# Transport Information System (TIS)

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**May 2007**

# Transport Information System (TIS)

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**Spring 2007**

# DECLARATION

In accordance with the requirements of the degree of Bachelor of Computer Science and Engineering in the division of Computer Science and Engineering, we present the following thesis entitled ‘Road Transport System’. This work was performed under the supervision of Munawwar Mahmud Sohul.

We hereby declare that the work submitted in this thesis is our own and based on the results found by ourselves. Materials of work found by other researcher are mentioned by reference. This thesis, neither in whole nor in part, has been previously submitted for any degree.

Signature of
Supervisor

Signature of
Author

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Munawwar Mahmud Sohul

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Md Shoaibe Anwar
Dider Morshed Chowdhury

# ACKNOWLEDGEMENT

First of all, We would like to thank my supervisor, Munawwar Mahmud Sohul. He gave us freedom to choose the thesis topic and complete guidance throughout its development. We was lucky enough to work under him for our thesis work. Although being extremely preoccupied with his busy schedule, he often showed much enthusiasm and took time and lot of pain to review my thesis work that enabled me to improve the system as well as adding new features. We learned plenty of useful things from his comments, revisions and discussions during this period.

We also also indebted to our friend Md. Moshfiqur Rahman student of BRAC University from the department of computer science and engineering to help us to learn about how to implement SMS Application.

Last but not the least, thanks to the Almighty Allah for helping us in every step of our work.

# ABSTRACT

In this paper, we present a GIS Based traveling information systems on a variety of transportation modes, Schedule status and transportation related information in the context of the available media of Bangladesh. The goal of this system is to go through an approach that will minimize travel time & cost on a variety of transportation modes using the available media that include telephone, SMS and the Internet. This system incorporates unbiased-ness (best output) and consistency (expected output) into its core operations.

At present there is no such type of system exists in our country. But similar kind of system exists in other countries. Some research work has already done in the development of this system.

The major focuses in building the web application are Generate Route Direction, View Specific Node and Edge Information

GIS information about each node is stored into the database where we provide the approximate location of the node by giving the GPS coordinate point.

Users can access this system through different available and flexible media. The comparison between the existing status of research and development of Traveler Information System and the system that we proposed indicate that yet we can enhance and improve the service through many different ways based on the availability and applications of current technology, equipments and resources. If we consider about the cost for the users if it is adapted by the city government then for web-based solution it will be free, for SMS based solution users will pay the same rate as the any other SMS push-pull services.

# TABLE OF CONTENT

DECLARATION ..... ii
ACKNOWLEDGEMENT ..... iii
ABSTRACT ..... iv
TABLE OF CONTENT ..... v
CHAPTER I: INTRODUCTION ..... 7
CHAPTER II: DESIGN ..... 10
2.1 USE Cases ..... 11
2.2 Block Diagram: ..... 20
2.3 System Engine: ..... 20
2.4 Database Design: ..... 21
2.5 Web Application: ..... 21
2.5.1 Generate Route Direction ..... 25
2.5.2 View Specific Node and Edge Information ..... 26
2.6 SMS Application: ..... 36
CHAPTER |||: IMPLEMENTATION ..... 31
CHAPTER |V: TESTING ..... 32
4.1 Unit Test ..... 32
4.2 Integration Test ..... 32
4.3 System Test ..... 32
4.4 SMS Application Test ..... 35
CHAPTER V: LIMITATIONS OF THE SYSTEM ..... 38
5.1 Data Collection And Manipulation ..... 38
5.2 Data Output Process ..... 39
CHAPTER VI: FUTURE VISIONS ..... 41
6.1 Include congestion control: ..... 41
6.2 Integrating the system with the different transport company. ..... 41
6.3 Enhance usability of the system by including more media ..... 41
CHAPTER VII: CONCLUSION ..... 43
REFERENCES ..... 63

# CHAPTER I: INTRODUCTION

Economic growth and rewarding contact between people require good transport facilities. Provision of transport that is socio-economically efficient and sustainable in the long term, and which satisfies the need for accessibility, is one of the tools for attaining the vision of a sustainable society and sustainable welfare. The road transport system and its development must satisfy a large number of changing requirements. The transport policy goals related to the environment are based on the goals of the environmental policy. As a first step, the goals are aimed at slowing the negative trend, and then at producing sustainable development in the future.
In Bangladesh the infrastructure of Road transport is not sustainable. It needs to improve a lot.

Comfortable Transport, Travel time and cost is an important issue in our everyday schedule. Everyone wants a comfortable journey and wants to make it short and cheap. But In Bangladesh there are 32257 registered public Buses. Only In Dhaka there are 138 different Bus Route's available.

