

**A GIS BASED APPLICATION FOR MAPPING LOCATION
OF RETAIL OUTLETS**

PROJECT SUBMITTED TO
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FOR PARTIAL FULFILLMENT OF THE M.Sc. DEGREE



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PREFACE

This project is submitted in partial fulfillment of the requirements for a Master's degree in Geoinformatics. It contains work done from December 2014 to May 2015. The project has been made solely by the author; and I have done my best to provide references to various sources that I have referred.

This project is focused on creating an application for monitoring data and information of stores selling Reliance Jio's products.

With the help of this web based application, all modern trade retail stores will be available for viewing through a web portal. The scope of this application is to retrieve information of stores, monitor store-wise sales statistics of Reliance Jio's products and to understand the modern trade business by capturing the data of the consumer behaviour. It is a visibility application for stores at Pan India level for modern trade.

The main goal of such a location-based application for retail outlets is to allow better presentation of the distribution of the stores across the country, with the aim to provide the users of the application with better metrics and analysis for informed decision-making.

TABLE OF CONTENTS

<i>Certificate</i>	2
<i>Acknowledgement</i>	3
<i>Preface</i>	4
<i>List of Figures</i>	6
<i>List of Tables</i>	7
<i>Abbreviations and Glossary</i>	8
Sections:	
1. Introduction.....	9
1.1 Background.....	9
1.2 About the Company.....	10
1.3 Objective.....	12
1.4 Organization of Study.....	12
2. Review of Literature.....	13
2.1 GIS in Retail.....	14
2.2 Similar applications.....	16
2.3 Reason for customized application.....	19
2.3.1 As-is process of retail mapping	19
2.3.2 Dashboards.....	19
2.3.3 From the company’s perspective.....	20
3. Study Area.....	21
4. Methodology.....	22
4.1 Scope of the application.....	22
4.2 Salient features.....	22
4.3 Project Execution Plan.....	23
4.4 Design Flow.....	24
4.5 Application Architecture.....	24
4.6 Procedure.....	24
5. Results.....	42
6. Discussion.....	44
6.1 Discussions.....	44
6.2 Challenges faced.....	45
7. Conclusion.....	46
7.1 Conclusion.....	46
7.2 Future Process.....	47
References.....	48

List of Figures

<i>Figure 1: Study area: India</i>	21
<i>Figure 2: Flow Design</i>	24
<i>Figure 3: Application Architecture</i>	24
<i>Figure 4: Application page for unauthorized users</i>	25
<i>Figure 5: Application page for authorized users</i>	26
<i>Figure 6: Selection of Chains for viewing according to area of Choice-1</i>	26
<i>Figure 7: Selection of Chains for viewing according to area of Choice-2</i>	26
<i>Figure 8: Selection of Multiple Chains for viewing</i>	27
<i>Figure 9: Map view on clicking 'Zoom' after selection of MultiChains</i>	28
<i>Figure 10: Selection of Category for viewing chains/ stores</i>	28
<i>Figure 11: Map View on clicking 'View' after selection of category-1</i>	29
<i>Figure 12: Map View on clicking 'View' after selection of category-2</i>	29
<i>Figure 13: Store Identification-1</i>	30
<i>Figure 14: Store Identification-2</i>	30
<i>Figure 15: Store Identification-3</i>	30
<i>Figure 16: Page for editing master table in the database</i>	31
<i>Figure 17: View on selection of Group and Company</i>	32
<i>Figure 18: Adding a new Group to the database</i>	32
<i>Figure 19: Adding a new Company to the database</i>	32
<i>Figure 20: Adding a new Chain to the database</i>	32
<i>Figure 21: Display of successfully added record</i>	33
<i>Figure 22: Editing an existing record</i>	33
<i>Figure 23: Deleting an existing record</i>	33
<i>Figure 24: Adding a store on map- 1</i>	34
<i>Figure 25: Adding a store on map- 2</i>	34
<i>Figure 26: Editing attributes of a store</i>	35
<i>Figure 27: Moving a store</i>	35
<i>Figure 28: Deleting a store</i>	35
<i>Figure 29: Overall count- Zonewise</i>	37
<i>Figure 30: Detailed count for a selected Zone</i>	37

<i>Figure 31: Overall count- Statewise</i>	<i>37</i>
<i>Figure 32: Percentage Chain Count-1</i>	<i>37</i>
<i>Figure 33: Percentage Chain Count-2</i>	<i>38</i>
<i>Figure 34: Detailed Count for Selected State and/or JC</i>	<i>38</i>
<i>Figure 35: Overall Count- Category wise</i>	<i>38</i>
<i>Figure 36: Detailed Count for selected Category</i>	<i>38</i>
<i>Figure 37: Chain Count per Zone</i>	<i>39</i>
<i>Figure 38: JC Count per State</i>	<i>39</i>
<i>Figure 39: States per Chain.</i>	<i>39</i>
<i>Figure 40: Chain, Store Count for selected State and/or JC</i>	<i>39</i>
<i>Figure 41: Chain Count per Category</i>	<i>40</i>
<i>Figure 42: Overall Count per Category</i>	<i>40</i>
<i>Figure 43: Count per Category; Statewise</i>	<i>40</i>
<i>Figure 44: Map by Zones</i>	<i>41</i>
<i>Figure 45: Map by States</i>	<i>41</i>
<i>Figure 46: Map by JCs</i>	<i>41</i>
<i>Figure 47: Detecting the high potential sales areas</i>	<i>44</i>
<i>Figure 48: Detecting under-performing areas – example.</i>	<i>44</i>

List of Tables

<i>Table 1: Application Development Timelines</i>	<i>22</i>
<i>Table 2: Tools in the application to perform various operations</i>	<i>32</i>
<i>Table 3: Results against the existing process</i>	<i>43</i>

Abbreviation list and Glossary

1. *ArcGIS*: It is ESRI's GIS platform for working with maps and geographic information. It is used for: creating and using maps; compiling geographic data; analyzing mapped information; sharing and discovering geographic information; using maps and geographic information in a range of applications; and managing geographic information in a database.
2. *ASP* : *Active Server Page*
3. *ESRI*: *Environmental System Research Institute*
4. *GIS*: *Geographical Information Systems*
5. *JC*: *Jio Center*
JC is the smallest organizational unit. It is the Geographical Boundary defined by RJIL for management of network.
6. *MT*: *Modern Trade*
7. *RJIL*: *Reliance Jio Infocomm Limited*

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1. INTRODUCTION

An 'outlet', 'store' or a 'retail outlet' is one in which manufacturers sell their stock directly to the public. Retail and service centers are often the final stocking points in a physical distribution network. They include facilities like departmental stores, supermarkets, branch banks, medical centers, etc.¹ The word 'retail' means to sell or be sold directly to individuals. Retail is the largest industry, and arguably the one with the most impact on the population.² For any organization to do business it needs to place its products within these outlets. They are the customer touch points and the breadth and depth of the sales channel. Therefore, having a list and knowledge of these outlets is one of the foremost and critical steps. This activity can be referred to as retail mapping i.e. mapping the location of retail outlets.

1.1 Background

GIS is used today to provide advanced analysis tools and complete data packages for analyzing retail and demographic information. These tools help retail planners in taking important retail planning decisions such as choosing retail locations, identifying and reaching potential customers, finding new markets, performing customer or store prospecting, defining customer-based or store trade areas, and identifying best retail locations.³

Retailers desire to set up their outlets in the best possible locations. The optimum store location for a retailer is based on many factors like the type of industry, the product category being sold, and the degree of competition. Retail stores are located where the opportunities offered by the market are at a maximum.⁴ GIS is considered a useful tool for retailers because it can help them in understanding their market, customers and

¹ Berman Barry and Evans Joel R. "Retail Management - A Strategic Approach". Eastern Economy

² Levy Michael, Barton A. Weitz, (2002) "Retailing Management", Tata Mcgraw Hill, Fourth edition, p.1 – 200

³ Hernandez, T, (2007) 'Enhancing retail location decision support: The development and application of geovisualization', Journal of Retailing and Consumer Services, Vol. 14, pp. 249–258

⁴ Store Location and Site Evaluation. Retrieved 8th May, 2015, from <http://www.icmrindia.org/courseware/Retail%20Management/Store%20Location-Site%20Evaluat.htm>

competitors. This can be achieved through the analysis of sales data, demographics and location data, boundaries and sales territories.⁵

A retailer can develop a map of its store using GIS software to calculate the actual Dimensions of a store. This can even handle multilevel stores and shelf depths. When a retailer has the store mapped, a consumer or user can view the map on a live website, and know the exact location and the item within the store. GIS allows planners to create maps for specific use.⁶

Indian retailing today is at an interesting crossroad. The retail sales are at the highest point in history and new technologies are improving retail productivity. Though there are many opportunities to start a new retail business, retailers are facing numerous challenges. One of the key challenges is LOCATION which implies "Right Place, Right choice".⁷ According to a review produced by Euro monitor International (Aug 2007), Indian retailers are driving their way into the Top 500 of retailers in Asia Pacific. There is great assurance in India's potential to tolerate a period of high growth. Retail location and real estate are one of the leading keys to the growth of organized retail in India. The value of location as a business measure is fast becoming an important deliberation for organizations.⁸

1.2 About the Company:

Reliance Jio Infocomm Limited (RJIL) is the only telecom company having Pan-India high speed wireless broadband service provider license and 4G spectrum. It provides broadband services through 4G LTE, Wi-Fi and FTTx to customers throughout India. To achieve a competitive edge, the company has embraced GIS as a technology that will enable it to survive, compete, and win market share. It has

⁵ Cheng, E, and Ling Yu, H, (2007) ' A GIS approach to shopping mall location selection Building and Environment' Vol. 42, pp. 884–892

⁶ Murad, A, (2007) 'Using GIS for Retail Planning in Jeddah City' American Journal of Applied Sciences Vol. 4 No.1, pp. 821-827

⁷ Indian Retail Industry – Current Scrnario. Retrieved 2nd May, 2015, from http://www.indianmba.com/Occasional_Papers/OP95/op95.html

⁸ IRACST - International Journal of Computer Science and Information Technology & Security (IJCSITS), ISSN: 2249-9555, Vol. 2, No.3, June 2012, pp. 535-536

implemented ESRI's Enterprise GIS customized to meet its needs - to manage its telecommunications network infrastructure and associated land base for its service area that covers India.

The enterprise GIS provides RJIL with a centralized corporate record of land base and facility data in an open environment. It enables the company's users to produce and maintain a comprehensive geodatabase containing network facilities, customer locations, buildings, roads, sales, marketing, and boundary data. All data is stored in a seamless geodatabase using ArcSDE and Oracle. The resulting data is then made available to various departments within Reliance using ArcGIS clients or via the corporate Intranet. There are currently many applications being developed within the company that are based on ESRI's ArcGIS platform. The web based GIS application for Modern Trade Business – for location of RJIL's Retail outlets discussed here is one of them.

As quoted by Dennis Hill, Vice President, Real Estate, Wendy's- "Everything we need— including mapping, analytics, and modeling— can be done on one platform that is scalable across our organization."⁹ The application discussed in this project is built on these lines.

The project aims at providing an application which will enable users of the modern trade business for Reliance Jio to view the stores-Retail outlets on the map. The application uses ArcGIS platform to view the map and the related data. The users will get an overall view of the distribution of the outlets all over the country. The application provides them with an option to view the stores/ chains/ outlets only in their choice of area. The application also provides a dashboard (containing graphs and tables) which makes it possible to view important information and metrics concerning the Modern Trade business of the company.

Users, and particularly retail analysts, of this GIS based web application will be able to carry out an analysis based on the distribution of the stores. They will also be able to get an understanding of various metrics, statistics and factors concerned with the locations of the Retail outlets.

⁹ Location Analytics for Retail. Retrieved 5th April, 2015 from <http://www.esri.com/library/brochures/pdfs/location-analytics-retail.pdf>

1.3 Objective:

The aim is to create a web based GIS application for monitoring data and information of stores selling Rjio's (Reliance Jio's) products.

The objectives of this project are –

- To make all modern trade retail stores of Rjio available for viewing through the web portal.
- To retrieve information of stores, monitor store-wise sales statistics of Rjio's products, view store and its location information and to understand the modern trade business by capturing the data of the consumer behaviour.
- To provide a dashboard to view important information and metrics concerning the Modern Trade stores (Retail outlets) for Rjio's products.

1.4 Organization of Study

The work has been divided into six sections. The first is the introductory section and includes the background, a brief description and objectives of study; the second section is a short description of the study area. The review of literature which comprises the third section deals with certain other similar type of works done in GIS in the retail sector. The methodology and procedure is included in the fourth section. The fifth and sixth are the sections where results, conclusions and recommendations have been discussed.

