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Intelligent Route Guide (IRG): A Research

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Abstract

Intelligent route guide (IRG) is the concept used to describe how information technology can be used in the transport sector. The idea with IRG is that the services should bring extra knowledge to travelers and operators in order to improve transport and travel activities. The new technology enables tourists and other travelers to choose appropriate route and mode of transport according to their convenience and the conveyance fare on the basis of the information provided to them. Conveyance information services are another type of IRG services. The aim with the service is to provide tourists and travelers with dynamic information about the various available modes of transport with their fare which will help them to plan their journey from specific source location to destination. It will also help in curbing the exploitation of tourists by the cab drivers and the local transport facilitators who charges extra rent for short distances. The rapid development of new technology will lead to drastically increased possibilities to provide road users, especially tourists, with various kinds of information. Information might be presented to the tourists on the basis of the current database about the routes and transport facilities on particular routes available to them. With the ever-increasing number of tourists in India, there is now an acute need for an intelligent-autonomous-efficient route guide. The project provides the solution to different problems faced by travelers by providing them with the visual help that is provided by means of line that highlights the shortest path in between the destinations that the traveler wishes to traverse. The problem of estimation of shortest distance is also sorted out and the shortest distance is provided to the traveler seeking it. The project also takes care of the problem faced by travelers in regard of the fare that has to be paid. For this, information of fares of taxis, buses, and metro are also provided to the travelers in between their destinations. The most striking feature of this project is the time estimation module that computes time on the basis of stoppage times that will have to be taken care of at different traffic lights. With this it will be possible to provide exact information of time required to travel the path.

Keywords: *IRG, transport sector, shortest path*

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INTRODUCTION

Purpose

Intelligent route guide (IRG) is the concept used to describe how information technology can be used in the transport sector. The idea with IRG is that the services should bring extra knowledge to travelers and operators in order to improve transport and travel activities. IRG comprises of the route detection modules which will provide the real time data through which tourists and travelers can plan their journey [1].

Project Scope

The current project can be extended to be installed as an application in mobile devices and will cover the spectrum of the entire country. It can be further extended into an intelligent device which would be capable of suggesting the most appropriate routes with shortest path and having minimal traffic. At present we are developing this only for a city having only road routes. In further extension on country level it can be incorporated with air routes also.

OBJECTIVE

In the current scenario the facility of transport is not only confined to the rich or well-off individuals rather have become an essential part of the routine life of every man. With the combination of web technology and database of various routes and modes of transport available, we can provide information about the available routes and various modes of transport available on those routes with their fare. The intelligent route guide (IRG) is thus conceived to achieve the following scenario:

- Comprehensive analysis of the currently available routes.
- Provide a centralized platform to tourists and travelers to decide their routes.
- Implement a public information portal to dispense route and transport service alerts and advisories.

These objectives give us an overall representation of the capability and adaptability of the system [1, 2].

SIGNIFICANCE

When a person starts his/her journey from one place to reach the other place, there are two things which he should know:

- Path which is to be followed, and
- Conveyance to be used.

Generally people inquire about these things from the person known to that place, but this information provided by any unknown person may be right or may be wrong so to be precise and accurate about this knowledge new method is needed which is provided in our project. Our project deals with providing information to people regarding the appropriate routes that are available between specific source and destination of their commutation.

This will also provide information of various transport facilities available on specific routes along with their fares. Apart from this it will help people to decide as to what route they should follow along with fare that, that particular route will incur. It will also help in curbing exploitation of tourists and travelers by transport facilitators who charge extra fares for small distances. It will also help the government in implementing the practice of appropriate fare charging [3].

MODELLING

For a person travelling from one place to another there are certain things which he should know before starting his/her journey i.e.:

- Path which is to be followed, and
- Conveyance which is to be used.

And nowadays there is another constraint added in the list i.e.:

- Time which will be consumed during journey.

Now the question arises how a person who is new to someplace or going to a new place will gather this information?

Now to answer this question we started our work of project intelligent route guide (IRG).
We divided our project into three categories i.e.:

- Shortest path from source to distance;
- Conveyances available on that path;
- Time consumed while travelling through road.

We are using dynamic map using Google API which will direct the path on a map to the user.