In every route there are 1-6 different Buses with different services. The major problem is to know which one I will choose, which one will give me a comfortable journey and take minimum time. This can be possible by

- Available comfortable Transports.
- There is trade off between cost and comfortable journey.
- Although less distance means less cost.
- Another important thing is, both cost and time depend on congestion control.

But this is not the exact solution that we are looking for. We don't concern about the traffic congestion and the ways to control it. Our main concern is to establish such a system that concentrate on the public services of Transport Information System (TIS) include pre-trip and/or en route traveler information based on Transport information,

source location, destination and additional information related to traveling. We propose a system that accomplish user requirements using most sophisticate way through the available media and ensure the best and unbiased solution.

From traveler perspective, the requirements of knowing the information about their optimal route (the route that will take less time) come forward. A system that always provide information about available transport by analyzing their request.

All these requirements indicate the establishment of such a system that can provide the transport information and response to user's request with the help of the available medium. This lead user to make decision about desired transport to choose that minimize their travel time as well as cost.

The idea to establish such a system leads us to concentrate on the possible media for transmitting the desired information. Among the possible media voice (phone), sms service, web client are commonly available in our country. So we will consider all these medium for both data receiving and transmitting.

At present there is no such type of system exists in our country. But similar kind of system exists in other countries. Some research work has already done in the development of this system. A complete idea about the entire structure of similar system can be obtained from the "Survey" part of this report that provides all necessary information about existing Transport Information Systems of different countries. We develop our system based on existing limited resources and keep open some field for further development of this service with additional resources. The "Limitations" and "Future Visions" part of this report provide a complete direction about further enhancement of this service when additional resources, equipments and technologies will be available.

At Design and Implementation phase of the service development we concentrate on the usage of the possible media and develop the system based on these. For each medium we develop separate application where all applications share a unique database and the common functionality of the central service engine. The web application is

further decomposed into two parts: text based output provider and map based output provider which can be categorized as the GIS enabled service. The internal structure of the system engine is shown in Figure: 2 that represent the each separate application. The complete description about each application, the database and the central service engine development is available on the “Design” and “Implementation” part of this report.

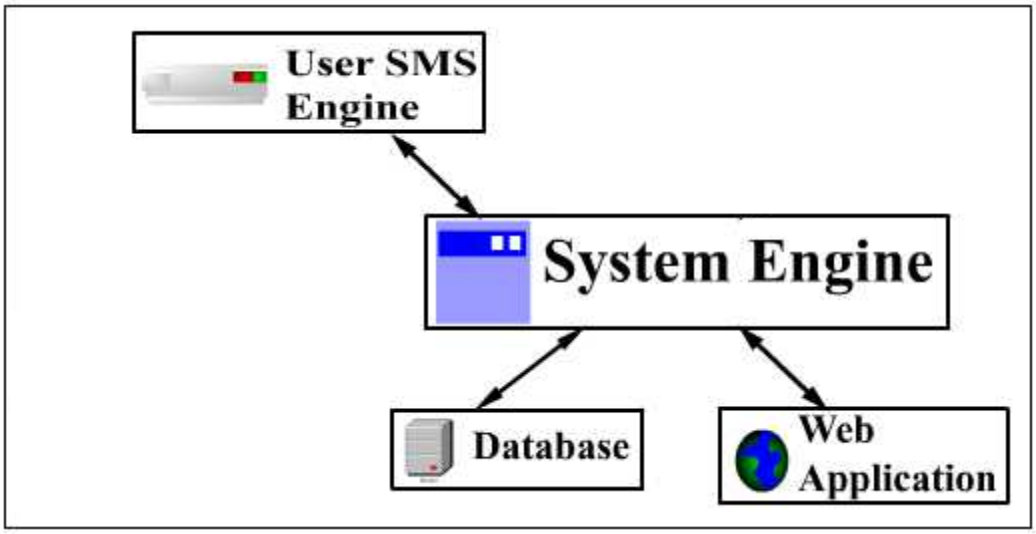



Fig: 2 Internal Structure of the System Engine

To implement the entire system we followed Extreme Programming style of Software Engineering. The entire modules were tested in unit testing approach using NUnit GUI. Programming language PHP, VisualBasic.Net was used to develop the entire system.

