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GIS with Shortest Path Finder

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Abstract

The GIS system is not commercially popular in Maharashtra. In this project, we propose to develop "GIS system with Shortest Path Finding software" after performing in- depth study on Road network of Maharashtra. This system will allow the user to locate the nearest landmarks, and can be used in, courier companies and also by Traveling agencies.

Keywords: courier, GIS, commercially, agencies

Scope of the paper: -

- The Shortest Path Finding software using GIS has been implemented for applications such as locating entities like Hotel, Hospital, Tourist Place etc. present in the real world on the map.
- Traveling agencies also can use this software to get the traveling related information such as distance, tourist places etc.
- This is completely web based application, clients get update of information easily, and it serves for multiple clients.

Literature Survey

A] Artificial Intelligence:-

It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.

Dijakstra Algo. is search based algorithm. Dijakstra Algo. Finds all the Shortest Path considering the only Source.

B] GIS (Geographical Information System)

A typical GIS can be understood by the help of various definitions given below:-

- A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on Earth
- Burrough in 1986 defined GIS as, "Set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes"
- Arnoff in 1989 defines GIS as, "a computer based system that provides four sets of capabilities to handle geo-referenced data :
    - data input
    - data management (data storage and retrieval)
    - manipulation and analysis

- data output.

C] Client – Server Architectures

The two –tier architecture is called as client – server architecture. One advantage of this architecture is that the database can be shared. In this architecture the user interface on the client machine, whereas the data is stored on server.

The core of the network application consists of a pair of program, a client program and a server program. A server program is one which provides some service to other (client) programs. The connection between client and server is normally by means of message passing, often over a network, and uses some protocol to encode the client's request and the server's responses. The server may run continuously waiting for requests. A client is a computer system or process that avails a service provided by a server using some protocol. When these programs are executed, a client and a server process are created, and these two processes communicate with each other by reading from and writing to sockets. When a creating a network application, the developer's main task is to write the code for both the client and server programs. Here is a simple diagram to show how a client retrieves a information from the server and display the it in the window.

D] Web Service :

Web services are web component that can be called by other application to perform a particular function and return a data. An XML Web service is a programmable entity that provides a particular element of functionality, such as application logic, and is accessible to any number of potentially disparate systems using ubiquitous Internet standards, such as XML and HTTP. XML Web services depend heavily upon the broad acceptance of XML and other Internet standards to create an infrastructure that supports application interoperability at a level that solves many of the problems that previously hindered such attempts.

An XML Web service can be used internally by a single application or exposed externally over the Internet for use by any number of applications. Because it is accessible through a standard interface, an XML Web service allows heterogeneous systems to work together as a single web of computation.

Theoretical Analysis of Topics and allied subject

1) Basic Database Requirements

(1) Incorporate (import) data from outside sources.

(2) Easily update and alter data.

The database management system (Microsoft SQL Server 2000) software that is a part of a GIS provides these capabilities.

2) Importing and Expanding the Database

Data imported into a GIS often comes in the form of standard ASCII (American Standard Code for Information Interchange) files. ASCII is a standardized code that can be read by nearly all computer systems. A GIS may also be capable of importing data files that are in other formats.

3) Updating Attributes

Another common task is updating or editing the database. Since no user can foresee all future data needs and applications, a GIS must provide ways to easily modify, refine, or correct the database. Attribute data are seldom static. Therefore, maintaining the currency of the data depends on updating capability.

4) Query the Database

Manipulating the database to answer specific data-related questions is accomplished through a process known as database analysis. Map output is the result of a database analysis query.

To query the database, logical expressions that impose limits or conditions on the database search are defined.

These logical expressions specify which geographical objects are to be included in the analysis and/or how that data is to be analyzed. A subset of the database is produced. Some logical expressions are simple and require only one condition while others are very complex and contain multiple conditions.

Graph Theory:

A graph is a set of vertices, connected by edges. In directed graph, each edge has a direction (represented by an arrow).In a weighted graph, each edge is assigned a weight. The weight can be assimilated to the distance between 2 vertices. Structures that can be represented as graphs are ubiquitous, and many problems of practical interest can be formulated as questions about certain graphs. One of the best example is a railway network:

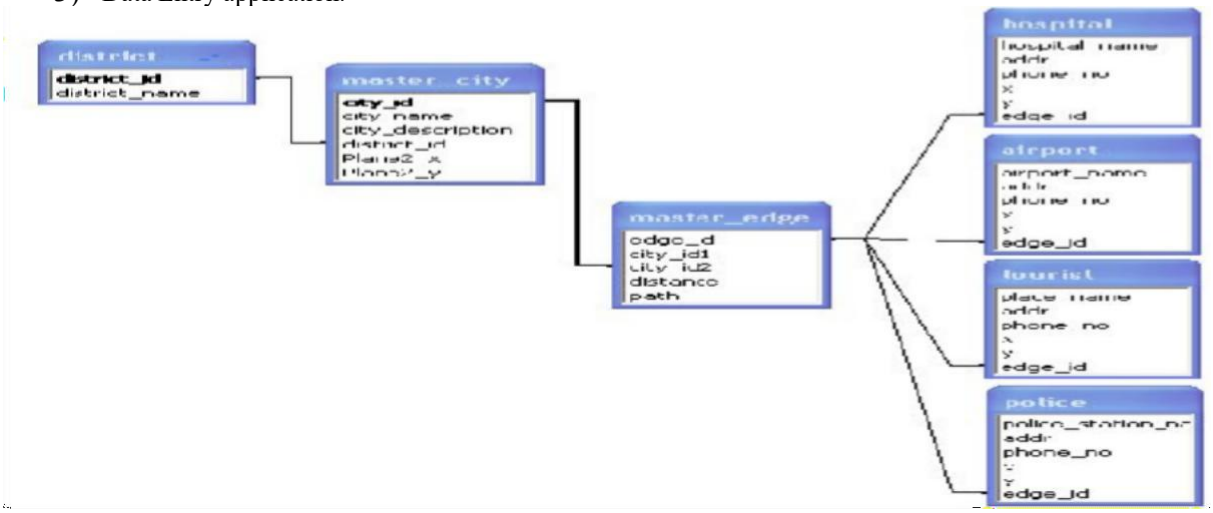
- Each train station is a vertex
- The railways between 2 stations are an edge
- The distance between 2 train stations is equivalent to the weight Typical problems which can be solved with graphs :
    - Shortest path problem
    - Route inspection problem (aka "Chinese Postman Problem")

Design And Implementation

Object oriented programming organizes a program around its data, i. e. objects and a set of well defined interfaces to that data. An object-oriented program can be characterized as data controlling access to code.Object-oriented programming is a technique for programming – a paradigm for writing ‘‘good’ ’programs for a set of problems. If the term ‘‘object-oriented programming language’’ means anything, it must mean a programming language that provides mechanisms that support the object oriented style of programming well. In OOP program, unit of program is object, which is nothing but combination of data and code. In OOPs program, it is accessible within the object and which in turn assures the security of the code. .Net is completely object oriented language, and its current fastest technology therefore we decide to used the .Net Visual Studio.

The project is mainly designed into following application

1) Client application
2) Server application (Web service)
3) Data Entry application.



A] Dijkstra Algorithm

- Dijkstra's algorithm solves the single-source shortest-path problem when all edges have non-negative weights.
- Algorithm starts at the source vertex, s, it grows a tree, T, that ultimately spans all vertices reachable from S.
- Vertices are added to T in order of distance i.e., first S, then the vertex closest to S, then the next closest, and so on.

B] Digitalizing the Natural Path :

- This algorithm is used to store the natural path into electronic form.
- This algorithm starts at the source vertex v1 from which we have to store the natural path to the adjacent vertex v2.
- This algorithm stores the direction in the form integer values are generates one path string.
- This path string contains the direction to travel the pixels from source point.

C] Converting digital to Natural Path

- This algorithm gets the input as a path string and recognizes the path.
- Makes the real x,y co-ordinates to plot on the map.
- Path string contains the information about the directions to travel the pixels from the source vertex (city) to destination (city).

Dijkstra's algorithm:

The input of the algorithm consists of a weighted directed graph G and a source vertex s in G. We will denote V the set of all vertices in the graph G. Each edge of the graph is an ordered pair of vertices (u,v) representing a connection from vertex u to vertex v. The set of all edges is denoted E. Weights of edges are given by a weight function w: $E \rightarrow [0, \infty]$; therefore $w(u,v)$ is the non-negative cost of moving directly from vertex u to vertex v. The cost of an edge can be thought of as (a generalization of) the distance between those two vertices. The cost of a path between two vertices is the sum of costs of the edges in that path. For a given pair of vertices s and t in V, the algorithm finds the path from s to t with lowest cost (i.e. the shortest path). It can also be used for finding costs of shortest paths from a single vertex s to all other vertices in the graph.

```
1   function Dijkstra (G, w, s)
2   for each vertex v in V [G]
3   d[v]:= infinity
4   previous[v]:= undefined
5   d[s]:= 0
6   S: = empty set
7   Q: = V [G]
8   while Q is not an empty set
9   u: = Extract_Min (Q)
10  S: = S union {u}
11  for each edge (u, v) outgoing from u
```

```
12              if d[v] > d[u] + w (u, v)
 13                 d[v]:= d[u] + w (u, v)
14                 previous[v]:= u
```

If we are only interested in a shortest path between vertices *s* and *t*, we can terminate the search at line 9 if *u* = *t*.