Shortest Path

In our project we use a map as a graph so that algorithms could be easily implemented. There are several algorithms which could be used to find the shortest path between the source and the destination provided by the user. But the problem arises when there are turns in the graph and we use those points as nodes and need the data of all the nodes in series which are being used while travelling from source to destination to represent the line in map and for further calculation of other categories of our project.

First we started working with single source shortest path algorithm (Dijikstra algorithm) as we were known with the source which is provided by the user. But in this algorithm problem raised was to find the nodes are which were being traversed in sequence of their traversal. We tried to modify the algorithm to fulfill our purpose but failed.

Now, after failure while working with Dijikstra algorithm, we switched over to an algorithm of all pairs shortest path algorithm (Floyd Warshall algorithm). Now, after implementing this algorithm we saved it to matrices, one of the all pairs shortest path and the other for the nodes which are to be followed from source node to destination node [4].

Conveyances and Fares
Now, comes the next part of our project i.e. conveyances available for travelling between the source and destination and their fares for travelling between the same.

The conveyances which could be available in a city are three:
- Buses,
- Metro,
- Auto.

Now a database is maintained for the available conveyances and their fares between different nodes in the graph. When a user enters a source and destination the nodes which are being followed from the particular source to the destination are fetched from the matrix which is being maintained by executing the Floyd Warshall algorithm. And accordingly the data for the conveyances and their fares, is fetched from the database maintained for these information and is delivered to the user [4].