# CHAPTER II: DESIGN

In this phase we are going to discuss about the design methodology of the entire system in brief. We started our design task from requirement elicitation. From the primary requirements we got the use cases. Analyzing the use cases we obtained a block diagram of the system. Decomposing the block diagram we got individual components of the system. Then for each individual component we got several use cases. From the use cases we designed relevant class diagrams. Then we developed the Entity Relationship Diagram. The following subsections are briefly described in each phase of design.

## 2.1 USE Cases

USE CASE: Real Time Traveler Information System

Primary Actor:

Travelers

Stakeholders and Interests:

System Admin

Operator

Preconditions:

Everyone (except SMS user) has to access in either internet or phone

User (who use SMS) has to know query pattern and destination

Post conditions:

Generate reliable path directions to reach origin to destination

Give available Transport information

Generate MAP to visualize path direction

Give specific Map of each Node

Main success scenario:

1. Traveler choose a medium (SMS, Web client or voice) by which he wants to make a query
2. Send his query through that medium (origin to destination)
3. System will generate list of reliable path direction, estimated time to reach destination and MAP information
4. System send this generated output to user through appropriate medium

Extensions:

*a System fails:

2a. invalid query: (invalid SMS pattern)

Reply with an error message and right query pattern

2b. query without sufficient data (missing origin or destination in web form)