Now we can read the shortest path from *s* to *t* by iteration:

```
1       S: = empty sequence
2       u: = t
3       while defined previous[u]
4       insert u to the beginning of S
5       u: = previous[u]
```

Now sequence *S* is the list of vertices on the shortest path from *s* to *t*, or the empty sequence if no path exists.

We can express the running time of Dijkstra's algorithm on a graph with *E* edges and *V* vertices as a function of |*E*| and |*V*| using the Big-O notation.

Algorithm for generation of path string 1]

Start.

2] Take input point as source point. 3]
Set path_string =””.

4] While (current point != destination point) 6] Get
current point as direction point.

7] Assign the code for current point .

a] if (current point = left top) code = “1”.

b] if (current point = top) code = “2”.

c] if (current point = right top) code = “3”.

d] if (current point = left) code = “4”.

e] if (current point = right) code = “6”.

f] if (current point = left bottom) code = “7”.

g] if (current point = bottom) code = “8”.

i] if (current point = right bottom) code = “8”.

8] path string = path_string + code. 9] Go
to step no 4.

10] Stop.

2) Algorithm for generation of natural path from path_string

1] Start.

2] Take input a source point . 3]
Take input a path string
4] current point = source point. 5] if
(path._string ! = null)
I] read first char (direction) from path string. a] if
(char= "1")
current point. = (current point .X – 1 , current point .Y – 1) b] if (char=
"2")
current point. = (current point .X, current point .Y – 1) c] if (char=
"3")
current point. = (current point .X + 1 , current point .Y - 1) d] if (char=
"4")
current point. = (current point .X – 1 , current point .Y) , e] if (char=
"6")
current point. = (current point .X – 1 , current point .Y) f] if (char=
"7")
current point. =(current point .X – 1 , current point .Y + 1) g] if (char=
"8")
current point. = (current point .X , current point .Y + 1) h] if (char=
"9")
current point. = (current point .X + 1 , current point .Y + 1)

II] plot current point.
III] remove first char from path_string. IV]
Go to step 5]. 6] Stop.

Performance Analysis of the algorithm to other Existing Methods.

Generally, GIS system contains Information about type of soil, type of land, type of rock, various types of crop grown etc. Which is may not be useful for particular system.

Our GIS System is specially developed for traveling related system, tourist peoples. So it contains the information that is needed for that (travel) particular domain.

Today's GIS System is contain a lot of data which may not be very useful for Application like Traveling Agencies.

Salient Features of the Project/Package

1. Simple Navigation.

Graphical output (Map of Maharshtra) is used to make the user interface more attractive. Zommer to Zoom the map to see the lowest level details. Navigator to navigate the map.

2. Disconnected database Architecture

VB.Net provides the facility to make the database architecture connectionless i.e. it makes the copy whole database into the memory. This techniques helps to fix the different problems.

1) power failure

- In connection oriented architecture the probability of corrupting the records is very high.
- In Disconnected approach this probability of corruption of record is

very low, because the .net provides the .net provides the dataset which can be fill as original database.

3. Easily deployable / Platform Independent

.NET provides the facility to make the setup of the project.

Platform independence is implemented using the CLR (Common Language Runtime system) under which the .net's managed code runs. But CLR is necessary for .net application to run on the machine, for that .Net Framework is should be installed on the machine.

4. Centralize Database

Due to Centralize database updates automatically gets reflected to the client side. Implementation of Web service is main reason behind the Centralize the database.

Importance of Package

This application can be useful in many ways. Travel Agencies can use this to find the certain important information about the tourist places, and also related information like to find the distance of that place from particular destination city.

Also you may find the Shortest Path to reach at that particular Point.

Also on the way information helps to plan the different things like Where to get Halt while traveling? i.e. finding the Hotels for halt, Where we can get Petrol? Finding the Petrol Pump etc. S.T. buses management can use this application for routing the buses with shortest path. And to find On The Way stops.

Further Enhancement

This current GIS system is developed by considering the small domain; because of collecting such large amount database is not a easy job. But, we got the information about the thane district.

In the future we will collect the real information about the cities, districts, and we will try to provide the much more and accurate information to the GIS user. Also we will try to make the database of different types (Granularity Level should be high) so the application will be useful in a different field. Providing the time table of railway and buses to reach at particular destination is will be main aim of our system. Increasing the zooming level of the map i.e. deep view on area is also the workable thing.

Implementation of the various factor such as time distance, quality of the road while retrieving the shortest path i.e. it the traffic gets jam on particular are then what should be the optional way. Also we also like to develop such system for mobile user's i.e. we require to change the user interface at client side.

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