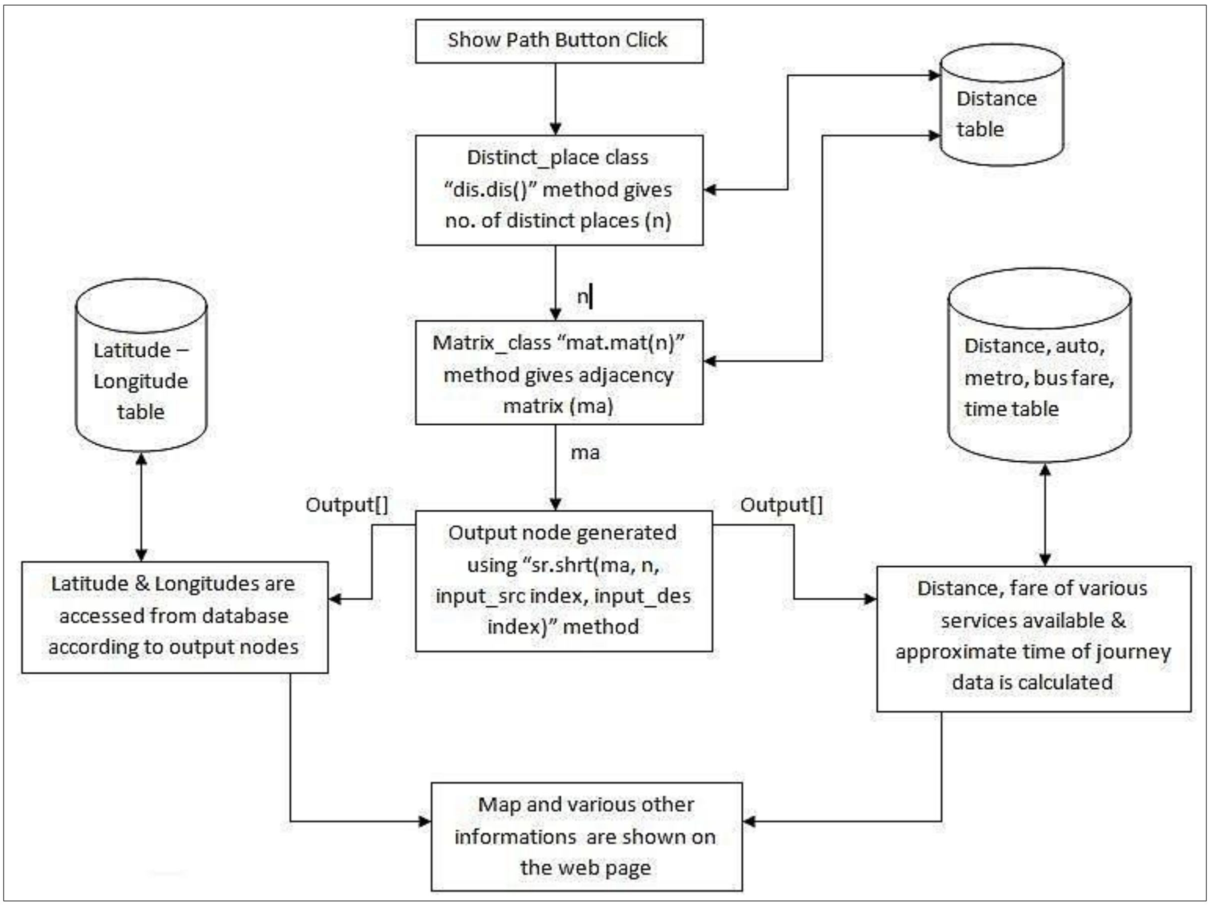

Fig. 1: *Flow chart for Intelligent Route Guide.*

Time
The time analysis is done for the travelers who are going to travel through road. Time analysis for the path from a specified source to a specified destination can be done keeping three things in mind:

- *Time consumption while travelling by a standard speed from source to destination.*

For this purpose a database will be maintained for the time between all nodes for the real time scenario.

- *Red lights in the path and their stoppage time.*

For this purpose also similar to the above a database for the red lights between all nodes and their stoppage time while being red will be developed.

- *Stoppage time during peak hour of traffic due to jam.*

This aspect for calculation of time consumption requires real time creation and updation of database. For this we could use different kind of sensors which will be placed over the areas where there is most probability of jam to record the jam timing/stoppage timing for a particular vehicle. These recorded data will be transferred to the main server station where the administrator will study the data and make the entries in the database. The updation of these data could be done as on weekly or monthly basis as per the need [5]. Our project will specify the approximate maximum time which could be taken while travelling through road by any passenger/traveler.

IMPLEMENTATION

Automotive technologies are gaining ground in modern path finding systems, since the number of road vehicles and passengers is growing rapidly. There are technologies such as GPS systems which are being used by passengers for route tracing. There is a perpetual need for the passengers that they should be guided for their journey with appropriate data in more precise way. Implementation of our website will fulfill this purpose to a good extent. As by using this website, a passenger will be able to acquire the knowledge not only about the shortest path but also about the conveyances available and time consumption while travelling through road route. The model of operation is described in different categories of our project.

Shortest Path

As specified in modeling part of this report, we are using a dynamic map by using Google Map API in the code. And the map is considered as graph where the turns in the road and the different places are considered as a node. To present these nodes on the dynamic map we are using the concept of latitude and longitude. To use this concept we made a database which stores latitudes and longitudes of different places/nodes. When a user enters the source and the destination the Floyd Warshall algorithm, calculates the shortest path and stores all the nodes in their sequence in an array which are being traversed while following the path from the provided source to the destination. According to the nodes stored in the array the latitudes and the longitudes are fetched and accordingly the line is drawn on the map. This is how the shortest path category is implemented in our project:

```
/* Assume a function edgeCost(i,j) which returns the cost of the edge from i to j
   (infinity if there is none).
   Also assume that n is the number of vertices and edgeCost(i,i) = 0
*/

int path[][];
/* A 2-dimensional matrix. At each step in the algorithm, path[i][j] is the shortest path
   from i to j using intermediate vertices (1..k-1).  Each path[i][j] is initialized to
   edgeCost(i,j).
*/

procedure FloydWarshall ()
   for k := 1 to n
      for i := 1 to n
         for j := 1 to n
            path[i][j] = min ( path[i][j], path[i][k]+path[k][j] );
```

Fig. 2: *Pseudo Code of Shortest Path (Floyd Warshall Algorithm).*

```
procedure FloydWarshallWithPathReconstruction ()
   for k := 1 to n
      for i := 1 to n
         for j := 1 to n
            if path[i][k] + path[k][j] < path[i][j] then
               path[i][j] := path[i][k]+path[k][j];
               next[i][j] := k;

procedure GetPath (i,j)
   if path[i][j] equals infinity then
     return "no path";
   int intermediate := next[i][j];
   if intermediate equals 'null' then
     return " ";   /* there is an edge from i to j, with no vertices between */
   else
     return GetPath(i,intermediate) + intermediate + GetPath(intermediate,j);
```

Fig. 3: *Pseudo Code with Path Reconstruction.*

Conveyance and Fares

For this part of project to be implemented, data about the availability of various conveyances for a particular route and their fares will be asked from the government; so that the data provided to the user would be accurate as decided by the government. Now the question is how this data is implemented and retrieved from the database correctly?

