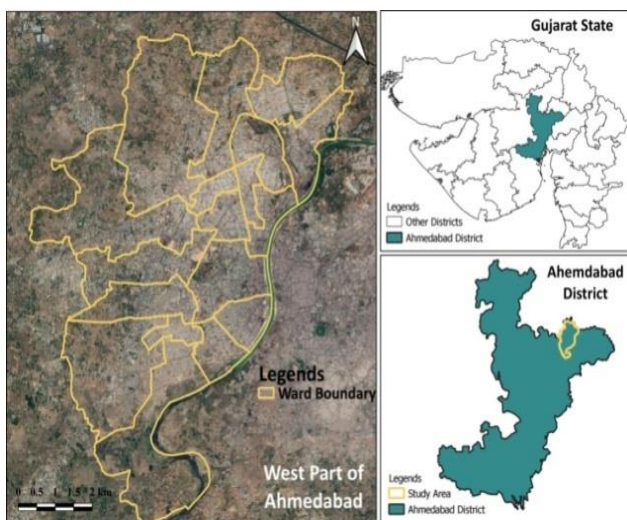


Figure-1: Map of Study area

II. RELATED WORKS

A. Vehicle Tracking, Monitoring and Alerting System: A Review Sumit S. Dukare Dattatray A. Patil Kantilal P. Rane

The goal of this paper is to review the past work of vehicle tracking, monitoring and alerting system, to categorize various methodologies and identify new trends. There are various challenges encountered in vehicle tracking, monitoring and alerting due to deficiency in proper real time vehicle location and problem of alerting system. GPS

(Global Positioning System) is most widely used technology for vehicle tracking and keep regular monitoring of vehicle. The objective of tracking system is to manage and control the transport using GPS trans receiver to know the current location of vehicle. In number of system, RFID (Radio Frequency Identification) is chosen as one of technology implemented for bus monitoring system. GSM (Global System for Mobile Communication) is most widely used for alerting system. Alerting system is essential for providing the location and information about vehicle to passenger, owner or user.

B. Design and Development of Real time Vehicle Tracking System, Sonali S. Solanke & C.S. Khandelwal

A vehicle tracking system is an electronic device installed in a vehicle to enable the owner or a third party to track the vehicle's location. This paper proposed to design a vehicle tracking system that works using GPS and GSM technology, which would be the cheapest source of vehicle tracking and it would work as anti-theft system

III. MATERIALS AND METHODOLOGY

GIS database is prepared as with spatial and non-spatial data. Every road data has both way roads and located at their exact geographic position. Road layers are digitized with the reference of Google satellite image. In this database total number of Hospital is 315 and total number of clinics is 46. Study area covers total 18 wards. The GIS database layers and their major fields are:

- I) Ward Boundary (Id, ward Name, Zone, Area in sq.km)
- II) Road (Id, Length, Traffic direction, Zone Id, Ward Id and Name, Road category, Road name, speed limit)
- III) Hospital (Id, Hospital name, Address, Ward)
- IV) Clinic (Id, Clinic name, address, Ward)
- V) Pharmaceutical Company (Id, Name, Address)
- VI) Building Footprint (Id, Remarks, Ward, Shape area)

For developed field service management software, there are three main parts of this software: Data preparation, Interact with Open source software and application development.

A. DATA CREATION AND NETWORK ANALYSIS

To develop Web based field service management software, it requires some data like Hospital information, Clinic Information, Road data and building information. Spatial data were collected from OSM. The data were located in QGIS for topological correction and preparation of attribute data.

Road data are which were initially in ZIP format were converted it into ESRI shape file format. More road data were digitized using QGIS and corresponding attributes data were populated. A pgRouting plug-in in QGIS was used to set the direction of the all roads as per need. After preparation of all spatial data, a Geo database was created and topological errors were checked. This was done to correct for digitization errors by filling gaps between lines,

Intersections and Snapping using QGIS topology checker plug-in. All hospitals and clinics were joined and secondary roads were created using Google map preference [12].

B. DATABASE PROCESS

PostgreSQL/ PostGIS are used in the Field service management system as a database server for storing and managing spatial data. PostgreSQL has a PostGIS extension which is running as a database server on local host. To manage data in PostgreSQL, firstly create a new database for the FSMS was created. In a newly created database, all required data was stored in shape file format. The new data has a geometry column which has spatial information about the geographic features represented[9].

C. MAP SERVER PROCESS

GeoServer is used as a map server to develop FSMS. GeoServer is a Java based server that can allow map creation and data sharing. GeoServer is used for styling, editing, and getting a better view of geospatial data. A new work space was created to manage all data in GeoServer and a new store was added and connected to the database server. GeoServer publishes data from many sources like PostGIS, shape file, vector data source, GeoTIFF, raster data and others. A grid set was made and zoom levels were set apart from applying style in order to present different data in different zoom levels. GeoServer has different formats for style data like YSLD, SLD and MBStyle[5].