2. REVIEW OF LITERATURE

Amid buzzwords that have hijacked discussions on the retail industry — “omnichannel,” “webrooming” — it’s easy to forget a stubborn truism of retail success: Location, location, location.¹⁰ Just as no man is an island, no retail store sits on its own. That’s why it’s critical to consider retail store network and store location. This will help determining a new retail store location, assess and analyse existing stores, how many retail stores can be opened in an area with existing stores, where retail store network can be expanded, what stores should be closed , etc.¹¹

Retail location review activity within the retail business deals with the collection, analysis and distribution of spatially referenced information which is preferably handled by GIS. GIS adds spatial intelligence, the one true source of justifiable competitive advantage, to retail organizations. GIS is a tool for handling business information of any kind according to where it’s located. Retailers can keep track of where customers are, site businesses, target marketing drives, enhance sales territories, and model retail spending outlines. Retail outlet location simplifies getting the stock to the ultimate consumer at the right place, at the right time, in the right quantities, and at the right price. In addition, location choices are deliberately important for the retailer because they help in evolving sustainable competitive advantage over the competitors that cannot be copied at any cost.

Understanding location is even more vital when businesses go into new location. To achieve an economical edge, telecommunication companies such as Reliance Infocomm Limited based in Mumbai, India, have comprised GIS as a technology that will enable them to endure, strive, and win market share.¹²

Thus, retailers can go outside standard data analysis by using GIS tools to assimilate, view, and analyze data using geography.

¹⁰ How Big Data Helps Chains Like Starbucks Pick Store Locations- An (Unsung) Key To Retail Success. Retrieved May 10th, 2015, from <http://www.forbes.com/sites/barbarathau/2014/04/24/how-big-data-helps-retailers-like-starbucks-pick-store-locations-an-unsung-key-to-retail-success/>

¹¹ Mapping Analytics – Retail Site Selection. Retrieved May 5th, 2015, from <http://www.mappinganalytics.com/site-selection/retail-site-selection.html>

¹² IRACST - International Journal of Computer Science and Information Technology & Security (IJCSITS), ISSN: 2249-9555, Vol. 2, No.3, June 2012, pp. 535-538

2.1 GIS in Retail

GIS with its ability to manage, display, and examine business information spatially, is evolving as a powerful location intellect tool. GIS mapping has evolved out of a long practice of map making. Earlier all spatial investigation were done by physical processing procedures but now, with the development of GIS, efficient handling of huge data and effective spatial analysis is possible.¹³

A computer-based GIS provides an electronic process for handling, assimilating, and evaluating huge amounts of geographic information by combining locational features with vivid data in a relational database management system.¹⁴

Today, ESRI has reformed GIS to show where probable growth can and can't occur. Through the use of a system based on digital maps, GIS software and diverse databases, the data are intensely distributed, being able itself, for example, to examine the market trends, to monitor the competition, to envisage opportunities and to launch marketing operations. It can even be used for sales area planning, meaning that a business will know how to organize its sales staff so they don't overlap with each other's' regions.¹⁵

GIS application in retail field is acknowledged and used by several international retailers. For example, Minute Man Company uses GIS for products delivery at the USA. It uses GIS and Global Position Systems (GPS) to point out the location of delivery customers, select the most appropriate vehicle type located closest to the collection point and provides a displayed map to driver showing the most efficient path to delivery of pick up point.¹⁶ There are several studies that have discussed the advantages of using GIS in retail planning. For example, Murad (2003), and Murad (2009), has pointed that GIS functions such as Buffer and Thiessen can be used in retail planning field for catchment area definition. Birkin et al (2002), have presented the use of GIS for sales territory planning. Miracle supermarket in Ontario, Canada has used GIS software for assessment

¹³ Birkin, M., Clarke, G., Clarke, M., Wilson, A., (1996) Intelligent GIS, Geoinformation International, Cambridge

¹⁴ Brian E. Mennecke, "Understanding the Role of Geographic Information Technologies in Business: Applications and Research Directions", Journal of Geographic Information and Decision Analysis, vol.1, no.1

¹⁵ IRACST - International Journal of Computer Science and Information Technology & Security (IJCSITS), ISSN: 2249-9555, Vol. 2, No.3, June 2012

¹⁶ Grimshaw D., (2000) Bringing Geographical Information Systems into Business, Wiley, New York

of new sites, and the processing of customer survey for existing stores. McDonald's uses a GIS system to join demographic information on maps to help recognize promising new store sites. Maatta-Juntunen et al (2010), have discussed a GIS application for measuring retail location accessibility in Finland and utilize GIS tools to assess store locations.

GIS is considered as a useful tool for retailers because it can help them in understanding their market, customers and competitors. Retailers can use thematic mapping technique to present any collection of tabular data. Data query tools in GIS can be applied on a single attribute field such as the number of retail customers, or on a multiple attribute data field such as retail demand and retail supply.¹⁷

The simplest GIS tool that can be used at every retail GIS application is related to displaying and querying spatial and attribute data. For example, ArcGIS software has several functions that can be used for data query and display.

Warner De Gooijer, a strategic analyst with Cisco Systems, Inc., on his discussion about how the Cisco Global Service Supply Chain (GSSC) had integrated the ArcGIS platform, making it easier to do business and provide value to the company at the ESRI Business Summit in July, 2013, said "ArcGIS is a foundational platform for Cisco that globally aligns information transparency and enhances customer intimacy through improved location awareness. " He stated that ArcGIS provided staff with an accurate visualization of the company's footprint and operational capabilities by linking into the business environment. Through this improved visibility of service territories, significant traction had been made in eliminating coverage overlaps, removing service gaps, and optimizing the service part delivery network.¹⁸

Simon Thompson, director of commercial business for location-analytics company ESRI, shared with Forbes how ArcGIS Online, its technology platform for visualizing data in the form of maps, is helping retailers ranging from Starbucks to Dress Barn fine tune how to pick a store location with the goal of driving more traffic and boosting sales. "Esri's software allowed staff to easily view sales records and customize demographics on existing restaurants without any additional training. The software also

¹⁷ Murad A., Creating A Gis Application For Retail Planning In Saudi Arabia, King Abdulaziz University, Jeddah, Saudi Arabia

¹⁸ Cisco Talks Successful Supply Chain at the Esri Business Summit. Retrieved 5th May, 2015, from <http://www.esri.com/esri-news/releases/13-2qtr/cisco-talks-successful-supply-chain-at-the-esri-business-summit>

enabled Wendy's to predict and assess the value and risks for new and existing restaurant locations by simply clicking on the map. In the future, Wendy's would like to use ESRI's software to look at the customer data to better understand how they want the interior of certain store locations to look in terms of their flow based on if it is a larger lunchtime or breakfast crowd," Thompson said.

"In 2007 and 2008, Starbucks used ESRI's mapping software to easily analyze massive amounts of data about planned store openings. The software analyzed location-based data and demographics to determine the best place to open Starbucks stores without hurting sales at other Starbucks locations." "As a retail-only real estate firm, location analytics enabled employees at The Shopping Center Group to combine their research experience, knowledge, and instincts to create critical insight into decision-making. ESRI's location analytics solution allows The Shopping Center Group to collaborate across its 22 offices across the country and share information anywhere on any device, including phones and tablets."¹⁹ "It is an example of how to more effectively model and manage the supply chain, reducing risk as well as costs while improving customer benefits. These are stories that everyone should hear."²⁰

2.2 Similar applications...

If you're swamped in comps, **BatchGeo** is a very quick analysis tool that can help visualize and geo-code your data. It's an incredibly useful (and free) online tool that quickly geo-codes any address and visually groups information using Google maps.²¹ BatchGeo makes it easy to create maps with their various tools. Some of which are Store Locator, Real Estate Mapping tool, Sales Mapping, etc.²² Their map tools make it easy to see one's information in new ways- find trends, hot spots, cold zones. It is easy to

¹⁹ How big data helps retailers. Retrieved 15th May, 2015 from <http://www.forbes.com/sites/barbarathau/2014/04/24/how-big-data-helps-retailers-like-starbucks-pick-store-locations-an-unsung-key-to-retail-success/>

²⁰ Cisco Talks Successful Supply Chain at the Esri Business Summit. Retrieved 5th May, 2015, from <http://www.esri.com/esri-news/releases/13-2qtr/cisco-talks-successful-supply-chain-at-the-esri-business-summit>

²¹ About BatchGeo. Retrieved 2nd May, 2015, from <http://www.biggerpockets.com/renewsblog/2013/02/03/batchgeo/>

²² About our mapping features. Retrieved 2nd May, 2015, from <http://en.batchgeo.com/features/>

visualize one's data using these tools.²³ The maps created by these tools serve visualization and analytical purposes.

Logility Voyager Solutions is a suite of collaborative, best-of-breed supply chain management (SCM) software solutions that help small, medium, large and Fortune 500 companies realize substantial bottom-line results in record time. Logility manages allocations at the store group level using unlimited attributes and group definitions. Logility's Voyager retail allocation software ensures product availability and improves customer satisfaction while efficiently managing inventory positions, strategically directing inventory to the proper channel or location to best serve customer demand. It provides the visibility and automation needed to proactively plan, source, schedule, produce, store, transport and trace supply chain activities, in industries with distribution-intensive supply networks.²⁴

aisle411 Inc. is a company that has developed a consumer service called **aisle411** that allows customers to use their phones to find products in stores. Eight out of 10 smart phone customers are assisted by their mobile phones while shopping. aisle411 allows consumers with smart phones to pull up a map pinpointing the aisle and location of the object of their desire in a particular store. aisle411 is a platform that makes it easy to integrate purchase-driving features into retailers' mobile apps including digital in-store maps, product search and location, in-store navigation, and geo-targeted offers. aisle411's proprietary technology has scaled thousands of retail stores' digital maps in weeks and powers over 13,000 store locations, handling frequent up.²⁵

Retail Advantage of ART Software Group is a comprehensive retail management, analysis and communication suite for shopping centres, retail groups and retail asset management companies. It delivers access to one's data live from an array of devices, on-the-move from almost anywhere. Retail Advantage is a tool for the comprehensive

²³ Create a store locator map for your website. Retrieved 2nd May, 2015, from <http://en.batchgeo.com/features/store-locator/>

²⁴Retail Allocation Software – Logility. Retrieved 5th April, 2015, from <http://www.logility.com/solutions/retail-management-software/retail-supply-chain-management-allocation>

²⁵ Indoor positioning. Retrieved 2nd May, 2015, from <http://aisle411.com/retailers/>

analysis of financial and performance data for shopping centres, outlet malls, retail parks and other managed retail locations. Providing continuous real-time analysis and reporting, Retail Advantage gives you key data analysis tools and smart visuals to maintain your business position at the forefront of your industry. Leading retail performance management tools give you insight into best paths to achieving goals and building upon successful trading.²⁶

Staples has got 2281 stores in the whole world with the retail range of theirs consisting of great number of products. With such big network and operation across the whole world we they developed the **Staples Store Locator** to help get the best advertisement and presentation of their stores. On their site, one is welcome to see entire list of states where Staples Stores are currently operated. When you click on one of them you'll be led further to districts and further on. You can search any location or their outlet on that page. They provide a search box for the same. When you click on a particular store of theirs, that store's description will be displayed.²⁷

Using any GPS-enabled mobile device, the **Xora GPS TimeTrack** mobile app collects and reports location, time and job information in near real-time, giving you the immediate information you need to make daily operational decisions and the historical trends data you need to assess and improve the overall productivity and performance of your mobile employees.²⁸

By combining data from the business intelligence and the location dimension, **Galigeo's software solutions** enable analysis that results in a better understanding of the density and distribution of the clients within the territory. Therefore, it is easier to transform the insight into an action plan to improve selling strategies.²⁹

²⁶ Retail Advantage. Retrieved 10th May, 2015, from <http://www.retailadvantage.co.uk/retail/>

²⁷ Staples Store Locator. Retrieved 10th May, 2015, from <http://www.stapleslocations.us/staples-store-locator/>

²⁸ Xora GPS TimeTrack Mobile Solutions for Business | GPS Mobile Enterprise Applications | Xora. (2012). Retrieved April 2012, from <http://www.xora.com/>

²⁹ Location Intelligence and Geomarketing to Improve Sales Territory Management. Retrieved April 2015, from Location Intelligence and Location Analytics software for Enterprises - <http://www.galigeo.com/products-overview/territory-management-products/galigeo-sell-where/>

2.3 Reason for customized application...

2.3.1 As-is process of retail mapping

Each sales representative visiting an outlet would have a template form on printed paper or so. He visits the shop and enquires about its performance and fills the form with the details as per the template. This activity would be done for each outlet. This information has to be consolidated for each road, colony, area and territory. Then it needs to be put into an electronic form, such as an Excel spreadsheet. Ultimately such lists are consolidated for various territories and add up to become the retail mapping tree for the entire region. This process has sources of errors which can lead to significant loss of time, money and resources, etc. for the organization. This application resolves many issues that exist with the as-is process.

2.3.2 Dashboards

Company owners commonly rely on business analysis dashboards for strategizing and reviewing data. The key benefits of using an analytics dashboard are:

- On the fly, interactive visual analysis of data in the form of tables, maps, charts, drill downs and quick filters, etc(Data Visualization Made Simple)
- Configure histograms, pie and bar charts, scatter graphs to provide key statistical insights
- Caching of in-memory data to speed up processing of big data
- Integration with web portals and seamless connectivity with 3rd party tools
- Interactive reporting and output in most industry formats
- Strict data security with multiple versioning of data
- Real-time visual representation of data filtered according to roles
- Effectively manage rapidly changing performance metrics

With the help of the developed application, users will be able to view important information, statistics and metrics concerning the Modern Trade business. Users can focus on the statistics and analysis of the stores with respect to their areas of concern.