Here in this project a database is created for different fares i.e. for buses, metro, and auto rikshaw specifically from different source ids to other destination ids. As the nodes are known which are being involved in the path desired by the user, accordingly the data is fetched and summed to provide the accurate fare of a particular conveyance, and if there exists any null value from any node to the other one for a particular path then a message for conveyance not availability is displayed for the particular conveyance (bus/metro). This is how the conveyance and fare category is implemented:

```
//............to find the bus fare .................
int f = 0;

for (i = 0; i < output.Length - 1; i++)
{
    try
    {
        //con = new SqlConnection("Data Source=CYBERKNIGHT-PC\\VISHAL;Initial Catalog=master;Integrated Security=True");
        cmd = new SqlCommand("select *from bus_fare where sid=" + output[i] + "AND did=" + output[i + 1] + "", con);
        con.Open();
        SqlDataReader dr8 = cmd.ExecuteReader();
        if (dr8.Read())
        {


            f = f + (int)dr8[2];


        }
    }
    catch (InvalidCastException)
    {
        f = 0;


    }
    con.Close();
}
```

Fig. 4: *Query Executing to Find Available Conveyance and Fare.*

Time Analysis

This is the most valuable part of project as it makes it different from others, as it determines the approximate time for the journey between specified source and destination by the user. Now come to the point, how it could be implemented, this is basically a real time part of project as deals with the real time information. The model of this category is as follows:

- Traffic data collection,
- Data communication,
- Analysis/assessment,
- Data reporting.

Also to integrate all these aspects together into a centrally monitored and controlled environment we employ a traffic analysis center to be the base of this entire system.

Traffic Data Collection

Traffic data collection is the first phase of operation of the system. We place traffic sensors all over the city road network to detect and measure the traffic data and report back to the analysis center.

We can employ various kinds of sensory technology to accurately scan for density of vehicles and enable quick and precise reporting of data.

Based on the various sensory technologies available we have the following options to utilize. All these devices have the inherent advantages and disadvantages that make them applicable to certain areas and situation.

- Radar based sensors,
- Laser scanning sensors,

- Visual (camera) based sensors,
- Sub surface traffic detection loops, and
- Surface mounted traffic detection loops.

Here, using these kinds of sensors there are some methods such as loop detection, and estimating traffic condition with the ambient traffic noise and other techniques.