D. INTERFACE DEVELOPMENT

The field service management software (FSMS) web GIS application initial user interface was developed using HTML, CSS and JavaScript. This was followed by connecting GeoServer and OpenLayers for getting data from the database server. OpenLayers render layers on the web through the WMS and WMTS open geospatial consortium (OGC) standards. Layers are already published and styled in GeoServer. Attribute information for map layers were accessed through PHP script and Wamp server on application. Wamp server was used to store a past visited path by a medical representative[7].

E. ROUTING FUNCTIONALITY

After completing spatial data and database preparation, routing a main part of the Field service management software. It was done through getting the shortest path functionality which was developed by Open source routing library: PgRouting. PgRouting is an extension of PostGIS and PostgreSQL geospatial database and adds routing and shortest path analysis functionality. Written function in PostgreSQL and using this function configure sql view and published in GeoServer. Through OpenLayers add this sql view on the web and develop Routing functionality. The layer filtration functionality is also developed for filter map layers and show attribute information of each fetcher on map through the popup event[2].

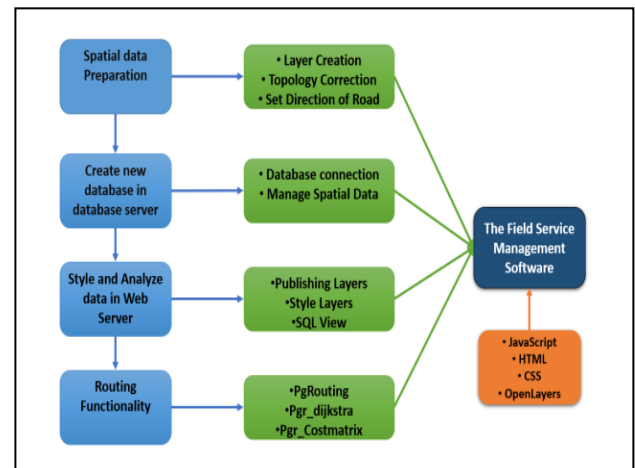


Figure 2. Methodology chart for FSMS development

IV. RESULT

The field service management software has different GIS based functionalities. Using this application, users can visualize, analyze and query the data of the West part of Ahmedabad city. It has a user-friendly interface, even if a non-GIS person can find it easy to use, understand and operate the system. For security propose for manager side, field service manager software has Login page which is describe in Figure-3. It requires a correct username and password. If anyone gave an incorrect password or username it doesn't go to the main page.

Figure-4 describes the main page of the FSMS. The base map was created by overlap on the ward boundary of the west part of Ahmadabad. On ward boundary, overlap a Road, Hospitals, Clinics, Pharmaceutical Company, etc. Users can zoom-in, Zoom-out, panning on map areas. At initial Zoom level users visualize only ward boundaries and some Roads. For Showing all data at a particular zoom lever, create a grid set. Users can render different layers with different zoom levels.

Users can add different layers from the layer switcher panel, which is describe in figure-5.