Show an error message to user

2c. Ask for such destination which is unavailable

Operator will give him a suggestion

3a. Limited output generation

Generate only single path direction and estimated time for SMS client

4a. Long delay to send output

Nothing to do

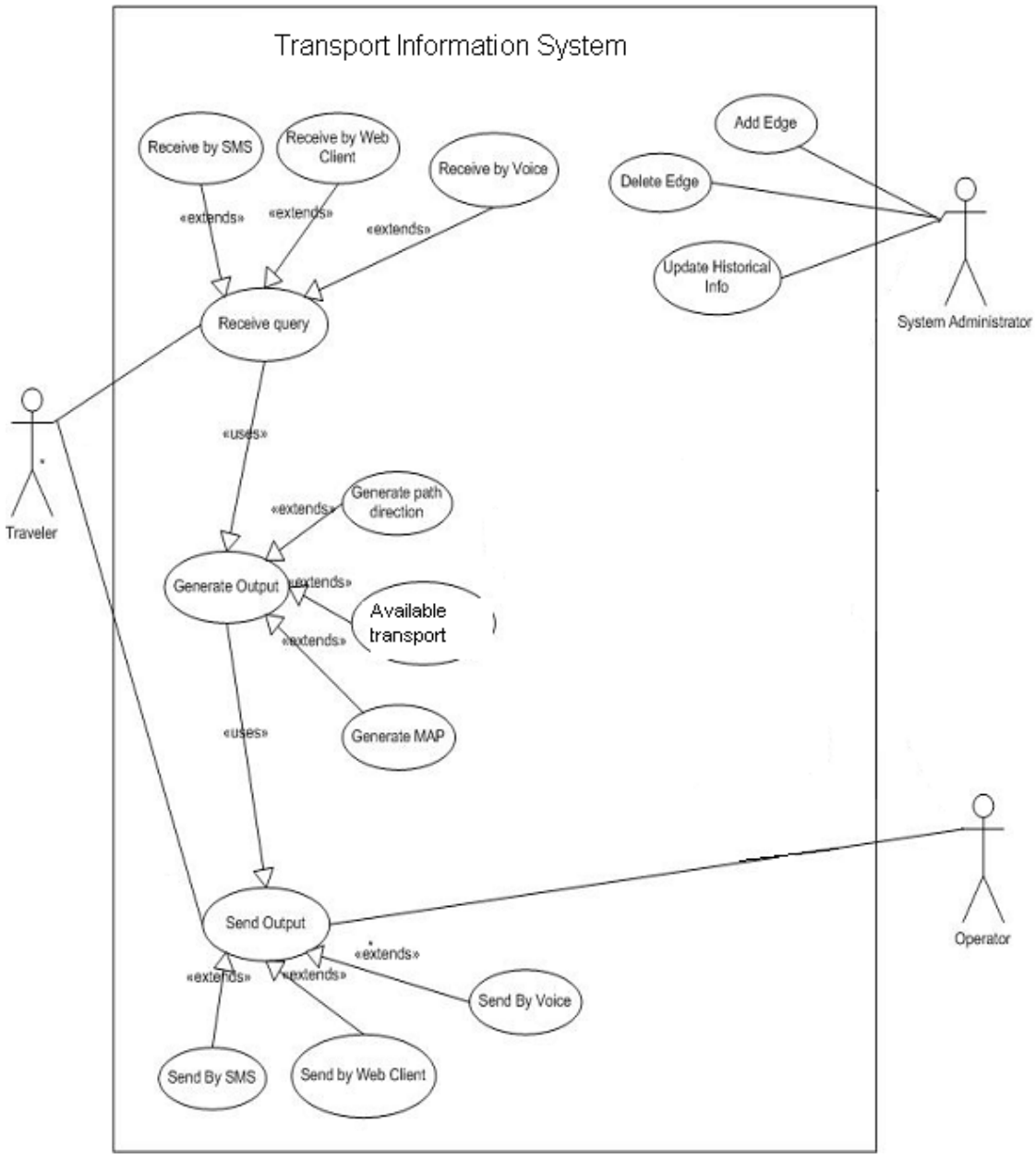



Figure:1 UML Diagram of TIS

USE CASE: Send query through SMS

Primary Actor:

Travelers

Stakeholders and Interests:

System Admin

Preconditions:

Traveler has to access compatible mobile phone

Traveler has to know query pattern

Traveler has to know destination/number (in which number the query should be send)

Post conditions:

System receive the query

Main success scenario:

1. Traveler take a mobile phone to write down the query
2. Write his desired query in predefined format
3. Send this query text to fixed number/node

Extensions:

*a System fails:

3a. Send invalid query

Reply an error message with correct query pattern to user

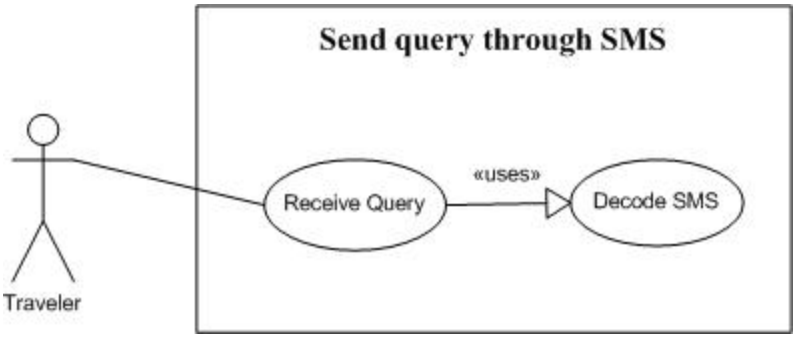



Figure:2 UML Diagram of “Send query through SMS”

USE CASE: Send query through web client

Primary Actor:

Travelers

Stakeholders and Interests:

System Admin

Operator

Preconditions:

Users have to have internet access

Users have to know the URL address

Post conditions:

System receive the query for generating path direction

Main success scenario:

1. User type the web address in browser application
2. User will get a web page from where he can make his query
3. Choose origin and destination from combo/list box
4. Click “Get Direction” button to send his query to the system

Extensions:

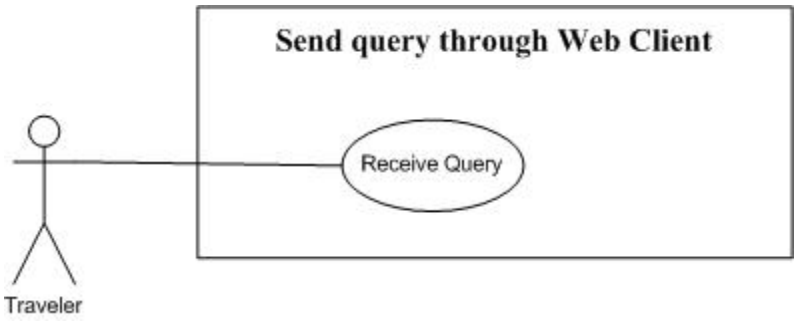
*a System fails:

1a. Type invalid URL

User will inform by browser output

3a. User can choose only origin or destination

Browser will give appropriate message



USE CASE: Send query through voice

Primary Actor:

Travelers

Stakeholders and Interests:

System Admin

Operator

Preconditions:

Users have to have phone access

Users have to know phone number of operator

Post conditions:

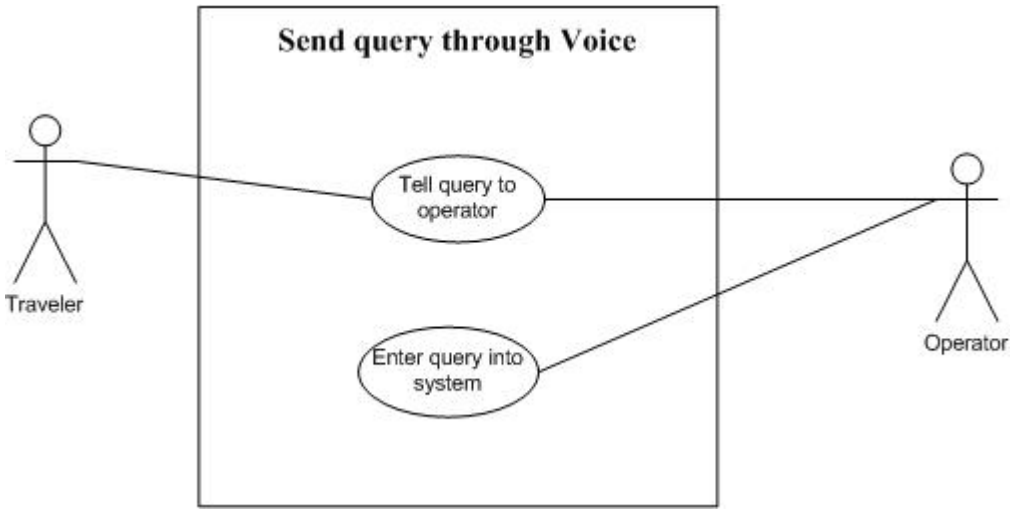
Operator receive oral query from user and send it to system through web client

Main success scenario:

1. User make a call to operator
2. Tell his query to operator
3. Operator listen user's query and identify origin and destination
4. Send this query through web client to system

Extensions:

4a System fails:



USE CASE: Receive output through SMS

Primary Actor:

Travelers

Stakeholders and Interests:

System Admin

Preconditions:

Traveler has to send a valid query through SMS

Post conditions:

Traveler gets a detail path direction

Traveler gets estimated time to reach destination

Main success scenario:

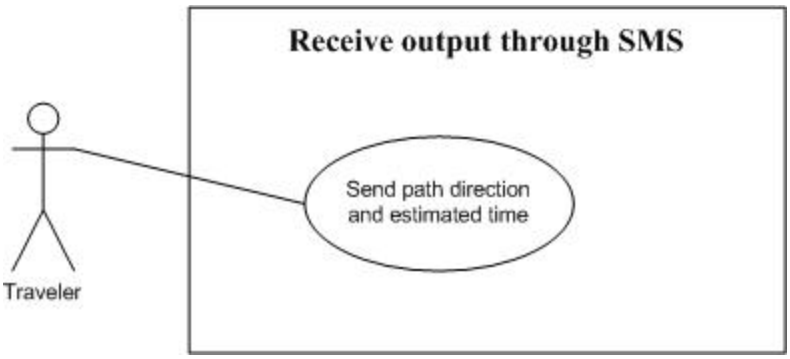
1. System apply “path reduction” on generated output
2. Send best path direction with estimated time to desired user (who initiate the query)

Extensions:

*a System fails:

2a. Long delay to send output

Nothing to do



USE CASE: Receive output through web client

Primary Actor:

Travelers

Stakeholders and Interests:

System Admin

Operator

Preconditions:

Traveler has to send a valid query through web client

Post conditions:

Traveler gets a list of detail path direction with available transport information

Traveler gets estimated to reach destination

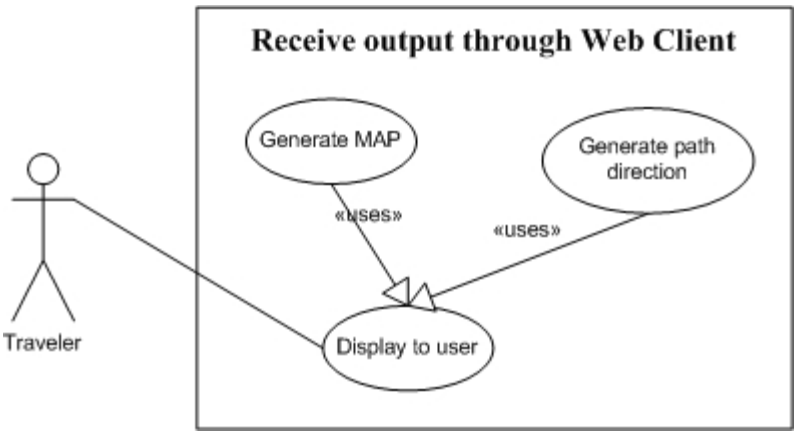
Traveler gets graphical MAP

Main success scenario:

1. System send generated list of path direction and MAP information to web client
2. Web client display the path direction and draw the MAP

Extensions:

*a System fails:



USE CASE: Receive output through voice

Primary Actor:

Travelers

Stakeholders and Interests:

System Admin

Operator

Preconditions:

Ask operator to get information

Operator has to input into web client

Post conditions:

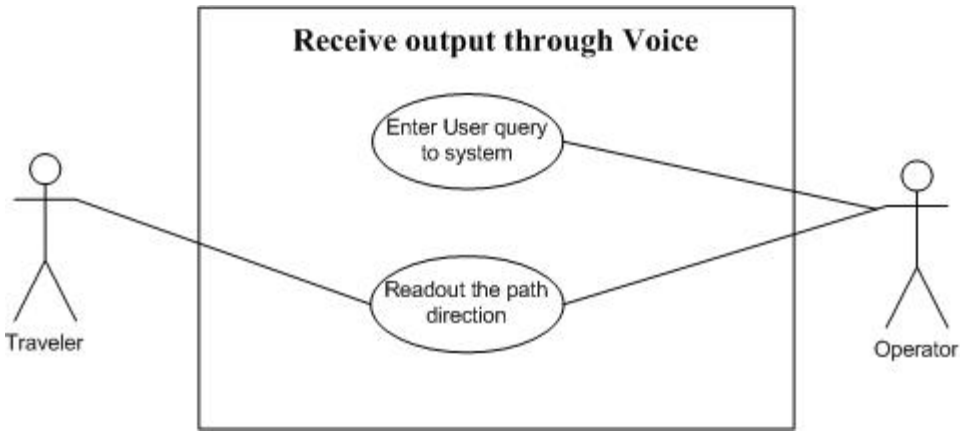
Operator readout the path direction for traveler

Main success scenario:

1. Operator receive output from web client
2. Readout this output for traveler in understandable format

Extensions:

*a System fails:



## 2.2 Block Diagram:

The block diagram of the system is shown in Figure: 1 where the system engine is the core part of the system that performs the major processing task. The system engine is supported to the components. The components are Web Application and User SMS Engine.

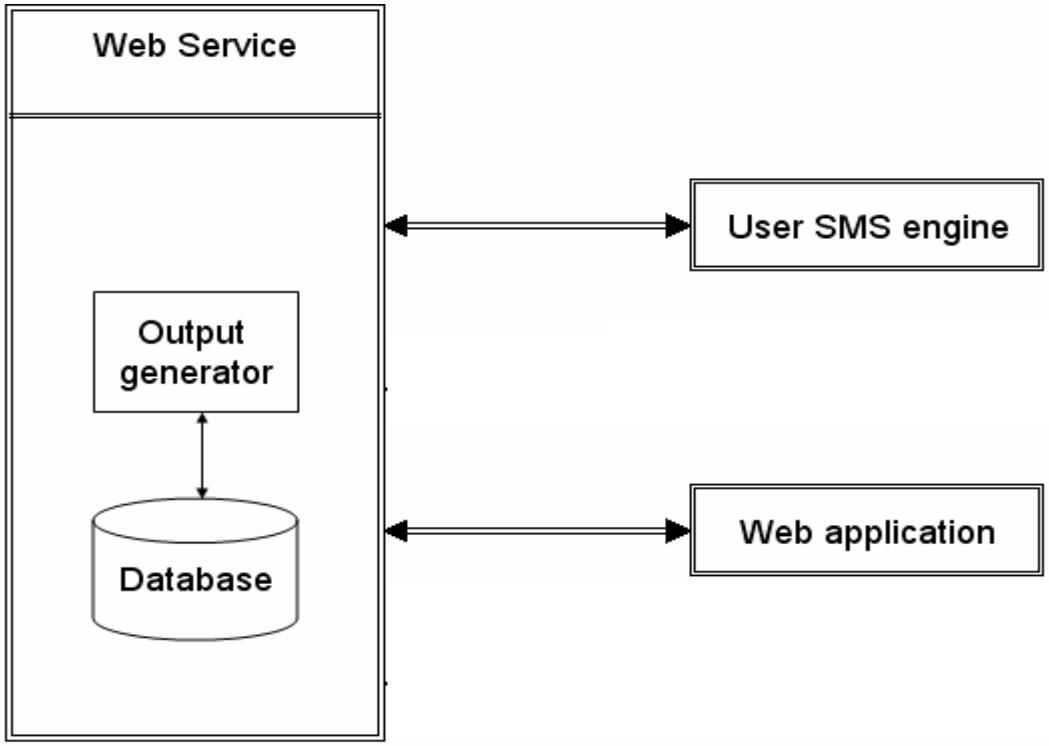



Figure: Block Diagram of the system

## 2.3 System Engine:

System engine performs some important task such as receiving query from web client or SMS user and takes action according to query to reply user. The portion of the system which generates the output uses Dijkstra algorithm. Dijkstra is a constraint based shortest path algorithm. It works on road map (directed graph) where each road/edge has a weight of Distance.