2.3.3 From the company's perspective

RJIL uses ESRI's ArcGIS platform. It has implemented ESRI's Enterprise GIS customized to meet its needs i.e. to manage its telecommunications network infrastructure and associated land base for its service area that covers India.

Reliance primarily uses ESRI's enterprise GIS software for spatial data storage; land base and facility data maintenance; specialty map production; and complete, open access to data and applications via the Reliance corporate Intranet. Reliance uses ArcSDE software as the universal spatial application server for storing and managing data seamlessly within its Oracle relational database management system.

Thus, ArcGIS with Oracle RDBMS become natural candidates for the application. The application has thus been built using ESRI's ArcGIS platform and Oracle 11.2g.

The developed application is specific to the business requirements. Unlike already available applications in the market, the application discussed here is specific to the Company only and is only concerned with Reliance Jio's products and Reliance Jio's outlets; it will only deal with the Sales and Stocks of Rjio. This application can only be accessed by authorized users- registered Reliance users thus providing security outside the Company's domain.

3. STUDY AREA

The study area includes the whole of India where there are stores (Retail outlets) selling Reliance Jio's products.

For this application, the country is divided into 4 zones (North, South, East and West). The zones contain states (R4G States as defined by the company). These states then contain Cities and JCs that are specially defined by the company.

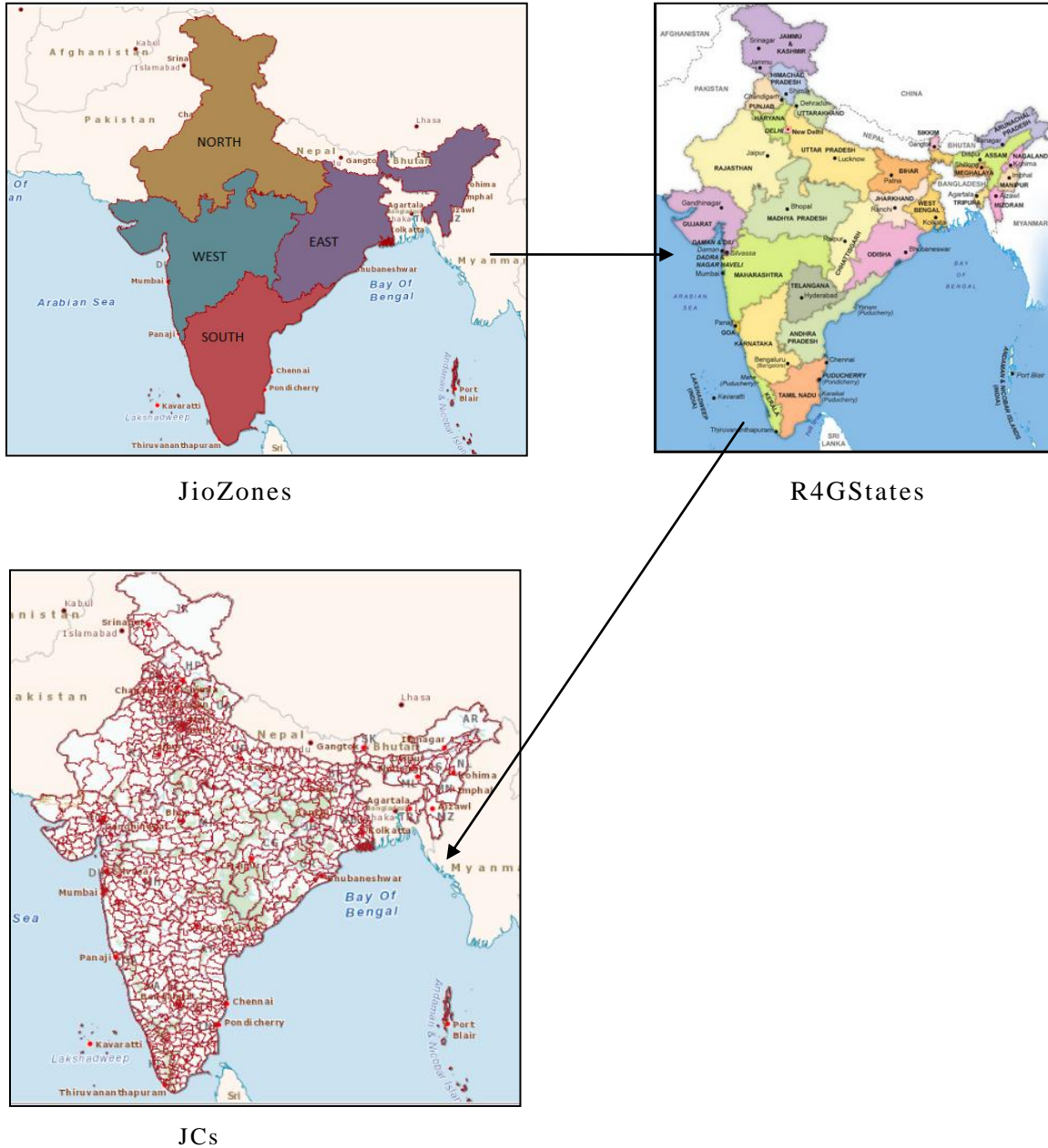


Fig. 1: Study Area-INDIA

4. METHODOLOGY

4.1 Scope of the Application

The application is titled ‘StÓchos’ meaning Target. It is a visibility application for stores at PAN India level for modern trade. With the help of this application-

- All Rjio’s modern trade retail stores will be available for viewing through a web portal
- The application is integrated with a centralized user management system so that only authorized users have access to addition/ modification of stores, attribute updation and/ or store deletion
- A dashboard is available to view important information and metrics concerning the Modern Trade business
- It will be possible to monitor data and information of stores selling Rjio’s products, Retrieve information of stores, monitor store-wise sales statistics of Rjio’s products, Understand the modern trade business by capturing the data of consumer behavior.

For this application, 3 User roles have been defined – View only, Editing store-wise data and master/reference data editing. Only those users registered as JC Managers or Store Managers or Store Representatives have rights to editing. The rest have access to viewing only.

4.2 Salient Features

1. Activities on Map - Users can carry out various functionalities on the map like Pan, Zoom, Identify, etc like that in ArcMap. This is made possible by using ArcGIS web API for JavaScript.

2. Editing Master Table – Authorized users can edit the master table which stores different Group names, Company names and Chain Names. This information is held within Oracle RDBMS.

3. Editing on Map – Authorized users can add, delete and modify or edit stores on the map. This is made possible using ArcSDE- ESRI spatial database, ArcGIS web API, Oracle RDBMS.

4. Dashboard- Users can view various metrics and statistics of store information with the help of graphs and tables. This is made possible using Highcharts API and Bootstrap datatable API.

4.3 Project Execution Plan

Activities/ Phase	Duration	Deliverable	Remarks
Requirement Assessment	2 weeks	FRS- Functional Requirement Specification	FRS was used as the input. The application is built in lines with the FRS.
Design	2 weeks	Application User Interface	The application UI was developed in lines with the finalized designs.
Development	16 weeks	Software Design Document	The development is the longest stage. An SDD was prepared that contains the entire functioning and detailing of the application and its working.
Unit Testing	2 days	Test Cases	Various defects were raised and were resolved and fixed.
Functional Testing	1 week		The application is tested against its required functionalities.
System Integration Testing	NA		-
User Acceptance Testing	1 week		Users of the application/ Clients test the application.
Deployment	0.5 weeks		The application is currently deployed as an intranet web portal. In future, it shall be deployed as an internet web portal.

Table 1: Application Development Timeline

Glossary:

Group- Organizational unit comprising of Companies owned by one firm and spread nationwide or worldwide, such as Aditya Birla Group.

Company- Organizational unit comprising of retail outlets owned by one group. Eg. Aditya Birla Retail Ltd.

Chain- Organization and distribution channel owned by a Company. Chain stores usually have (1) similar architecture, (2) store design and layout, and (3) choice of products. Eg. More

4.4 Design Flow

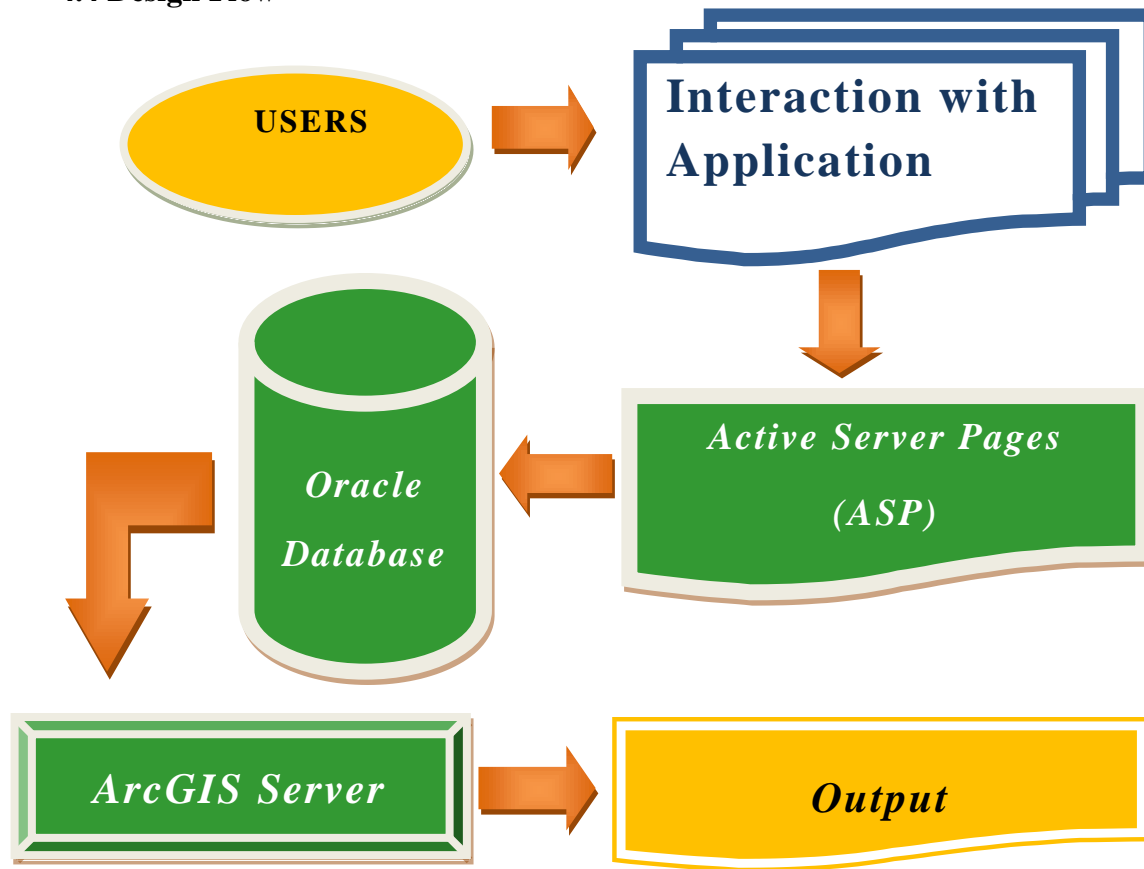


Fig. 2: Flow Design

4.5 Application Architecture

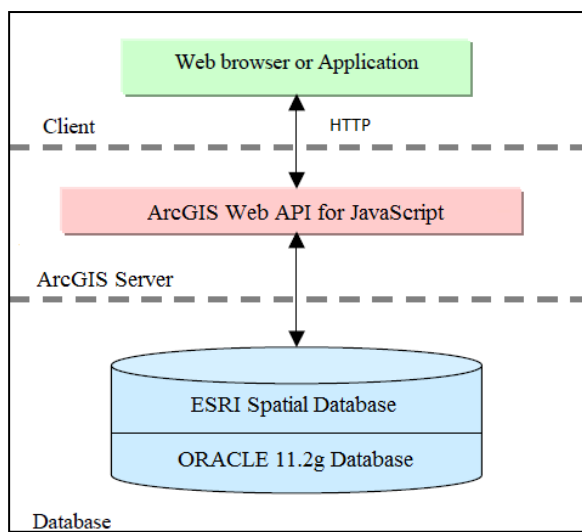


Fig. 3: Application Architecture

The system runs on an Oracle Database 11g (RDBMS) and ESRI Spatial Database which provides a platform that supports a wide range of applications—from automated mapping/facilities management and GIS, to wireless location services and location-enabled business intelligence. With it, both, spatial and attribute data are stored. The application uses the services of ArcGIS Server for rendering the maps to the Internet. The technologies used are C#, Asp .Net, JavaScript, JQuery, ArcGIS Web API for JavaScript.

4.6 Procedure

The GIS based web application for mapping location of Retail outlets would require the users to first register themselves as JC Managers and Sales Managers without which they will only be able to view and not perform any editing operations in the application.