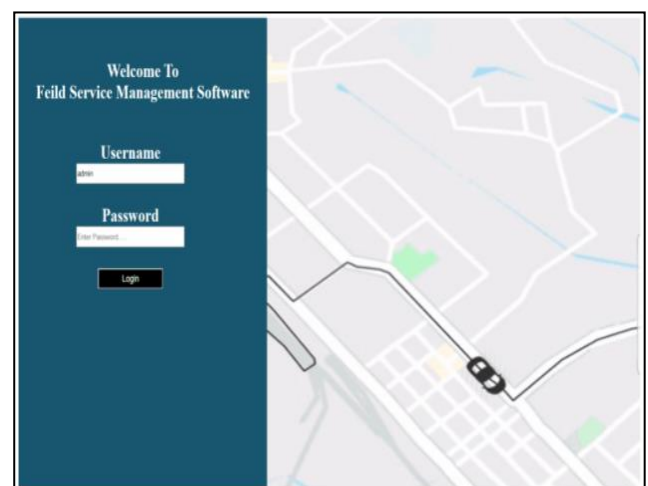


Figure 3. Login page of FSMS



Figure 4. Main interface of FSMS

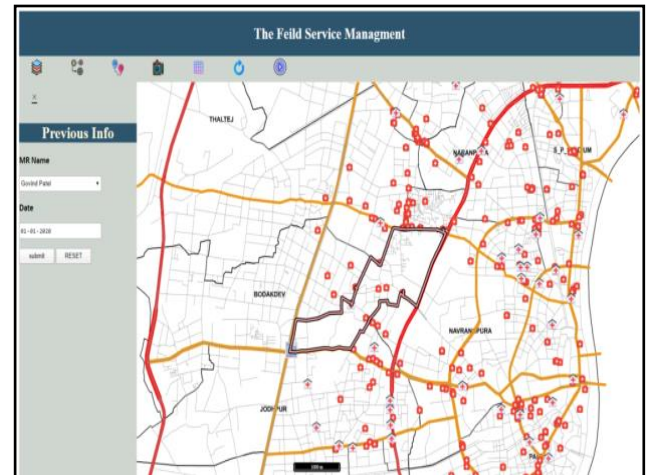


Figure 7. Previous visited routes

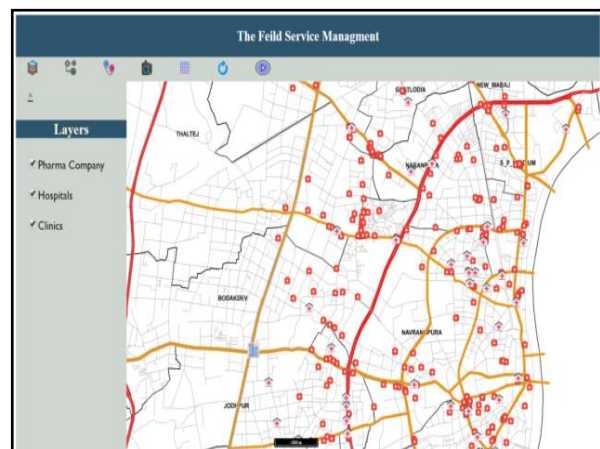


Figure 5. Add Layers using Layer switcher panel

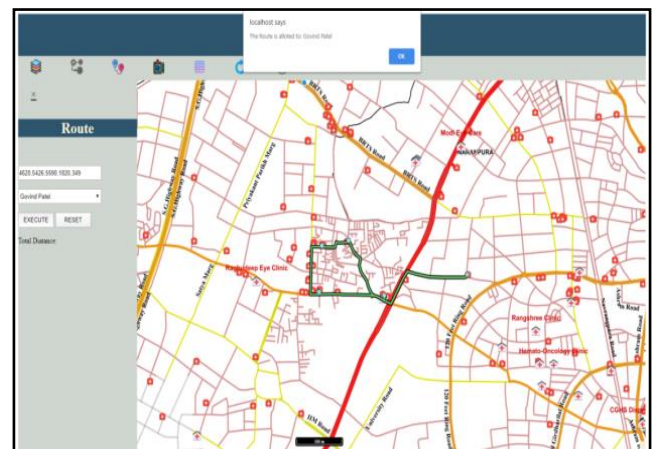


Figure 8. Assign route to Employee's

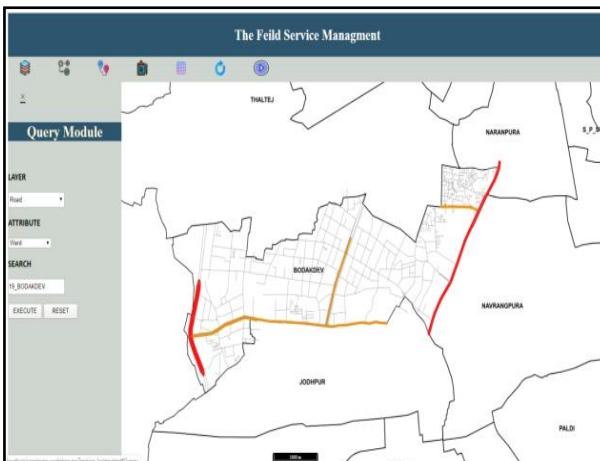


Figure 6. Filtering layers

The user likes to search any attribute from the data on the map, this functionality has a query module which is shown in figure-6.

This system can also store past information about every employee's date which is shown in figure-7.

Users can create target points for their employees and create a shortest path for that. Distance can also be calculated along the created route which is shown in figure-8.

This application also provides attribute information for all features and on single click on Feature, it also gives a popup window which contains attribute information about particular features Shown in figure-9.