## 2.4 Database Design:

After analyzing the requirements we design the entity relationship diagram.

There are Four Database

1. PlaceInfo.
2. DistanceInfo
3. Intercity Bus
4. intercity Train

## 2.5 Web Application:

From the Use Cases we identified the major tasks for building the web application are:

- Generate Route Direction
- View Specific Node and Edge Information
- Send available Transport Information and cost
- Administrative Option

The desired route direction against specific origin and destination is generated under “Generate Route Direction" task. The generated direction can be viewed by either text mode or in visual (Map) mode. Information about any particular node or edge can get by clicking the specific node link. Here user will get information in visual (Map) mode and they have the option to interact using mouse pointer by clicking and pointing.

All these tasks use functionality of the Web Service that is working as the System Engine. To design each tasks we prepare class diagram, Interface and Dialogue Design and for map based service we draw a map by AUTO CAD. A brief description of the entire design task of the web application is given below. The choice of different tasks is shown in figure: 1.

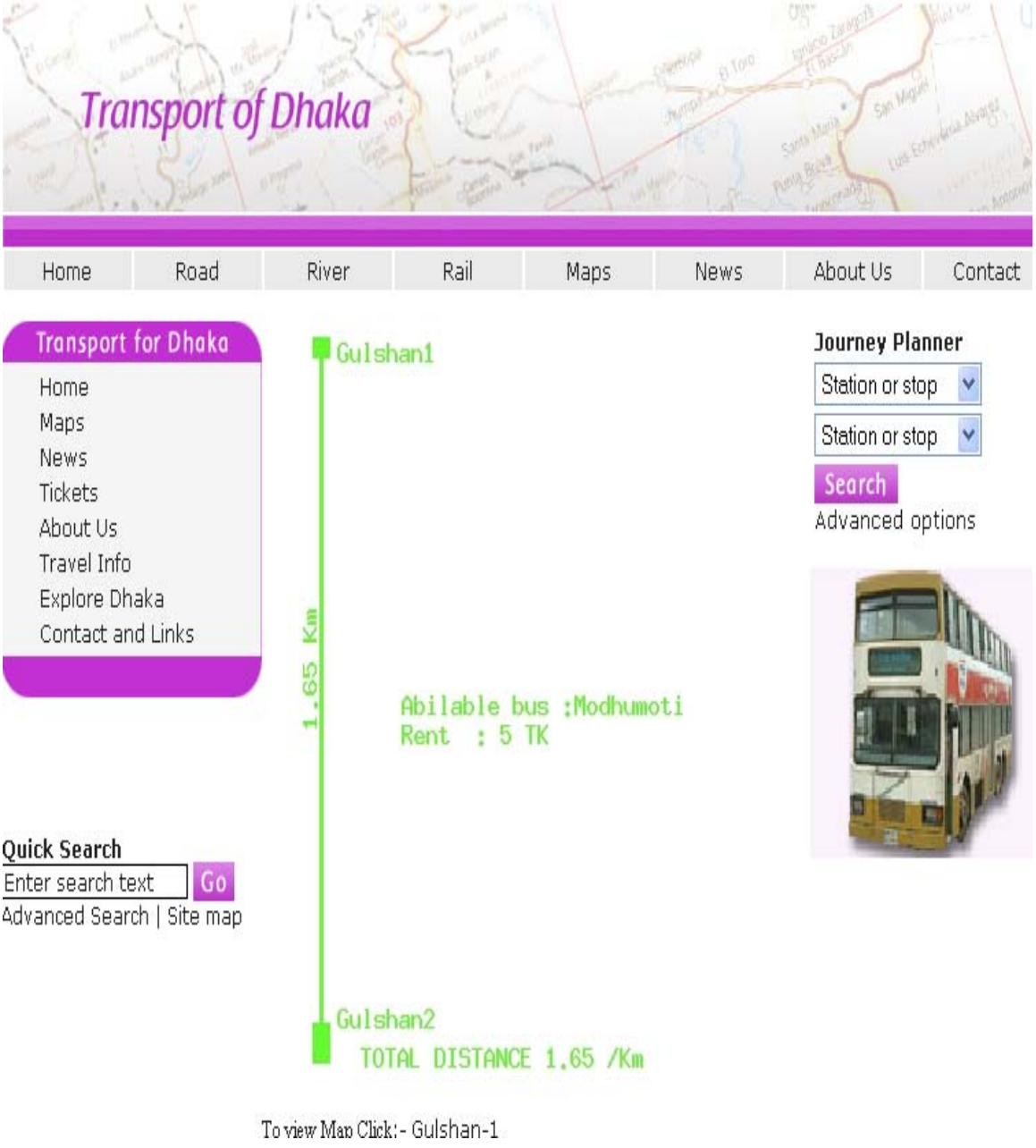



Figure-1: showing choices and transport information

The class diagram of the web service and the web application is shown in figure 2 and 3. From the class diagram we can get idea about the structure and functionality of web service and web application.

