ROAD NAVIGATION APPLICATION
OF DELHI CITY

By

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Table of Contents

Acknowledgments ......................................................................................... 2
Table of Contents .......................................................................................... 3
List of Tables and Figures ............................................................................. 4
Abstract .......................................................................................................... 5

Chapter-1. Introduction ................................................................................... 6
  1.1. Introduction .......................................................................................... 6
  1.2. Objective ............................................................................................. 8
  1.3. Study Area .......................................................................................... 9

Chapter-2. Methodology .................................................................................. 10
  2.1. Data ..................................................................................................... 10
  2.2. Software ............................................................................................... 10
  2.3. Workflow ............................................................................................. 11
  2.4. SWOT Analysis .................................................................................. 14
  2.5. Logical frame work ............................................................................ 15

Chapter-3. Processes and Results .................................................................. 16
  3.1 Process .................................................................................................. 16
  3.2 Project Budget ....................................................................................... 17
  3.3 Project Timeline ..................................................................................... 18
  3.4 Resources list ....................................................................................... 19
  3.5 Resources Plan ..................................................................................... 20

Chapter-4. Conclusions .................................................................................. 22
References .................................................................................................... 23
List of Tables

Table 1.1 Project Budget Sheet ........................................ 16
Table 3.1 Resources Plan table ........................................ 19

List of Figures

Figure 1.1 Study Area .................................................. 9
Figure 1.2 Process Flow Diagram ..................................... 11
Figure 2.1 SWOT Analysis .............................................. 14
Figure 2.2. Logical Framework ........................................ 15
Figure 3.1 Gantt chart .................................................. 17
Figure 3.2. Milestone chart ............................................ 18
Figure 3.3. Network Flow ............................................. 18
Figure 3.4. Resources List ............................................. 19
Abstract:

Roads are main arteries of modern society’s infrastructure, contributing heavily to the distribution of goods and persons. GIS provides many helpful applications for ensuring a smooth flow, by aiding design, routing, traffic control and real-time navigation. Road navigation systems has become a life and time saving option to all, who drive their way to unfamiliar destinations. With the availability of extra features at a few extra costs, the drives are ensured to be smooth and hassle free. In this project plan, I would like to discuss the design of road navigation application and I will explain the process flow of it. I would like to discuss some analysis tool which plays a major role in the design of the project.
Introduction:

1.1 Introduction

Delhi is the capital city of India and one of the fast growing cities too. Most of people choose this city for their likelihood due to business, jobs, etc. The Delhi road network is well developed and plays a crucial role in connecting Delhi with the neighbouring states. In fact the Delhi road network is vast, well planned and provides helpful services to tourists as well as Indians. However, the road network has been changed drastically in the last couple of years. Hence it’s very difficult for common people and travellers to reach their destination.

Navigator software will provide the solution for above issues. It helps for route guide (travel from one place to another place), tourism locations and routes, major important places (POI) information, travel guidelines details (like speed limit details, Traffic signal information, road lane information, road restrictions, road name …) and best possible routes to reach the destination in time.

Planning and design:

GIS provides a valuable tool in the process of planning and designing roads. This is closely related to the term Computer Aided Design (CAD), but it is hard to tell at what level of detail CAD stops and where GIS actually begins. Modern software (e.g. Bentley’s Microstation) tends to bridge this gap between discipline-specific applications and GIS in a way that they are fully integrated.

A GIS can help visualise and communicate the effects of roads on their environment. Presenting the road by displaying a 3D drive-through along a highway or a bird’s eye view of the landscape from any angle the user wants to hover.
Routing:
Route planning is one of the most popular applications within transportation, for obvious reasons. Roads are part of the infrastructure that makes up the spinal cord of modern society, but roads can just as easily turn into bottlenecks. Consequently, any business deploying vehicles is interested in determining which route is the best to follow as means to save time and essentially gain the best cost/benefit ratio. This can be used to distribute goods, deliver pizza, respond to emergency calls, or to plan your personal travel.