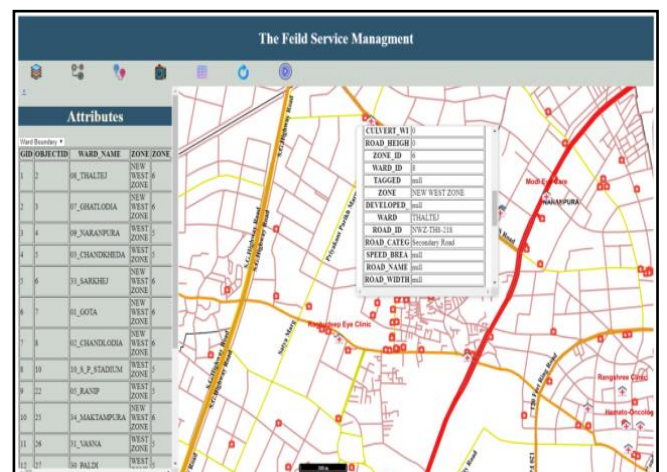


Figure 9. Attribute information and popup

V. DISCUSSION

The WebGIS based application consists of various useful GIS tools for Tracking based spatial data. The application has been developed using open source web-based software's like PostgreSQL, GeoServer, Apache, PHP and Wamp. The field service management software has different GIS based functionalities. Using this application, user data is visualized, analyzes and queried. It has a user-friendly interface, even if a non-GIS person can like to use it so they can easily understand and operate this system. The main objective was to create a web-based application for medical representative management digitally on the manager's screen. The Field service management software also tracks their employees on a single screen. With this software manager gets the location information of their every employee in every second. Head person can also give a daily basis task to the medical representative and also stored past information of the visited path by medical representatives.

VI. CONCLUSION AND FUTURE SCOPE

The field service management software developed for the pharmaceutical industries. The new generation employee tracking system is a revolutionary WebGIS based desktop application. The prototype visualization tool developed here successfully enables users to spatially visualize model results in real time. The field service management system will provide easy online access to the employees that are currently at work and what they are working on. The complex workings of the system are hidden from the user and the automatic rendering design used in this system enables users with no prior knowledge of GIS to visualize their data and immediately gain some understanding of the spatial structure of their data. The field service management software monitors the employee's performance. The whole system is very convenient, it has also substantial business value because it reduces handwork and digitally work can be done with saves much time.

The field service management software has much functionality which helps easily manage and manipulate the field service management data with using Web-GIS. However, more enhancements can be done in field service management software. In future we can develop a GPS device which can track through the GPS satellites. The GPS device can place on the MR's vehicles or it can be placed on their mobiles. In additionally, we can also develop android application for the medical representatives. Each employee has their login id, when they login in to the application the manager can get the present information and provide them daily task. The manager can send a daily task location and routes to the employee's application and employees can follow up that route. If they complete one task, they can check the task detail and send to the manager. So that manager can get the better and accurate information about the employees. As per order, pharmaceutical companies sent a product to

the doctors and medical stores. In this study, all scopes are not implemented because of less time and study of programming took much time. Live tracking information was not developed because it firstly needs to develop GPS device and connect it to a server.

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AUTHOR PROFILE

Ms. Jinal Patel currently parsing her master of science in Geoinformatics from department of Earth science, Gujarat University. She completed her Bachelor of Science in chemistry since 2018.



Dr. Shital Hardik Shukla is presently working as Head of Department of Earth Sciences, Gujarat University at Ahmedabad. She is having more than twenty years of experience in teaching and research. She has obtained her PhD on Sustainable Development of the Coastal Environment of Gujarat from Gujarat University. Her areas of research work include climate change and disasters management, sustainable development and environmental planning, urban and regional planning, research methodology for social science, and natural resource management. She has worked on many research projects funded by Government of India, Government of Gujarat, UNDP, WHO, IDPAD and ICSSR. She has published two books and more than 25 papers in national and international reputed journals. She has remained a member of International Scientific and Technical Committee IDRC (The International Disaster and Risk Conference) DAVOS, Switzerland and a joint secretary of Indian Society of Remote Sensing- Ahmedabad Chapter. She is honoured with a “Bhugol Bhashan” Award by The Deccan Geographical Society, India.



Mr. Santosh Gaikwad, is working as a Head, GeoSolutions at Nascent Info Technologies Pvt. Ltd., Gujarat, Ahmedabad, India. He holds a master's degree in Agriculture and an advanced diploma in Bioinformatics. His area of expertise is Spatial Informatics with more than 16 years of experience in it. His career has been focussed on geospatial aspects in various domains such as wetlands, biodiversity, agriculture, marine, education, insurance etc. His professional interests include software development, web mapping applications, spatial analysis and data visualisations. He has been awarded a Chevening scholarship in the area of biodiversity informatics at UNEP-WCMC, Cambridge, UK. He is a charter member of OSGeo foundation and closely associated with OSGeo-India chapter. He has working exposure with international/national organizations. Currently he is leading the development of “CityLayers” spatially enabled DSS product at Nascent.