1. *Activities on Map*

The application provides the user with a Pan India view of the various Modern Trade Stores (Reliance JioInfocomm Outlets). The Maps in the application provide much functionality to the user as that in ArcMap - Zoom, Pan, Identify, Selection, etc.

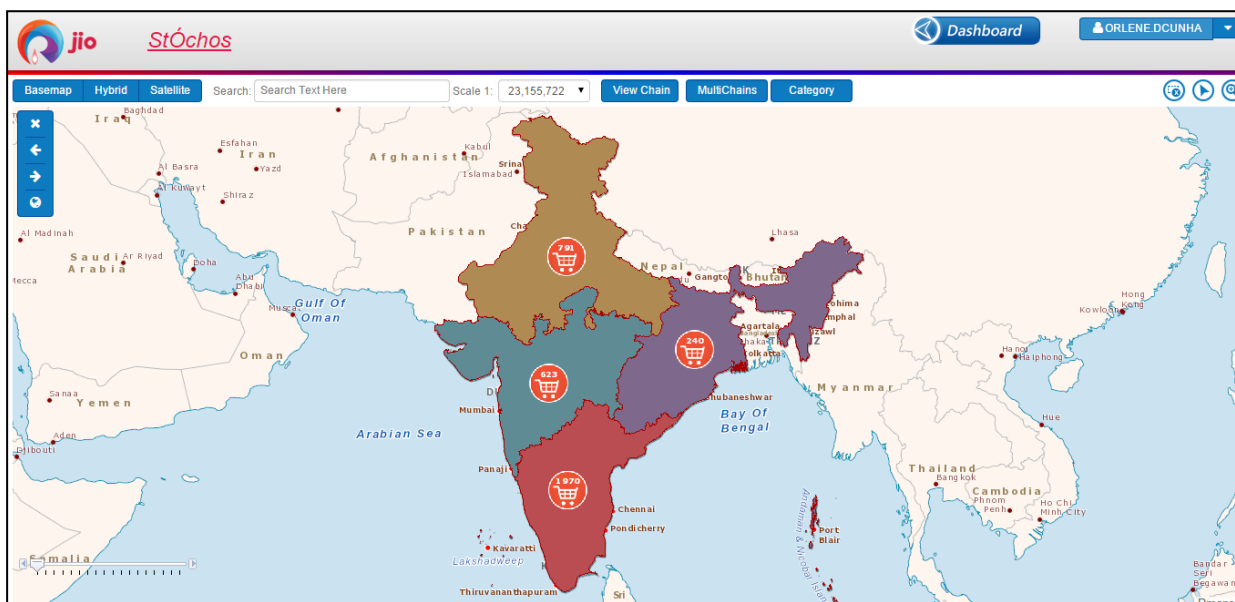


Fig. 4: Application page for users not registered as JC Managers / Sales Managers

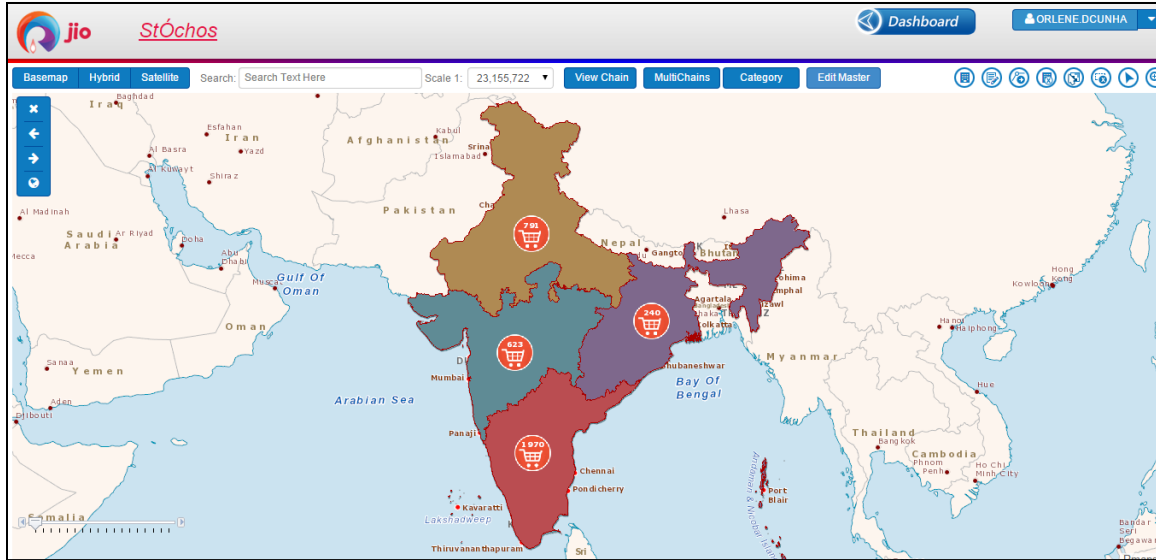


Fig. 5: Application page for user registered as JC Managers / Sales Managers

The figures displayed on the map (within the circles) indicate the total number of stores in the respective Zones, States and JCs.

Users can view various stores on the map according to their area of choice. They can view chains based on Zones, States, Cities or JCs. Based on any kind of selection of area, users can view stores. Thus, one can select a single chain or multiple chains region wise and get data of the respective stores.

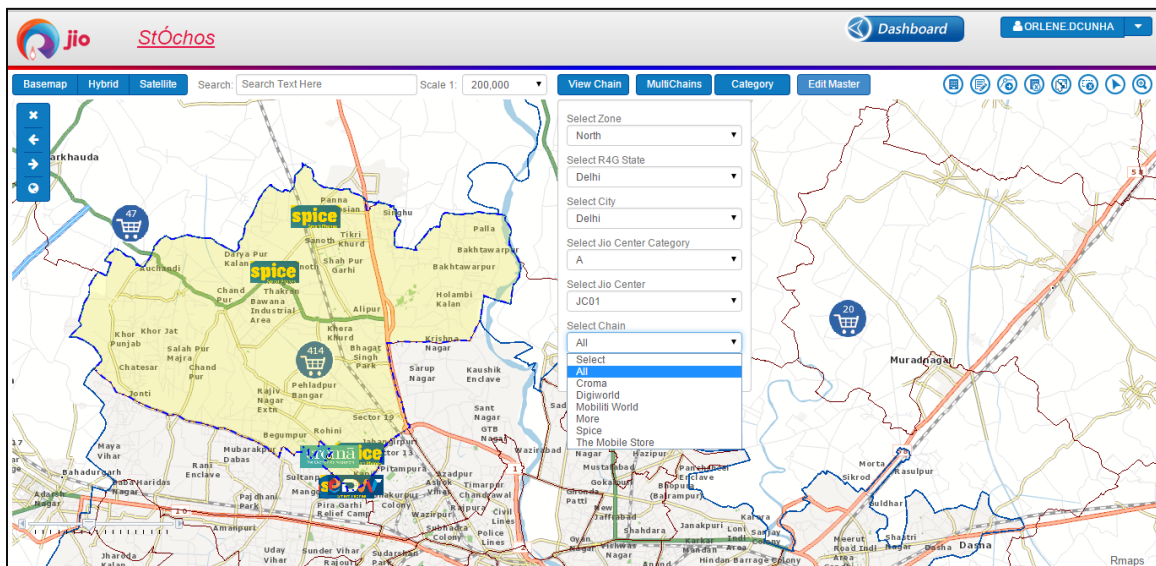


Fig. 6: Selection of Chain/s for viewing according to area of Choice – 1

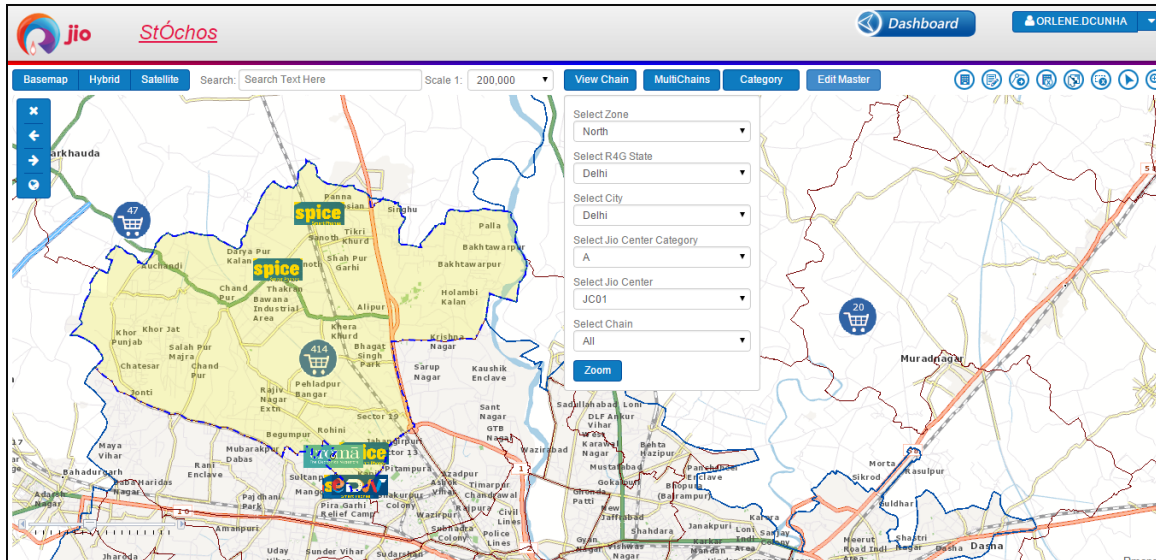


Fig. 7: Selection of Chain/s for viewing according to area of Choice – 2

The yellow graphic on the map is the highlighted JC boundary. Whenever a user selects a JC as his/ her area of interest, the corresponding boundary gets highlighted.

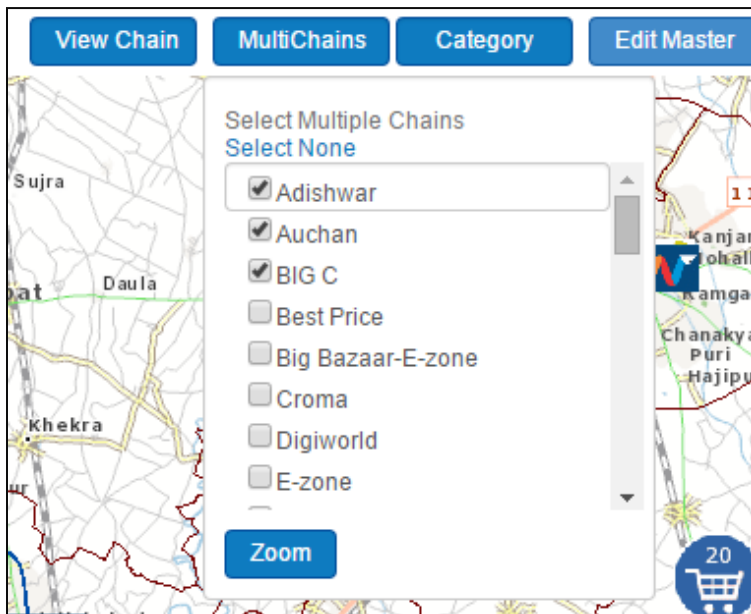


Fig. 8: Selection of Multiple Chains for viewing

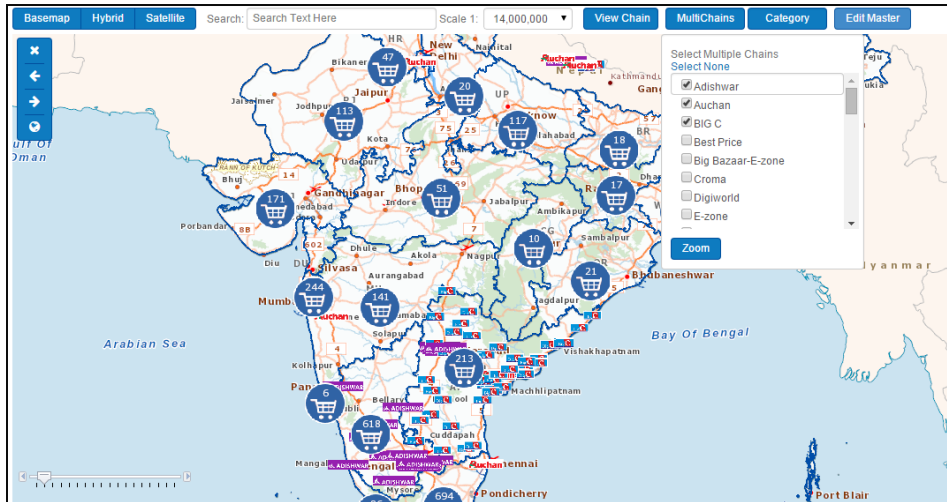


Fig. 9: Map view on clicking 'Zoom' after selection of MultiChains

Users can also view chains and stores on the map on the basis of store category.