Navigation:
Route planning in advance of a journey is one way to enhance transportation management. Using an in-car navigation system is another one, and has been on the market for some time. It gives the information about the traffic restrictions, road information and POI’s information which helps the user to travel in a right path and fulfil all the needs of the users.

Real Time Vehicle Tracking:
Tracking and monitoring of vehicle movements emerged with the advances in mobile communication (GSM) and satellite navigation (GPS). The position of a vehicle is monitored via on-board GPS, transmitted back to a base via GSM, and loaded into a GIS where it can be displayed on map.

Traffic Control:
GIS helps to control the traffic flow in multiple ways. We can monitor the real time traffic flow by using the GIS. This information can be visualized by using navigators also. Traffic information (traffic lights, pedestrians crossing, RDM’s… can be known before itself from the navigators. So that the user will be more cautions in those locations.
1.2 Background:

About Delhi Road Network:

The Delhi road network is well developed and plays a crucial role in connecting Delhi with the neighbouring states. In fact the Delhi road network is vast, well planned and provides helpful services to tourists as well as Indians.

Different agencies are employed to maintain the quality of Delhi road network. In Delhi there are 6 such agencies- DDA, NHAI, MCD, PWD, NDMC and Delhi Containment Boards.

The important national highways connecting Delhi and Haryana are NH 1, NH 8, NH 2 and NH10. These highways of Delhi are well kept and there is chain of motels along the roads.

In 1996, the entire length of Delhi road network was 25,949 km. By 2001 the entire length of Delhi road network was 28,508 km.

In 2006, the entire length of Delhi road network was 31,183 km and it is due to the efforts of the government that it is in good condition. Now for 2011, the entire length of Delhi road network was ~34,000 km.
1.3 Objective:

1. Design Road Navigation Application for the entire Delhi city.

2. Application helps customers to fulfil their needs like

   ➢ Travel from one place to another place.

   ➢ Real time vehicle tracking is possible if your software is accessing through GPS.

   ➢ Identify the fastest path/shortest path to reach the destination

   ➢ Restrictions will be updated

   ➢ Tracking POI information as per their needs
1.4 Area of Focus:

India has a road network of over 4,320,000 kilometers (2,680,000 mi) in 2011, the second largest road network in the world. At 0.66 km of roads per square kilometer of land, the quantitative density of India’s road network is similar to that of the United States (0.65) and far higher than that of China (0.16) or Brazil (0.20). However, qualitatively India’s roads are a mix of modern highways and narrow, unpaved roads, and are undergoing drastic improvement.

![Map of India showing road network](image.png)

**Figure 1.1: Study Area**

Study area covers entire Delhi city as phase-1 works, which covers ~34,000 k.ms (Excluding NCR region) of road network in Indian road network. The road network of this city has been changed drastically in the last couple of years. It’s very difficult for common people and travellers to reach their destination. Hence we have initiated our phase-1 works for entire Delhi City. However, we are working on National highways and state highways for complete India to provide the connectivity for Delhi to entire India.
2. Methodology:

2.1 Data:

1. **Road Maps**: Existing Delhi road network data and road network maps: It is used as a reference data for road network.

2. **Satellite images**: High resolution data (Cartosat-2) is used to digitize the road network and adjust the existing road network within the road bed. (Centreline digitization is not mandatory for street roads and village roads)

3. **Non Spatial Data**: Attribute information will be collected by ground level survey. POI information and all other non-spatial information will be collected with GPS.

4. **GPS**: GPS is fixed in the vehicle with navigation application the location of the user.

2.2 Softwares:

1. GPS instruments are used for gathering Non-spatial Data and GPS instrument is used to locate the position of the user.

2. GIS software like Arc Map is used for Pre-processing activity and Microstation software is used for digitization of road network and attributes coding.