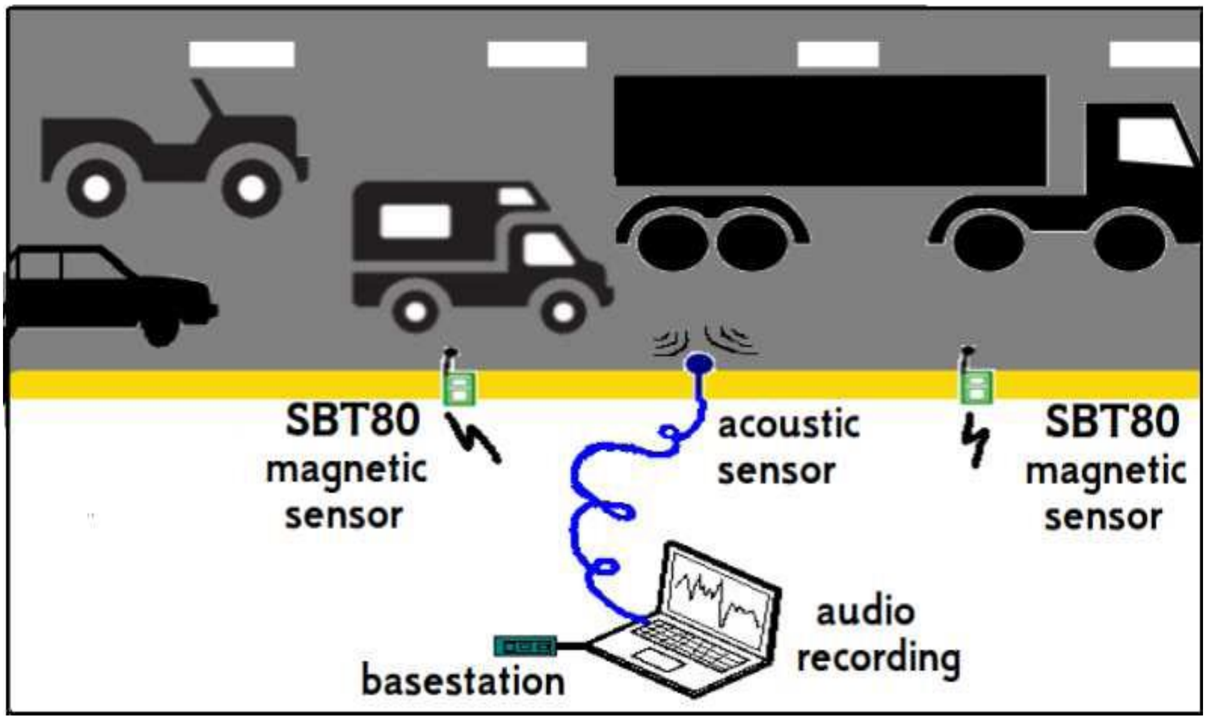

Fig. 5: *Curb-Side Sensing Setup.*

The intuition is as follows, different traffic states generate different kinds/levels of ambient noise/acoustic signals. The source and magnitude of noise can vary greatly depending on the kind of traffic scene, e.g., slow and congested traffic will probably have high magnitude signals originating from brakes, honks and engines. Accelerating traffic generates louder noise than freely flowing or static traffics, owing to the roaring engine. Specifically, we aim to classify traffic into the following categories: (i) slow and congested, (ii) static, (iii) fast and (iv) empty.

Data Communication

Data communication is the backbone of the traffic information system. Essentially our system is a distributed system of embedded platform based sensors. We need a reliable, highly available and maintainable system to facilitate robust communication of data to the communication center. We can rely on the existing GSM infrastructure to provide a medium for our communication. The benefits incurred in the following process are as follows:

- Wide coverage area,
- Huge load capacity,
- Robust, and
- Scalability.

Here in above Figure 5 there is a sensor named RTMS X3 sensors, the remote traffic microwave sensor is a low-cost advanced sensor for the detection and measurement of traffic at intersections and on roadways. Here, decision support system (DSS) is a computer-based information system that supports business or organizational decision-making activities. DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

Analysis/Assessment

After collecting and reporting the data back to the analysis center we must now analyze this data in real time and report to the public domain portals for immediate use. Also this data must be made available to the traffic controllers first hand so that regulatory measures can be taken to overcome any obstacles. Traffic analysis center is the location where all this data processing shall take place. Performing computations on such vast amount of data requires a lot of processing power which can be achieved by the use of a real time processing grid computing system which can handle the load of the processing; also using a grid based system makes it easier for us to scale the system to enable required performance under increasing load. All the incoming live data needs to be first assorted into a database and then we need to first visualize it to the through various stats and metrics to present it to the personnel working so that they can take first hand corrective action in case of any emergency. Also constant vigilance by these operators shall ensure security and safety of the commuters at all times making their journey quick and pleasurable.