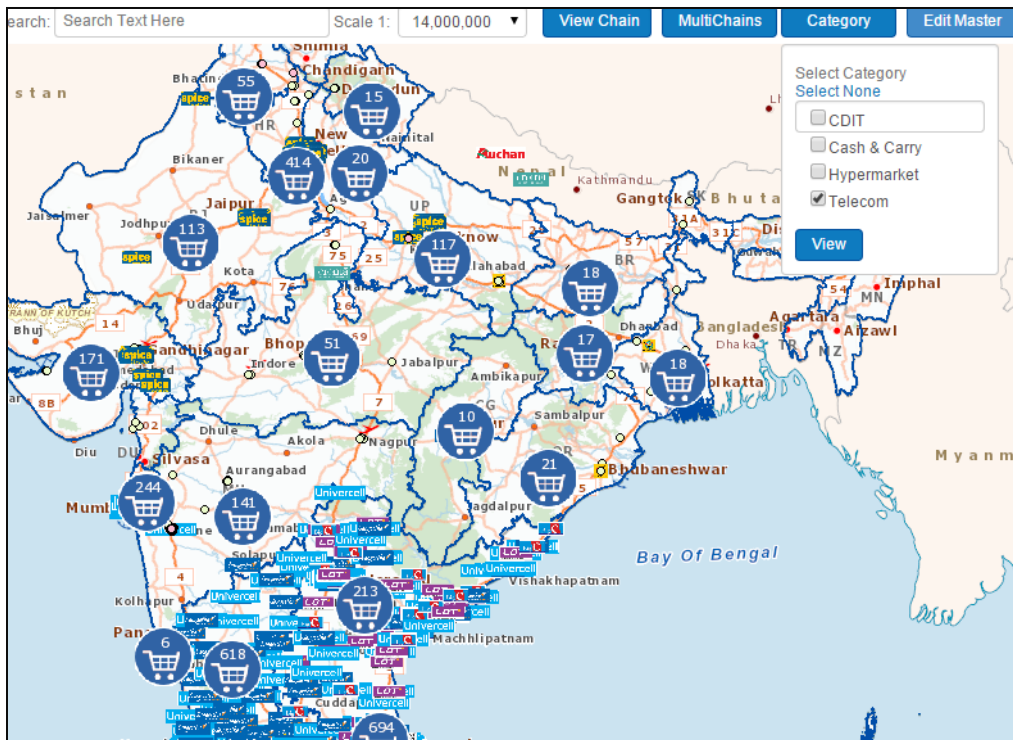


Fig. 10: Selection of Category for viewing chains/ stores

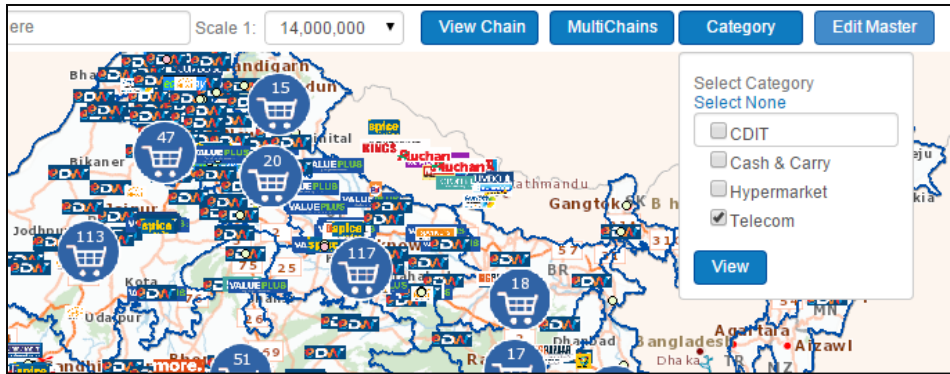


Fig. 11: Map View on clicking 'View' after selection of category-1

In the figure above, category selected is Telecom. Thus, stores of chains like Spice, Univercell, The Mobile Store, etc. are displayed.

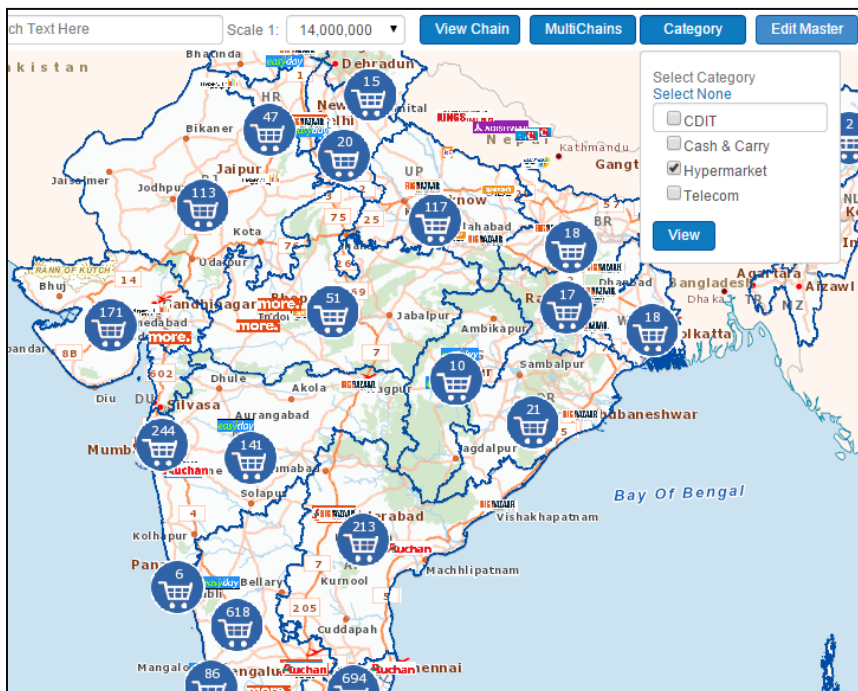


Fig. 12: Map View on clicking 'View' after selection of category-2

In the figure above, category selected is Hypermarket. Thus, stores of chains like More, EasyDay, Auchan, etc. are displayed.

By clicking on a particular store, the user can view the details of that store. This function is the same as identify tool that works on ArcGIS Desktop. After clicking on a store, the user can hence view the store information, its respective JC information, photos, and also stock and sales data when it will be incorporated.

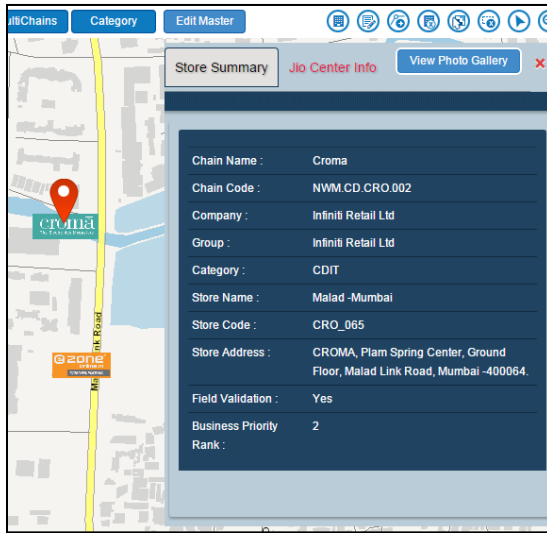


Fig. 13: Store Identification-1

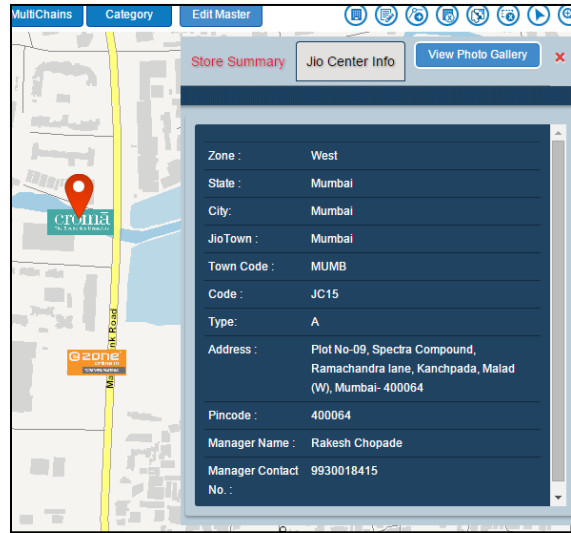


Fig. 14: Store Identification-2

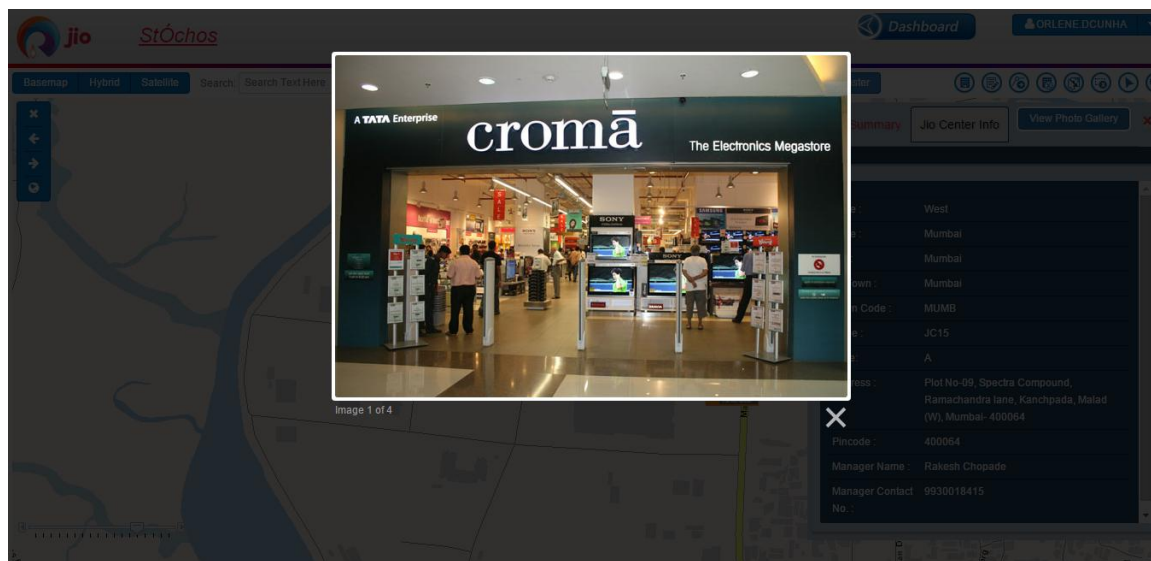


Fig. 15: Store Identification-3

2. *Editing Master Table*

An authorized user can add, edit or delete the names of Groups and/or Companies and/or Chains through the 'EditMaster.aspx' page. This page is only accessible to users registered as JC Managers and Sales managers. With the help of this page, the authorized users can make appropriate additions, updates and remove specific Groups and/or Companies and/or Chains as required from the master table in the database. This page can be accessed by clicking on the 'EditMaster' button on the main Map page.

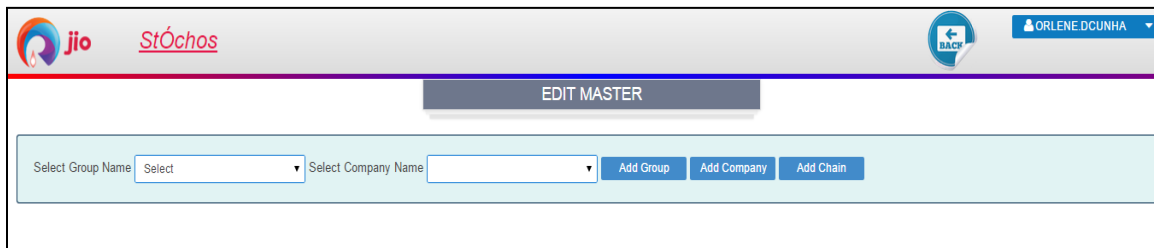
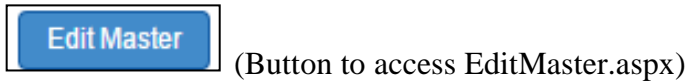


Fig. 16: Page for editing master table in the database

By selection from the dropdowns provided, the user can view the existing Groups, Companies, and Chains.

The user can add a new Group and/or Company and/or Chain by clicking on the respective buttons. He/she can add a new Group; add a new Company within a Group; add a new Chain within a Company and Group.

By clicking on a specific record, the user can edit / modify the details or he/ she can delete that corresponding record.

Suitable message is displayed to the user in response to the activity he/ she has performed. For example, after the user has successfully edited a record; a pop-up is displayed notifying the user 'Record successfully updated'. If unsuccessful, the user is notified 'Unable to update'.

Validations have been included so that the user does not leave the required fields blank or does not add an already existing Group, Company or Chain name to the database.