3. Application softwares are used for application integration

4. Manual and automation Testing tools will be used for testing the software

5. Openproj software is used for complete planning and managing of project
2.3 Methodology:

The entire project is divided into 4 phases. Each phase will be considered as milestone.

Figure 2: Process Flow Diagram
**Gathering Requirements:**

In this phase we will collect all the required inputs for the projects. Requirements are mentioned below:

1. **Existing Delhi road network data and road network maps:** It is used as a reference data for road network.
2. **Satellite images:** To digitize the road network (Cartosat-2) and adjust the existing road network within the road bed. (Centreline digitization is not mandatory for street roads and village roads)
3. **Attribute information will be collected by ground level survey. POI information and all other non-spatial information will be collected with GPS.**
4. **GPS:** GPS is fixed in the vehicle with navigation application the location of the user.

**Data Conversion:**

This phase deals with the pre-processing activity, digitization and attribute coding. Post completion of these activities quality control team and quality assurance team will perform the random checks of the data to ensure a quality product.

**Pre-processing:**

1. Convert the existing road network data into shape files and use these road shape files as reference data for new road network.
2. Non-spatial data which was collected from the field survey using GPS devices will be pre-processed and the data will be stored in the server. This data will converted into the attribute format and stored in the database which will be further useful at the time of data conversion task.
Data Conversion:

- Digitization of road network by using the spatial data
- Perform attribute attachment task.
- Perform data merging before saving the complete data into the geodatabase
- Save the data in geodatabase server.

Application Integration:

- Integrate the final data into navigator software.
- End user will fix the Navigator software to his vehicle and access.

Consumers will use this software in so many ways. Few of them are mentioned below;

- Travel from one place to other place.
- Real time vehicle tracking is possible if your software is accessing through GPS.
- Identify the fastest path/shortest path to reach the destination
- Restrictions will be updated
- Tracking POI information as per there needs
2.4 SWOT Analysis:

In general SWOT analysis will be performed to analyse the project strengths, weakness, opportunities and strengths. Based on the results one will come to conclusion whether project need to be executed or not. Sometimes companies will perform this analysis on the currently running projects to improve its performance by identifying its weakness and threats.

SWOT analysis for this project is mentioned below,
2.5 Logical Framework:

The logical framework gives common understanding about the complete project. The logical framework remain useful during the life of the project, it should remain a valid summary description of the overall project. One will get clear picture about the project by viewing it.