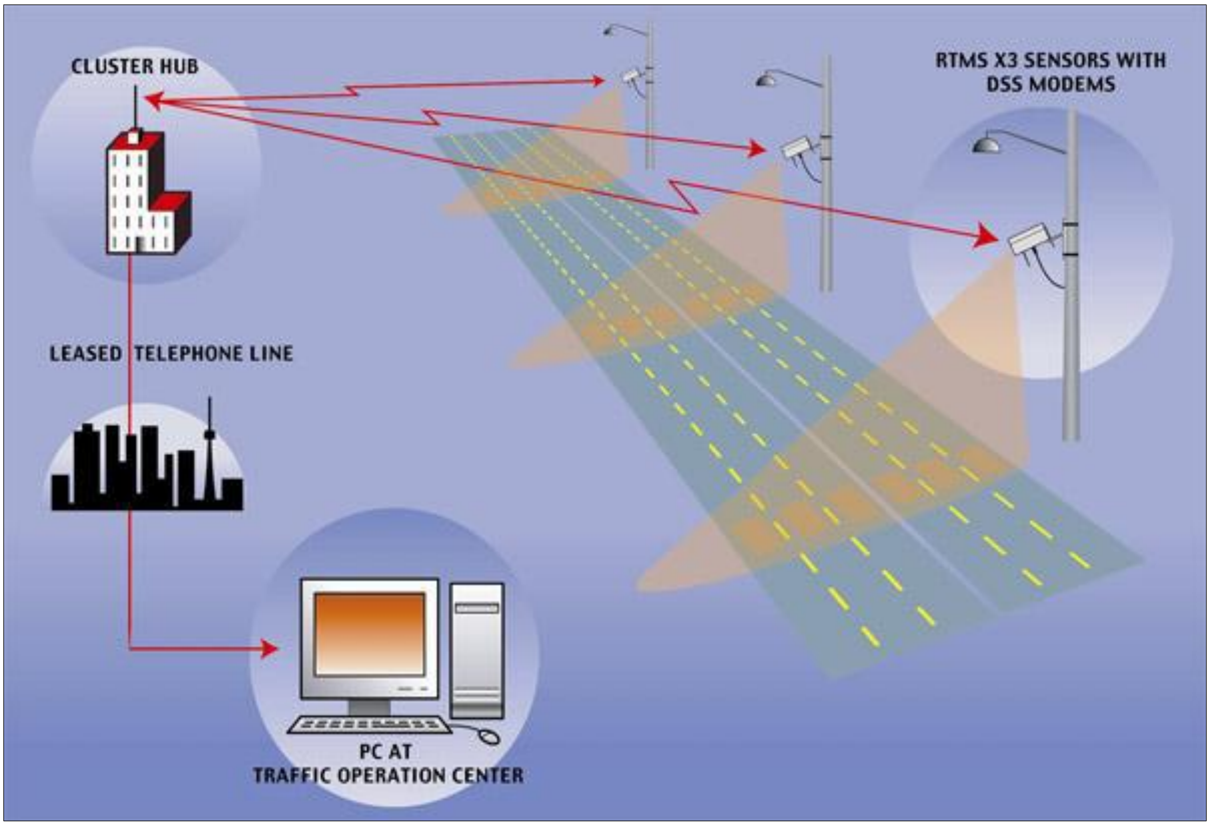

Fig. 6: *Showing Network Path.*

Data Reporting

The optimal information feedback is very important to many socioeconomic systems like stock market and traffic systems, aiming to make full use of resources. As to traffic flow, a reasonable real-time information feedback can improve the urban traffic condition by providing route guidance. Simulation results adopting an optimal information feedback strategy have demonstrated high efficiency in controlling spatial distribution of traffic patterns compared with the other two information feedback strategies, i.e., travel time and mean velocity. After extracting all the useful knowledge from the data though the use of various schemes and processing we must make the data available to the end users.

The results obtained must be clarified simplified and presented in an appropriate manner so that they can present the entire result in a useful manner.

So, keeping above things in mind the received data from sensors is formalized and stored in a table and retrieved similarly as shortest path and conveyance and fares are retrieved and calculated. The calculated data is provided to the user according to query provided by the user.

H/W AND S/W REQUIREMENTS

Hardware Requirements

Processor : Pentium 4 or higher,
RAM : 1 GB (minimum),
Hard Disc Space: 5 GB (approximately).

Software Requirements

Operating System : Windows XP or higher,
Language used : ASP.net and C#,
Framework used : Visual Studio 2008,
Server used : SQL Server,
Browser : Internet Explorer.