The screenshot shows the 'EDIT MASTER' interface. At the top, there are logos for 'jio' and 'StOchos', and a user profile for 'ORLENE.DCUNHA'. Below the header, there are dropdown menus for 'Select Group Name' (set to 'Others') and 'Select Company Name' (set to 'Select'). There are three buttons: 'Add Group', 'Add Company', and 'Add Chain'. Below this is a table with 10 records per page. The table has columns for Group Name, Company Name, Chain Name, Edit, and Delete. The records are as follows:

Group Name	Company Name	Chain Name	Edit	Delete
Others	Malaika Appliances Pvt Ltd	Malaika	Edit	Delete
Others	Poorvika Mobiles Pvt Ltd	Poorvika	Edit	Delete
Others	Sony Mony Electronics	Sony Mony	Edit	Delete
Others	PCH Retail Ltd	PCH	Edit	Delete
Others	Vishal Video & Appliances Private Limited	Value Plus	Edit	Delete
Others	Vasanth & Co Pvt Ltd	Vasanth & Co.	Edit	Delete
Others	Girias Investment Pvt Ltd	Girias	Edit	Delete
Others	QRS Retail Ltd	QRS	Edit	Delete
Others	Sales India	Sales India	Edit	Delete
Others	The Chennai Mobiles Pvt Ltd	The Chennai Mobiles	Edit	Delete

At the bottom of the table, it says 'Showing 1 to 10 of 21 records'. There are navigation buttons: 'Previous', 'Next', and a search bar.

Fig. 17: View on selection of Group and Company

The 'Add Group Name' dialog box has three input fields: 'Group Name *', 'Company Name *', and 'Chain Name *'. There are 'Close' and 'Add' buttons at the bottom right.

Fig. 18: Adding a new Group to the database

The 'Add Company Name' dialog box has three input fields: 'Group Name', 'Company Name *', and 'Chain Name *'. The 'Group Name' field contains 'Aditya Birla Group'. There are 'Close' and 'Add' buttons at the bottom right.

Fig. 19: Adding a new Company to the database

The 'Add Chain Name' dialog box has three input fields: 'Group Name' (set to 'Others'), 'Company Name' (set to 'Vijay Sales Ltd'), and 'Chain Name *'. There are 'Close' and 'Add' buttons at the bottom right.

Fig. 20: Adding a new Chain to the database

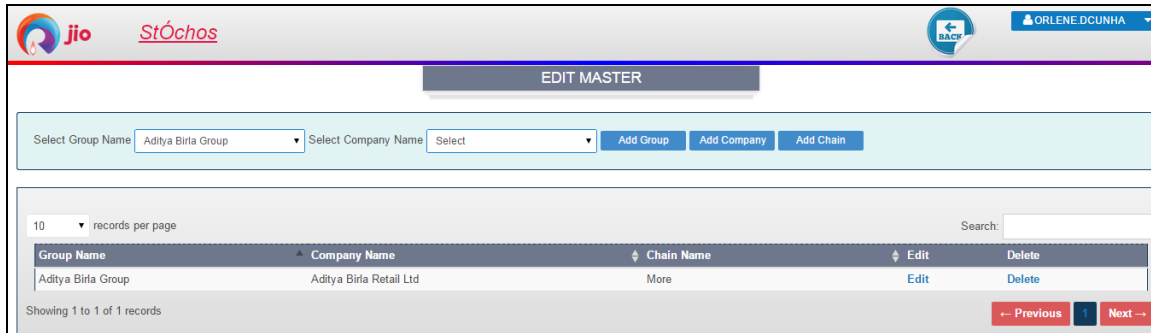


Fig. 21: Display of successfully added record.

The user can click on ‘Edit’ or ‘Delete’ to perform the same on that record.

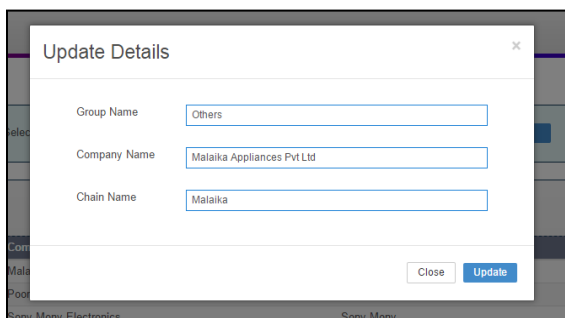


Fig. 22: Editing an existing record

The above pop-up is displayed on clicking ‘Edit’ against a record. On ‘Update’, the record is updated.

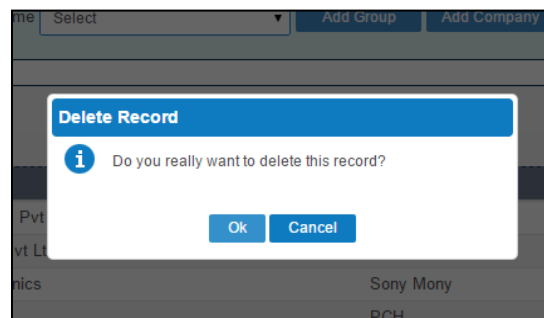


Fig. 23: Deleting an existing record

The above pop-up is displayed on clicking ‘Delete’ against a record following which the record is deleted.

3. Editing Operations on Map

Following are the tools to perform various activities on the map:

	To display the navigation panel at top left of the application
	Zoom to Coordinates: Specify Lat, Lon to Zoom to
	To add a store on map
	To edit the attributes of a selected store
	To move a selected store
	To delete a selected store
	To select a store in order to edit, move or delete
	To clear all definitions and graphics on the map

Table 2: Tools in the application to perform various operations

The authorized user in order to add a store on the map can click anywhere on the map where he/she wants to add a store and enters the details (attributes) of that store. He/she can select and fill in the attributes as desired/ needed. The user can select which chain he/she wants to add from a selection that comes from the master table from the database. (Ref. Fig. 24)

Once a store is successfully added, user is notified about successful addition. One can now click on it to view its information. The added store is also saved and reflected in the database and the corresponding feature class. (Ref. Fig. 25)

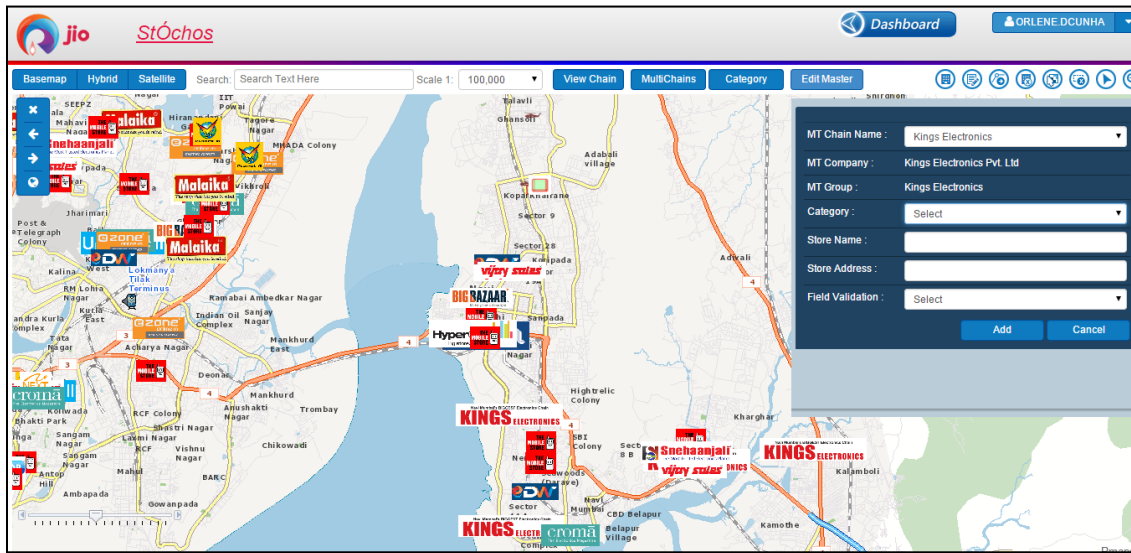


Fig. 24: Adding a store on map- 1

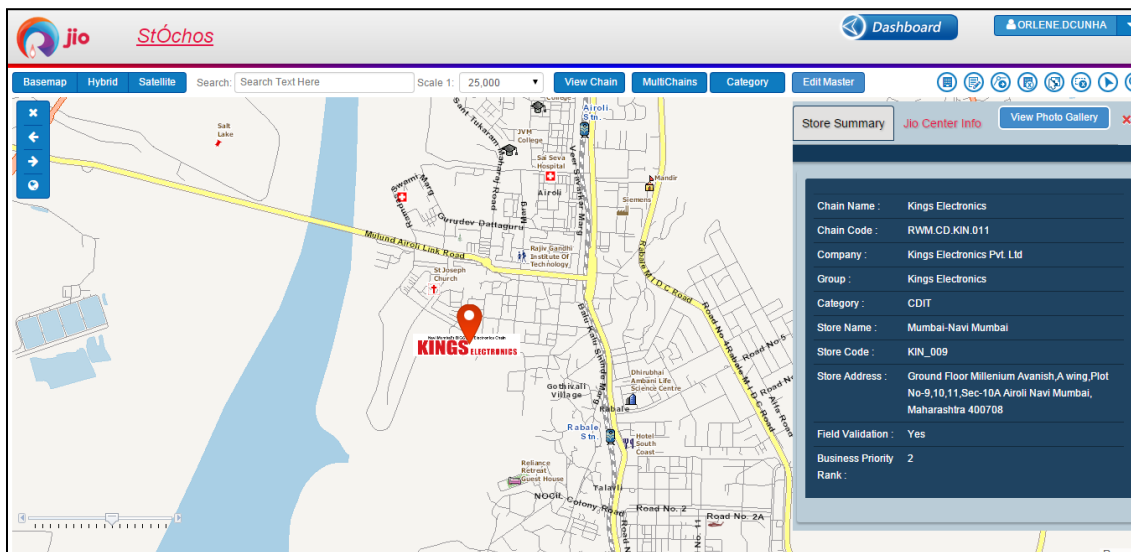
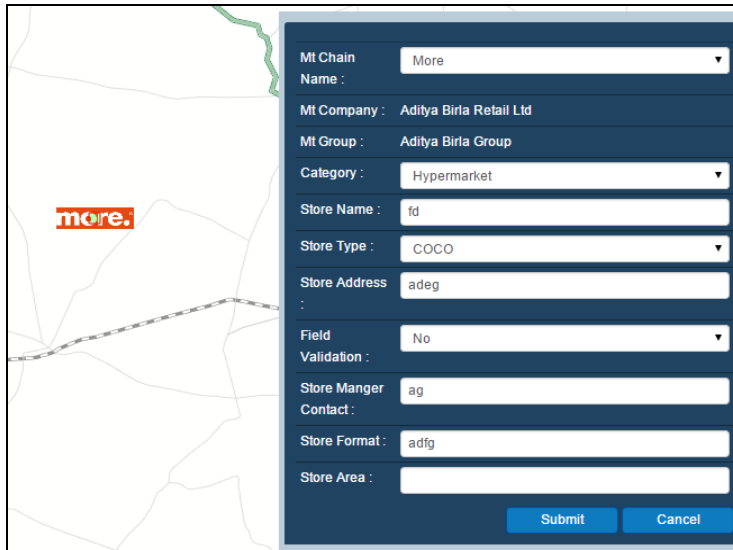


Fig. 25: Adding a store on map- 2



The user is also provided with an option to edit the attributes of an existing store. He/ she needs to select a particular store to edit its attributes.

Fig. 26: Editing attributes of a store

An already existing store on the map can be moved or deleted by the user as required. As in the case of editing attributes, the user needs to select a store first so that he/ she can move or delete it.

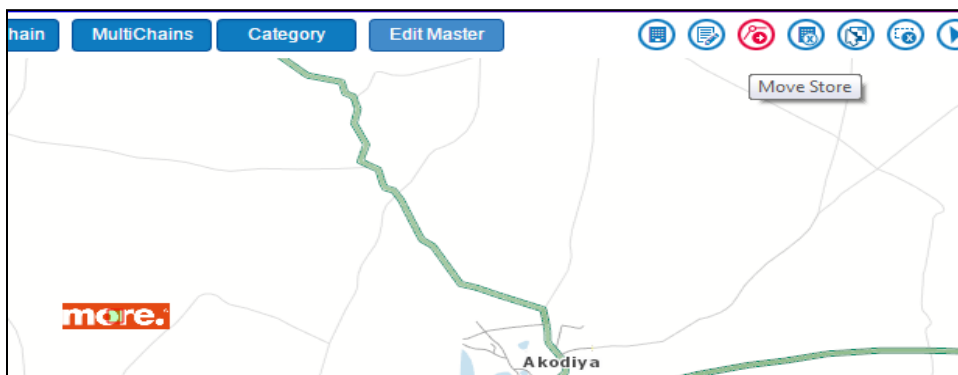


Fig. 27: Moving a store

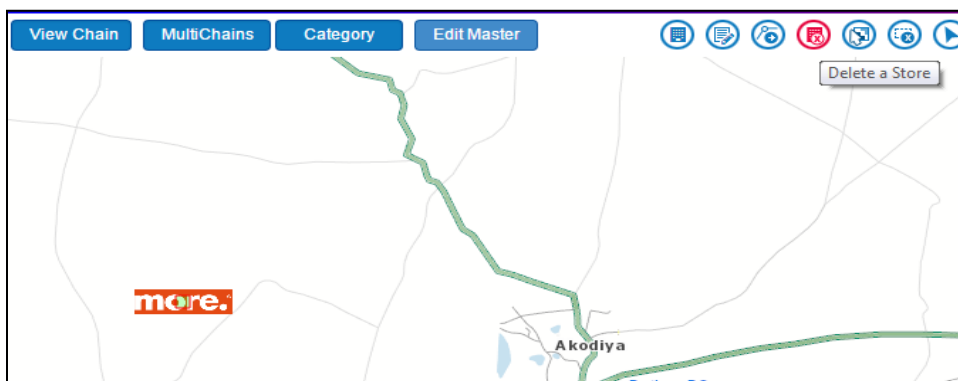
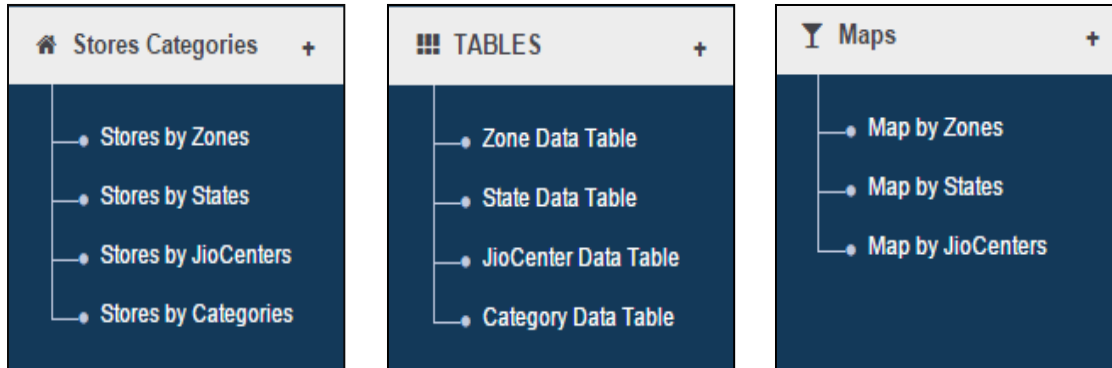