Logical Framework for my project is mentioned below,

<table>
<thead>
<tr>
<th>Activities</th>
<th>Objective verifiable indicators of achievement</th>
<th>Sources and means of verification</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over all objective</td>
<td>Developing a road navigation application which is user friendly and satisfy the needs of the users</td>
<td>The Road Navigation application will be ready by 31st Dec’ 2013.</td>
<td>Developed application and maintained in a stand alone database. Data will be accessed from the database by using FTP servers.</td>
</tr>
<tr>
<td>Specific objectives</td>
<td>1) Design and creation of geodatabase for storage and access the information.</td>
<td>1) Geodatabase will be ready by 30th Nov’ 2012.</td>
<td>1) Licence is required to start the project and to perform survey in entire delhi.</td>
</tr>
<tr>
<td></td>
<td>2) To generate a base map</td>
<td>2) Base map will be ready by</td>
<td>2) Defined project standards and guidelines are not changed.</td>
</tr>
<tr>
<td></td>
<td>3) Application design and integration</td>
<td></td>
<td>3) No climatic obstructions due to the period of survey.</td>
</tr>
<tr>
<td>Expected results</td>
<td>1) Navigation</td>
<td>Testing after the data integration into the road navigation application by the testing team. This task will be completed by 30th Jan’ 2013.</td>
<td>1) No server compliances and system issues which results in data loss.</td>
</tr>
<tr>
<td></td>
<td>2) Routing</td>
<td></td>
<td>2) Complete knowledge about the applications.</td>
</tr>
<tr>
<td></td>
<td>3) Real time vehicle tracking</td>
<td></td>
<td>3) Sufficient permissions required to the database.</td>
</tr>
<tr>
<td></td>
<td>4) Traffic control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Creation of Geodatabase</td>
<td>1.1 Database Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 Database Creation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) Collection of Spatial data (Existing road maps and satellite images)</td>
<td>1Person/one month - 25000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Collection of Non-spatial data (Field survey using GPS device)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) Survey data collection</td>
<td>1) 1Person/one day - 1500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2) Field Survey Persons- 1 1/2 Month - 45 persons - 4.05,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Domain Expert - 1 1/2 Month - 1 Person - 25,500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Supervisors - 1 1/2 Month - 3 Persons - 40,500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5) Manager - 1 1/2 Month - 1 Person - 42,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 Quality control</td>
<td>1) 1Person/one day - 1500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4 Quality Assurance</td>
<td>2) Field Survey Persons- 1 1/2 Month - 45 persons - 4.05,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Domain Expert - 1 1/2 Month - 1 Person - 25,500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Supervisors - 1 1/2 Month - 3 Persons - 40,500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5) Manager - 1 1/2 Month - 1 Person - 42,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4) Road Navigation Application</td>
<td>1) Manager - 1 Month - 0.5 Person - 20,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2) Project Lead - 1Month - 2 Persons - 40,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Subject Matter Expert (SME) - 2Month - 2 Persons - 60,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Sr. GIS Engineers - 2 Month - 10 Persons - 2,00,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5) GIS Engineers - 2 Months - 25 Persons - 4,00,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6) Project Trainer - 2 Months - 1 Person - 30,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2 Testing</td>
<td>1) 1Person/one day - 1500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2) Field Survey Persons- 1 1/2 Month - 45 persons - 4.05,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3) Domain Expert - 1 1/2 Month - 1 Person - 25,500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4) Supervisors - 1 1/2 Month - 3 Persons - 40,500/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5) Manager - 1 1/2 Month - 1 Person - 42,000/-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6) Project Trainer - 2 Months - 1 Person - 30,000/-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Field survey will be performed in the suitable climatic conditions and period

Figure 2.2: Logical Framework
3. Process and Results:

3.1 Project Budget:

This sheet brings you the complete information about the project such as how many months the project is, what are the different tasks which are need to be performed and mainly budget of the each task and also provides the complete budget of this project.

Table 1.1: Project Budget Sheet
3.2 Project Timelines:

The below Gantt chart figure will provide the information about the complete details about the tasks in the project, timelines and duration of the projects. The project is planned to complete it by 31st Jan’ 2013.

Below is the schedule of the project,

![Gantt chart](image)

**Figure 3.1: Gantt chart**
3.3 Milestones:

Milestones are the crucial tasks of the project. Achieving the milestones in time leads the project in success path. Below table shows the milestones of the project.

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Nov-12</th>
<th>Dec-12</th>
<th>Jan-13</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-11-12 to 30-11-12</td>
<td>1-12-12 to 31-12-12</td>
<td>1-01-13 to 31-01-13</td>
</tr>
<tr>
<td>Data Integration</td>
<td>Week 1</td>
<td>W1</td>
<td>W2 W3 W4 W5</td>
</tr>
<tr>
<td>Collecting Spatial and Non Spatial data</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>DataBase Design and creation</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Pre processing Activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digitisation/Attribute coding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality Control (QC)</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Quality Assurance (QA)</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Tool Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application Designing of Navigator device</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Data Integration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing and Application launch</td>
<td></td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

**Important Note:**
1,2,3…are project milestones

Note:
1) Project start date is 01 November 2012 and end data is 31 January 2013
2) In the milestone sheet, the first week of November is considered as W1
3) Please refer the project Gantt chart for detail time schedule of each task

Figure 3.2: Milestone chart

Figure 3.3: Network Flow
3.4 Resources List:

Resources are key persons for any project. A total resource of this project is 90, in that 50 resources are planned for field survey task and 40 resources are aligned for data conversion task.