Working Snapshots

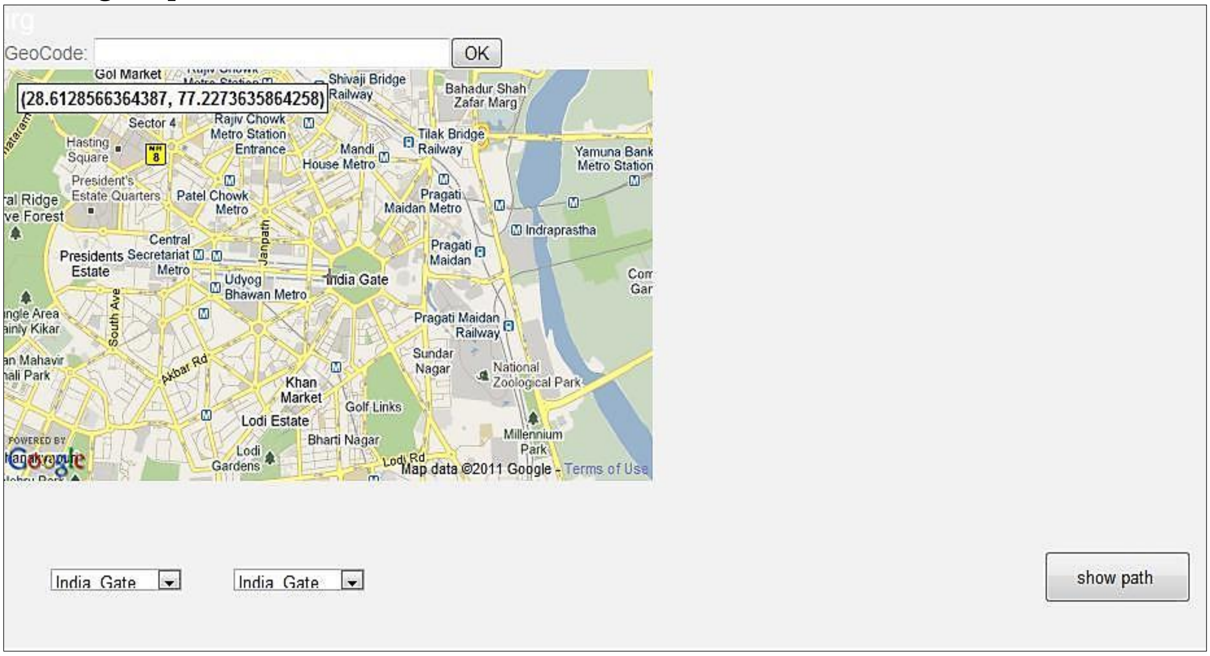

Fig. 7: *Default Page of Website.*

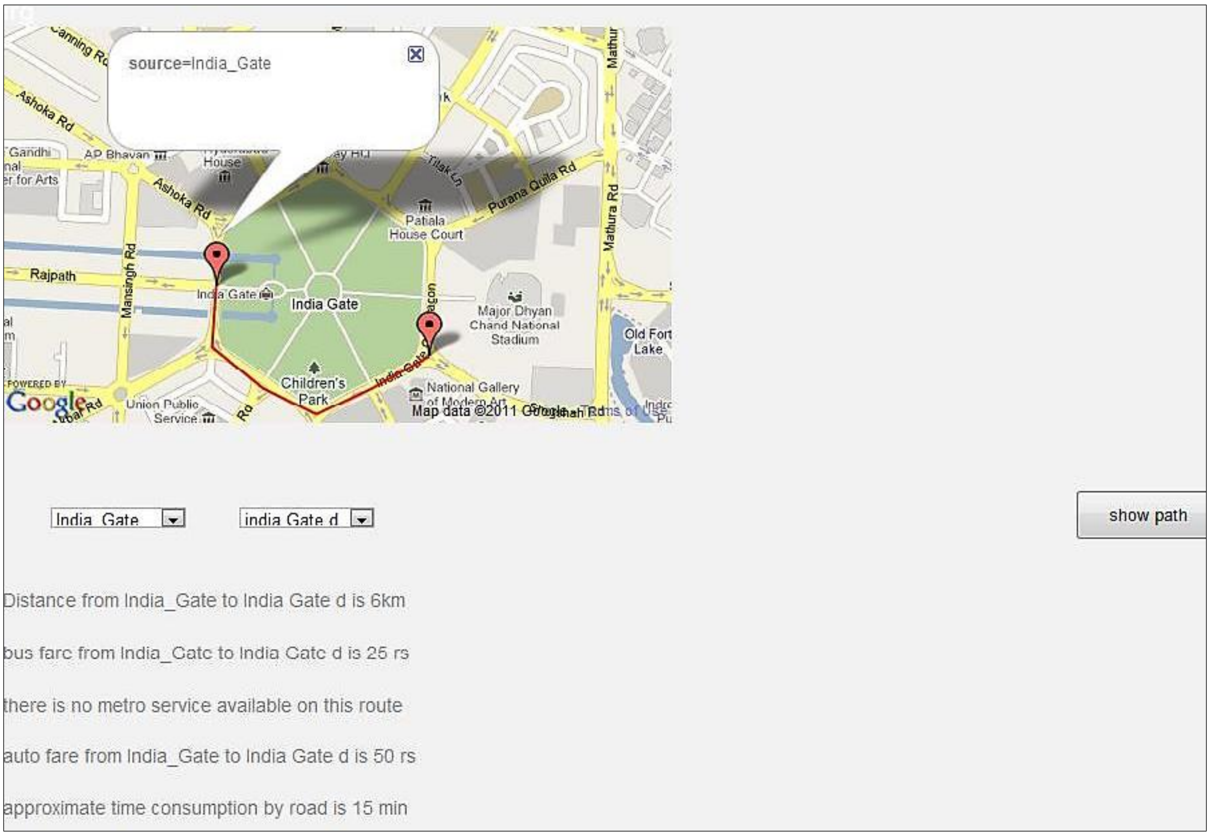

Fig. 8: *Showing the Path and Other Information.*

SAMPLE TABLES USED IN DATABASE

Table 1: *Place and Id Table.*

id	place
0	India_Gate
1	India_Gate_a
2	India_Gate_a1
3	Baroda House b
4	b1
5	India Gate c
6	India Gate d
7	d1
8	e
9	e1
10	f
11	ms road point
12	ms road right
13	ms road left
14	dr rajendra prasad road
15	ashok road a
16	jaswant singh road
17	ap bhawan
18	ashok road b
NULL	NULL

Table 2: *Distance Table.*

sid	did	distance
14	15	1
15	16	1
16	17	1
17	18	1
18	1	5
1	0	3
2	1	1
3	2	1
4	3	2
5	4	1
6	5	3
7	6	2
8	7	1
9	8	1
10	9	1
0	10	1
11	0	6
12	11	5
13	11	5
14	12	1
15	14	1
16	15	1
17	16	1
18	17	1
12	18	1
18	12	1
NULL	NULL	NULL

Table 3: *Longitude and Latitude Table.*

id	lat	lnq
0	28.6130073336544190	77.2276639938354490
1	28.6147780097434530	77.2277069091796880
2	28.6156068265917900	77.2295951843261720
3	28.6162849446024910	77.2310972213745120
4	28.6154561331058800	77.2329425811767580
5	28.6144201095368760	77.2346806526184080
6	28.6109917405000760	77.2344875335693360
7	28.6101063742716840	77.2327065467834470
8	28.6093528652205470	77.2309041023254390
9	28.6101252119287150	77.2291660308837890
10	28.6112743026190910	77.2275137901306150
11	28.6131674492092570	77.2247672080993650
12	28.6160306508616140	77.2250139713287350
13	28.6102288189819520	77.2246706485748290
14	28.6163885455796710	77.2246706485748290
15	28.6165674924813000	77.2247779369354250
16	28.6166710931797360	77.2250461578369140
17	28.6164921464546430	77.2253358364105220
18	28.6162095983730930	77.2252714633941650
NULL	NULL	NULL

CONCLUSION

The success of any scheme is measured by public confidence and acceptance. If the public feels that a system is not reliable, accurate or fair then there will be greater opposition, but if a scheme is proven to work effectively then the public's faith increases and the expansion or rollout of additional charging areas is the end result.

The above Figures outline the basic functioning of the system. The collection of data in database, for time analysis collecting data using sensors and setting up the other network requirements so that accurate data should be collected.

Moreover implementation of this system in the highly erratic commuter corridors of any major Indian city should be with precision. While the necessity may be great, the solution should provide a basic framework on which further enhancements can be added and newer technologies be implemented. The proposed system aims to provide a basis for application of intelligent technology in the transport sector.

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