Fig. 28: Deleting a store

4. Dashboard

Once the user has carried out his / her operations on the map i.e. edits, addition or deletion, the corresponding changes are reflected in the dashboard. Any new store added or any store deleted will be reflected in the dashboard.

The dash board has been categorized into :



Statistics in the form of graphs

Statistics in the form of tables

Data reflected in maps

Stores Categories: View Chain and Store statistics in the form of bar charts, column graphs, and donut graphs. The graphs are user friendly, animated and highly interactive. A user can click on a column in a graph to view complete information or hover to view all information. Shown below are a few out of the many graphs for Zones, States, JCs and Categories.

Tables: View all data with respect to Chains and Stores in the form of Tables. The tables are user friendly and provide sorting, searching and pagination functionalities. Shown below are a few out of the many tables for Zones, States, JCs and Categories.

Maps: View the total store count on maps based on the category selected.

Stores Categories

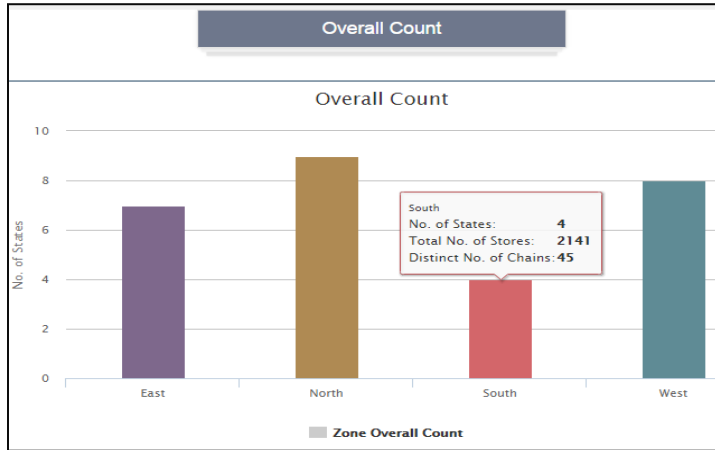


Fig. 29: Overall count- Zonewise

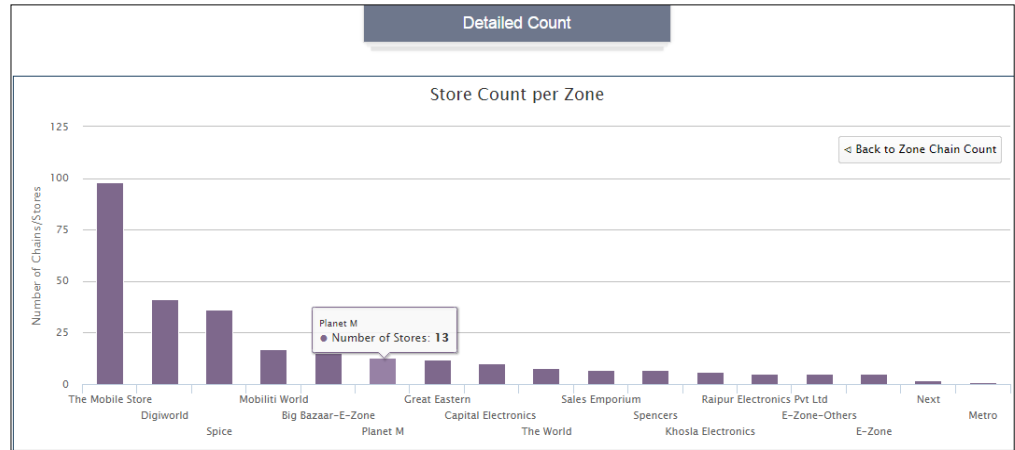


Fig. 30: Detailed count for a selected Zone (In this case for East Zone)

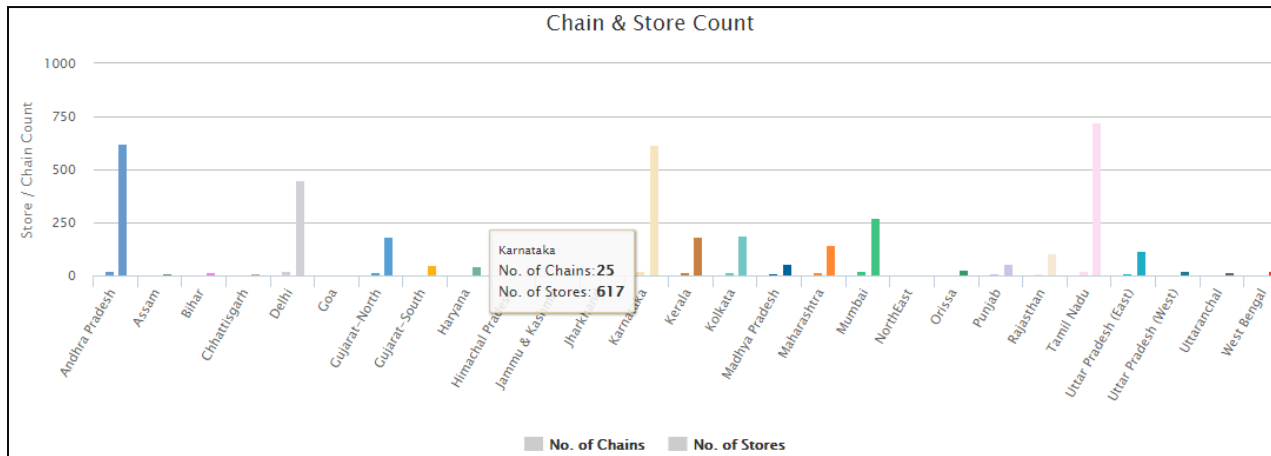


Fig. 31: Overall count- Statewise

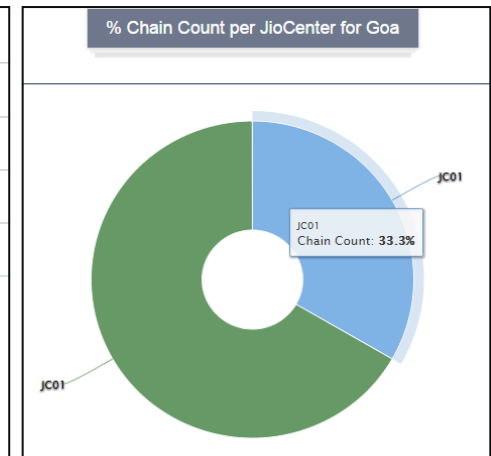


Fig. 32: % Chain Count-1

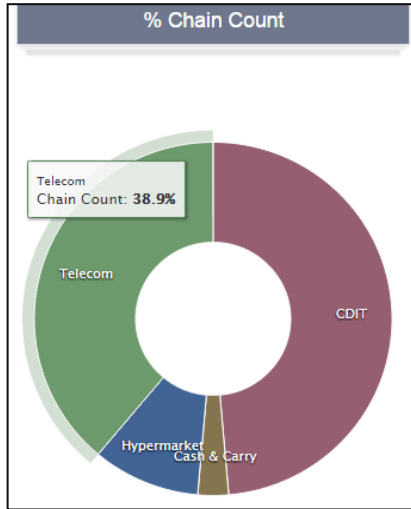


Fig. 33: % Chain Count-2

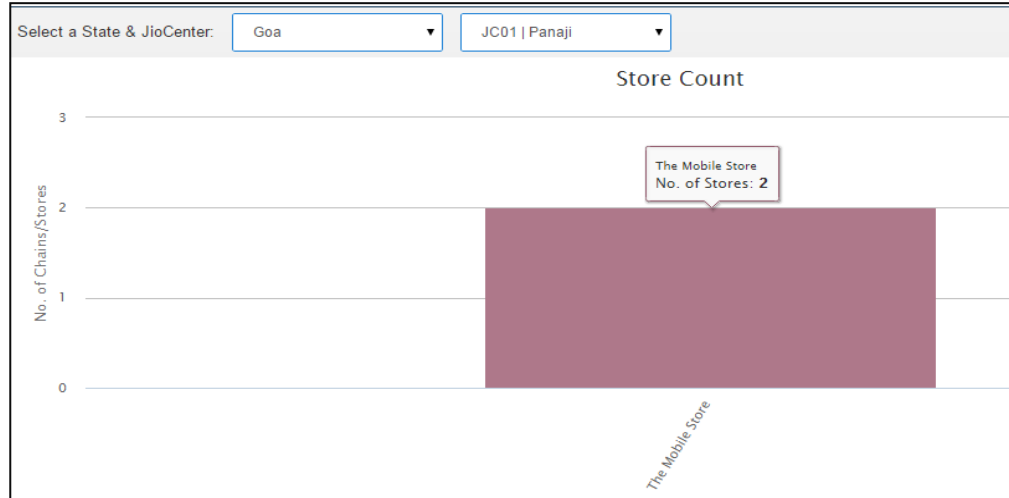


Fig. 34: Detailed Count for Selected State and/or JC

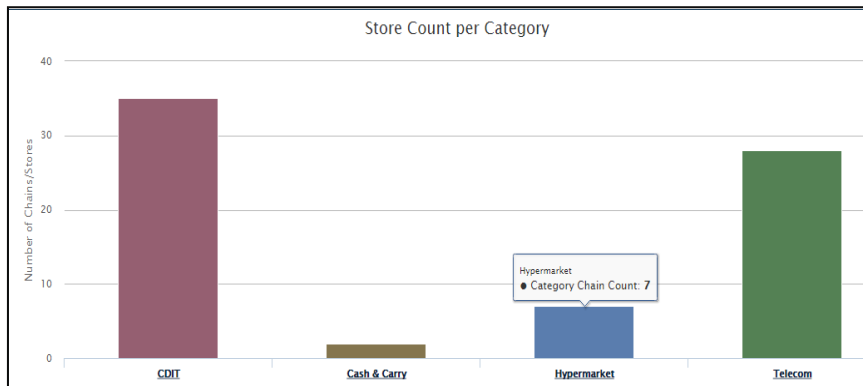


Fig. 35: Overall Count- Category wise

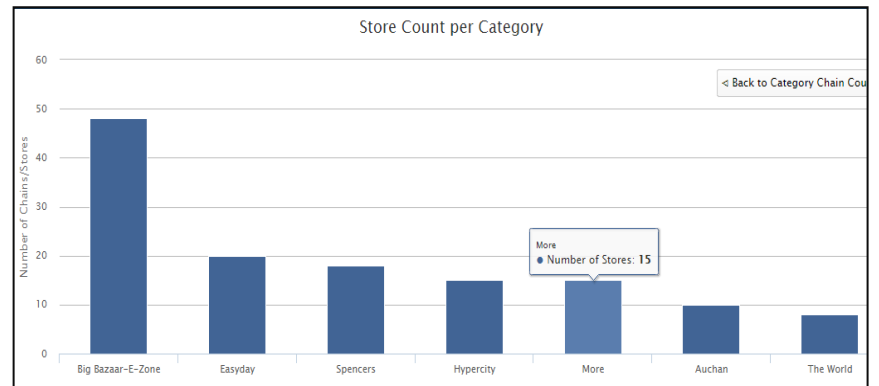


Fig. 36: Detailed Count for selected Category (In this case, Hypermarket)