<table>
<thead>
<tr>
<th>Resource Planning for Data Conversion task</th>
<th>Resource Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production level GIS engineer</td>
<td>25</td>
</tr>
<tr>
<td>Quality control</td>
<td>10</td>
</tr>
<tr>
<td>Quality Assurance team</td>
<td>2</td>
</tr>
<tr>
<td>Team Leader</td>
<td>1</td>
</tr>
<tr>
<td>Manager</td>
<td>1</td>
</tr>
<tr>
<td>Database Designer</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total No of Resources</strong></td>
<td><strong>40</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource Planning for Field Survey task</th>
<th>Resource Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Level surviers</td>
<td>45</td>
</tr>
<tr>
<td>Supervisors (each supervisor handles 3 teams)</td>
<td>3</td>
</tr>
<tr>
<td>Domain specialist (Technical Support)</td>
<td>1</td>
</tr>
<tr>
<td>Manager</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total No of Survey Team</strong></td>
<td><strong>50</strong></td>
</tr>
</tbody>
</table>

![Figure 3.4: Resources List](image-url)
3.5 Resources Plan:

- **Field Survey Task:**
  In this stage, Field survey team will work on the collection of Non-spatial data like POI information, speed information, lane information, restrictions… using GPS device. This Non-spatial information was tagged to the road map data which makes the map more informative.

- **Pre-processing Task:**
  In this stage, pre-processing team will convert the existing road network data into shape files and use these road shape files as reference data for new road network and also download the GPS data (Non spatial data) into the server and convert it into Non spatial data which can be easily accessed and attached at the time of data conversion process. And also the entire is planned and divided into different individual parts which make easier for execution the data conversion process.

- **Digitization and Attribute attaching task:**
  In this stage, GIS engineer team will digitize the base maps by using the sources (spatial and non- spatial data) and attached the non-spatial information to those maps. Once non spatial data is attached, then it is a complete base map. This data will be processed to quality control team post attachment of non-spatial data.

- **Quality control:**
  In this stage, Sr. GIS Engineer team will perform quality checks on the completed data which was received from the GIS Engineer team. This task is very important task as it is the crucial stage to obtain a quality output data. Post validations, data merging will be done which makes the divided parts into single frame of work.
➢ **Quality Assurance:**

In this stage, Subject matter expert team will perform final checks randomly on the complied data to check the quality of the data. Post validation the data will be saved in the geodatabase. This data will be integrated into the road navigator application from the standalone server.

➢ **Domain Experts:**

These people will provide the technical support for the project. Specially in the field survey these people will resolve the technical issues which comes out while field survey
Conclusion:

1) The results shows that the road navigation application helps customers to reach there unfamiliar destinations with in short span of time and it’s a user friendly application which is compatible with different applications like Standalone navigator device, android applications etc. With the availability of extra features at a few extra costs, the drives are ensured to be smooth and hassle free.

2) We have performed SWOT analysis to identify the strengths, weakness, threats and opportunities of the project. The results shows the weakness and threats of the project which need to be resolved by using the strengths and opportunities of the project. However, this kind of analysis will be useful effectively in the currently running projects to improve the project performance through identifying the weakness and threats and resolve it.

3) Logical framework analysis gives the valid summary of my overall project. By viewing this one will get clear picture about the project. However, it will not give the comprehensive explanation comprising all technical details.

4) Openproj software helps to design project plan of my overall project for monitoring the project. Scheduling the project planning, resource planning, time schedule and budgeting are the effective tools in the Openproj software.

   This software is not so effective tool for big project plans as we cannot perform few operations like updating information is more difficult when compare with other softwares like Microsoft project. Defining the parallel running tasks in Openproj is not possible and in Openproj, we have to create resources in the resources sheet.
References:

http://en.wikipedia.org/wiki/Automotive_navigation_system/