Tables

Chain Count Per Zone					
10 records per page	Search:				
Chain Name	South	North	East	West	
3G Mobileworld	20	0	0	0	
Adishwar	51	0	0	0	
Alif Mobiles	6	0	0	0	
Apple & Berry	0	0	0	5	
Auchan	8	1	0	1	
Best Price	4	10	0	6	
Bhatia'S The Mobile One Stop Shop	0	0	0	17	
Big Bazaar-E-Zone	13	14	15	6	
Big C	118	0	0	0	
Bismi	8	0	0	0	

Showing 1 to 10 of 72 records

Fig. 37: Chain Count per Zone

Select a State: Select			
10 records per page	Search:		
State Name	No. of JioCenters	No. of JioCenterTypes	JioCenterTypes
Andhra Pradesh	105	1	A
Assam	4	2	A, C
Bihar	7	2	A, C
Chhattisgarh	4	1	C
Delhi	49	2	A, C
Goa	2	1	C
Gujarat-North	43	3	A, B, C
Gujarat-South	13	2	A, C
Haryana	24	2	B, C
Himachal Pradesh	6	1	C

Showing 1 to 10 of 27 records

Fig. 38: JC Count per State

States Per Chain		
10 records per page	Search:	
Chain Name	No. of States	States in Which Present
3G Mobileworld	1	Kerala
Adishwar	2	Andhra Pradesh, Karnataka
Alif Mobiles	1	Kerala
Apple & Berry	1	Gujarat-North
Auchan	5	Andhra Pradesh, Delhi, Karnataka, Maharashtra, Tamil Nadu
Best Price	9	Andhra Pradesh, Chhattisgarh, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Uttar Pradesh (East), Uttar Pradesh (West)
Bhatia'S The Mobile One Stop Shop	1	Gujarat-South
Big Bazaar-E-Zone	13	Andhra Pradesh, Assam, Bihar, Delhi, Jharkhand, Karnataka, Kolkata, Maharashtra, Mumbai, Orissa, Punjab, Tamil Nadu, Uttar Pradesh (East)
Big C	1	Andhra Pradesh
Bismi	1	Kerala

Fig. 39: States per Chain

Select a State: Mumbai	JC07 Mumbai	Back to Overall Count
Chains for JC07 Mumbai		
Chain Name	No. of Stores	
Croma	1	
Kohinoor Electronics	1	
Malaika	1	
The Mobile Store	1	
Univercell	1	
Vijay Sales	1	

Showing 1 to 6 of 6 records

Fig. 40: Chain, Store Count for selected State and/or JC

Chain Count Per Category		
Search: <input type="text"/>		
Category	No. of Chains	Chains
Cash & Carry	2	Best Price, Metro
CDIT	35	Adishwar, Bismi, Capital Electronics, Croma, Digworld, E - Planet, E-Zone, E-Zone-Others, Fridge House, Girias, Great Eastern, Jumbo, Kannankandy, Khosla Electronics, Kings Electronics, Kohinoor Electronics, Lotus, Malaika, Nandilath G Mart, National Electronics, Next, PCH, Pal, QRS, Raipur Electronics Pvt Ltd, Sales Emporium, Sales India, Sargam Electronics, Snehaanjali, Sony Mory, TMC, Value Plus, Vasanth & Co., Vijay Sales, Viveks
Hypermarket	7	Auchan, Big Bazaar-E-Zone, Easyday, Hypercity, More, Spencers, The World
Telecom	28	3G Mobileworld, Alif Mobiles, Apple & Berry, Bhatia'S The Mobile One Stop Shop, Big C, Cell Point, Fone 4, Go Mobile, Jasmin Mobile, King Mobile, Kore Mobile, Lot Mobiles, Memmo, Mobile World, Mobile Xpress, Mobiliti World, My Mobile, Phone Merchant, Planet M, Poorvika, Sangeetha, Sharptronics, Smile Mobile, Spice, The Chennai Mobiles, The Mobile Store, Top 10, Univercell

Fig. 41: Chain Count per Category

Overall Count		
Select to View Category:	<input type="text" value="Select"/> <input type="text" value="Select"/> <input type="text" value="Zone-Wise"/> <input type="text" value="State-Wise"/>	
Category	No. of Chains	No. of Stores
Cash & Carry	2	42
CDIT	35	1352
Hypermarket	7	134
Telecom	28	2446

Fig. 42: Overall Count per Category

Store Count By Category: State-Wise					
Search: <input type="text"/>					
10	records per page				
State	CDIT	Cash & Carry	Hypermarket	Telecom	
+ Andhra Pradesh	88	11	13	508	
± Assam	2	0	1	10	
+ Bihar	10	0	2	6	
+ Chhattisgarh	6	1	2	1	
+ Delhi	103	1	26	320	
+ Goa	3	0	0	3	
+ Gujarat-North	89	0	3	89	
+ Gujarat-South	20	0	0	32	
+ Haryana	38	0	0	8	
+ Himachal Pradesh	6	0	0	0	

Showing 1 to 10 of 27 records

← Previous
1
2
3
Next →

Category	No. of Chains	Chains
CDIT	1	Digworld
Hypermarket	1	Big Bazaar-E-Zone
Telecom	3	Planet M, Spice, The Mobile Store

Close

Fig. 43: Count per Category; Statewise

By clicking on a state, its detailed category count can be displayed.

5. RESULTS

This application will be of great help to understand the growth, distribution and important information and metrics concerning the Modern Trade business for Reliance Jio's products .

The initiative of making such a GIS based application will enable business parties to analyse everything concerning their business.

The Information submitted by the users are stored/ saved and reflected in the database and corresponding feature class. This data can hence be displayed on the map (i.e. any operations done by an authorized user will be reflected on the map). Multiple versioning is taken care of by the server. Whenever there is an update made regarding any outlet, it flows to the server and a new version can be created.

Each sales representative or a JC manager would visit the shop, gather the data and feed them into the enterprise application running on the hand-held device. This information would flow to a server in near real-time and update the central database. Additionally, the latitude and longitude of the outlet would also be recorded and updated. The server would record information from all the sale representatives, JC managers and collate that information into a single master list.

This process thus eliminate the issues present in the as-is process of retail mapping and makes retail mapping enterprise friendly, automated and systematic.

The application highlights critical areas in India where highest number of stores and lowest number of stores i.e. outlets for Reliance Jio's products exist. The mapped outputs can be used for future decision making processes, analysis and further planning by the retail analysts.

This retail GIS project provides an understanding of the concentration, location and various statistics of the retail outlets of the company.

Mapping Location of Retail Outlets provided by this application help:

- Measure performance of each region
- Identify underperforming sales territories
- Adjust resource allocation
- Outline high-potential zones to explore new services
- Improve visits by sales representatives
- Redefine territory assignment
- Improve sales coverage
- Gain better insight into sales effectiveness and performance by territory

In Comparison to the existing process, the application developed is a better solution for retail mapping.

Issue with existing solution	Advantage over the issue with the developed application (Resolution)
Manual entry leading to errors; Noise in data	The activities of manually generating the stores list and data by sales representatives and also manually collating the list by a backend person are eliminated in this application. Noise, such as incorrect data entry, incorrect outlet names and categories, is not present.
Re-work	Whenever there is an update made regarding any outlet, it flows to the server and database directly. No manual updating or modification of any kind of data needs to be done.
Quality	The quality of data and the process is improved. No noise and redundancy in the data as everything is linked to the database. All relevant and real time data, metrics and statistics are reflected in the dashboard.
Time and Expenditure	Money, Time and resources are reduced as the application allows for an automated process with all the relevant information as required.

Table 3: Results against the existing process

The telecom industry has a highly dynamic sales setup with multiple changes happening on a daily basis. It is feasible for a sales representative (sales manager) or a JC manager to track and pursue all these changes in a timely and effective manner. Location intelligence solutions which are the outcome of an application as the one discussed in this paper help him to proactively deal with issues in his territory and optimize his travel to increase operational efficiency.

6. DISCUSSION

6.1 Discussions

The developed application can prove to be of great use with many advantages.

Better Strategy Formulation

Since sales are all about handling the geographical territory, it makes great sense to map the parameters (Ref. Figure 47). This can give vital inputs in formulating an efficacious strategy.

Better targeting of low performance areas

The zonal manager often deals with a large area with many sales representatives reporting to him. It is not feasible for him to cover the entire territory during his visits. He needs to identify the areas which require his attention and target them during his visit.

Hypothetical Scenario: Consider a hypothetical map showing the Spice Chain outlets (Ref. Fig. 48), indicating that they have not made the expected sales or progress. The zonal manager / JC manager can visit these outlets and areas to understand the causes and take corrective action.

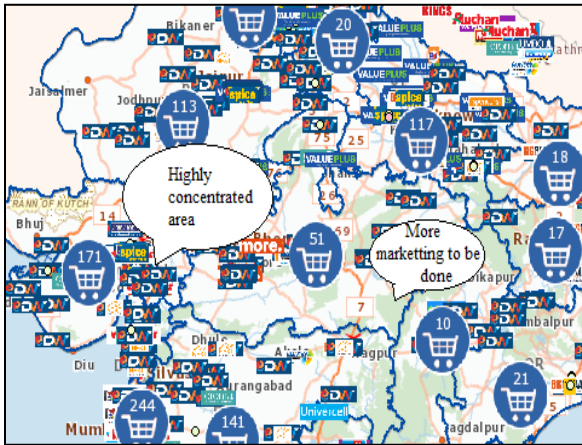


Figure 47: Detecting the high potential sales areas

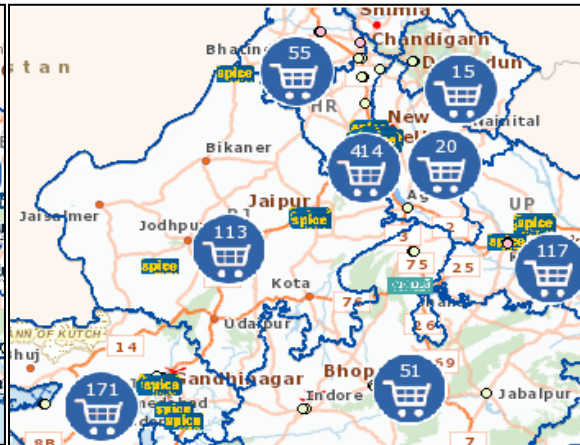


Figure 48: Detecting under-performing areas – example

6.2 Challenges faced

1. One of the major challenges faced was to display the count- total number of stores per Zone, State, JC on the map.
It was finally achieved by using Oracle Aggregate Functions and creating a view of the result.
2. For creating the dashboard, there was a need for finding suitable graphs and tables to display store information. After much effort, it was finally decided that Highcharts API and bootstrap datatable API be used. There were difficulties in customizing the charts and tables in a manner that were required by the users since these APIs come with their own functionalities. However, over time, this too was achievable.
3. Integrating gallery option in the application is another challenge to be dealt with. As of now, only retrieving gallery i.e. store images from the database has been worked upon. Providing users with the option to upload store images in a compressed format and save them against a particular store code is a challenge and still needs to be worked upon.

7. CONCLUSION

7.1 Conclusion

The use of information technology for mapping retail outlets not only eliminates the disadvantages of the current process, but it also leads to various additional benefits that impact an organization at the strategic level and make a huge impact on its revenue and profits. Accurate mapping of retail outlets is a critical asset for any organization. Even after the launch, the information from retail mapping (mapping of the retail stores / outlets) contributes significantly to strategic decision making.

Retail mapping can be considered as part of an overall marketing strategy which helps increase operational efficiency. Real-time sales updates help the sales representative to take immediate action when near the geographical point of sale. These real-time updates help to increase channel satisfaction and revenues.

Usage of information and location technology like the application developed reveals the following conclusions:

1. The activities of manually generating the electronic form of the list by sales representatives and also manually collating the list by a backend person are eliminated. Hence noise, such as incorrect data entry, incorrect outlet names and categories, is not present.
2. Multiple versioning can be taken care of by the server. Whenever there is an update made regarding any outlet, it flows to the server and a new version can be created. The versions can also be tracked and controlled by the server.
3. The sales force can concentrate on other priority activities like channel management and feedback from market.
4. Wasteful expenditure in creating incorrect branding elements is eliminated.
5. The real-time capture and update of store performance data can help to effectively tune the sales and marketing strategy.

The aforementioned discussion is part of a greater concept called location intelligence that provides the ability to organize and understand information through a geographical perspective to facilitate informed decision making. This helps organizations align better with the realities of their market territories, and thus improves performance and results.

7.2 Future Process:

- The application shall be released/ deployed on the internet in the near future given that it is an intranet web portal as of now.
- The application will be transferred to a hand help device enabled with GPS so that the same functionalities can be carried out by accessing the location of the user.
- In every store there shall be a Sales Representative who shall be able to update/ deactivate/activate/ add the store and store information.
- Allowing authorized users to upload in-store photographs and to be included.
- The application shall receive data for stocks and sales from SAP system to display. Also, the application shall allow the nominated user to feed the sales and stocks data to SAP system.
- User will be able to upload photographs of the stores and products in it and also be able to see/ view the existing ones.
- Warehouse data of corresponding stores to be incorporated in the application.
- Allowing upload of data in excel format that will be added to the database and application.

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