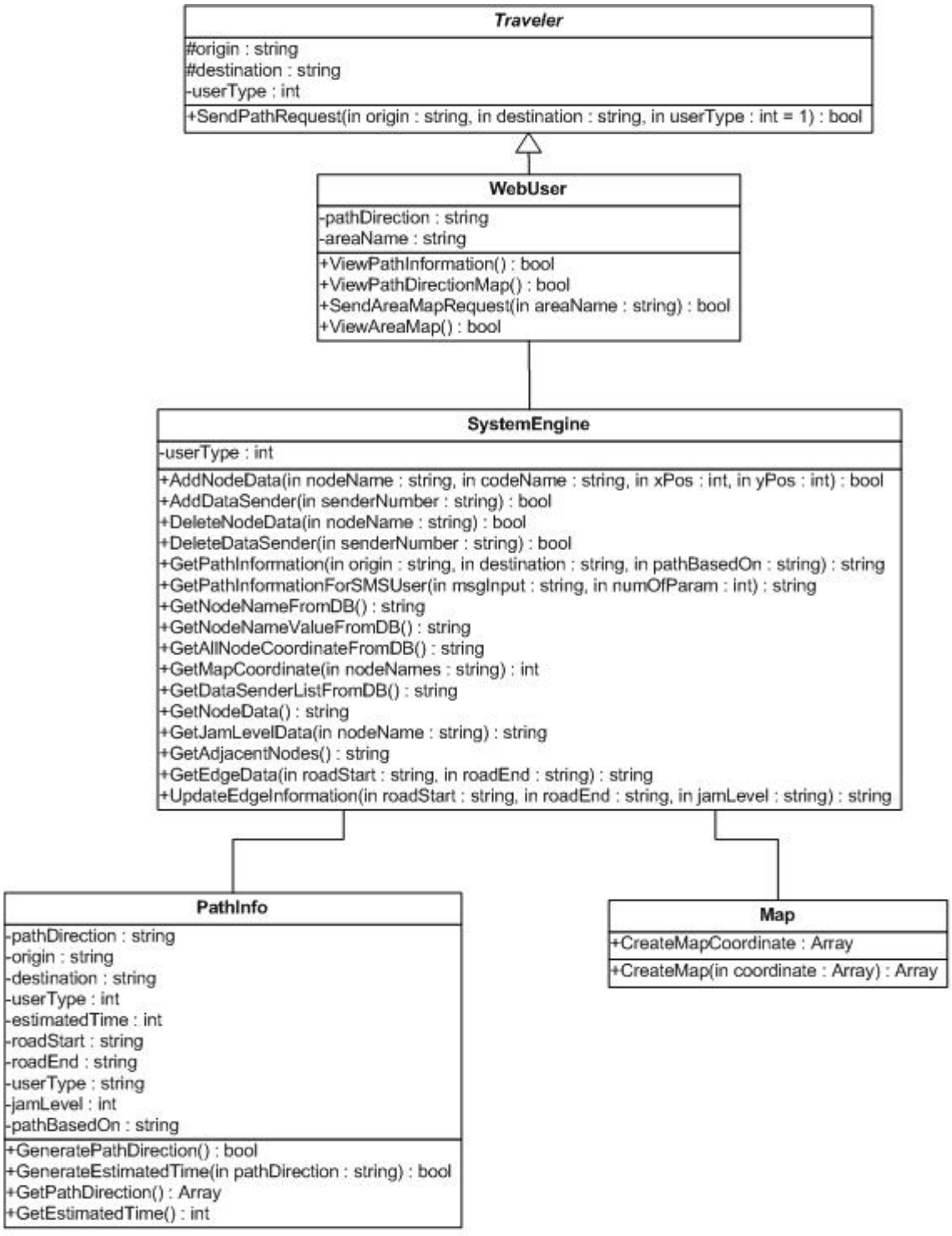



Figure-2: Class Diagram of Web Service

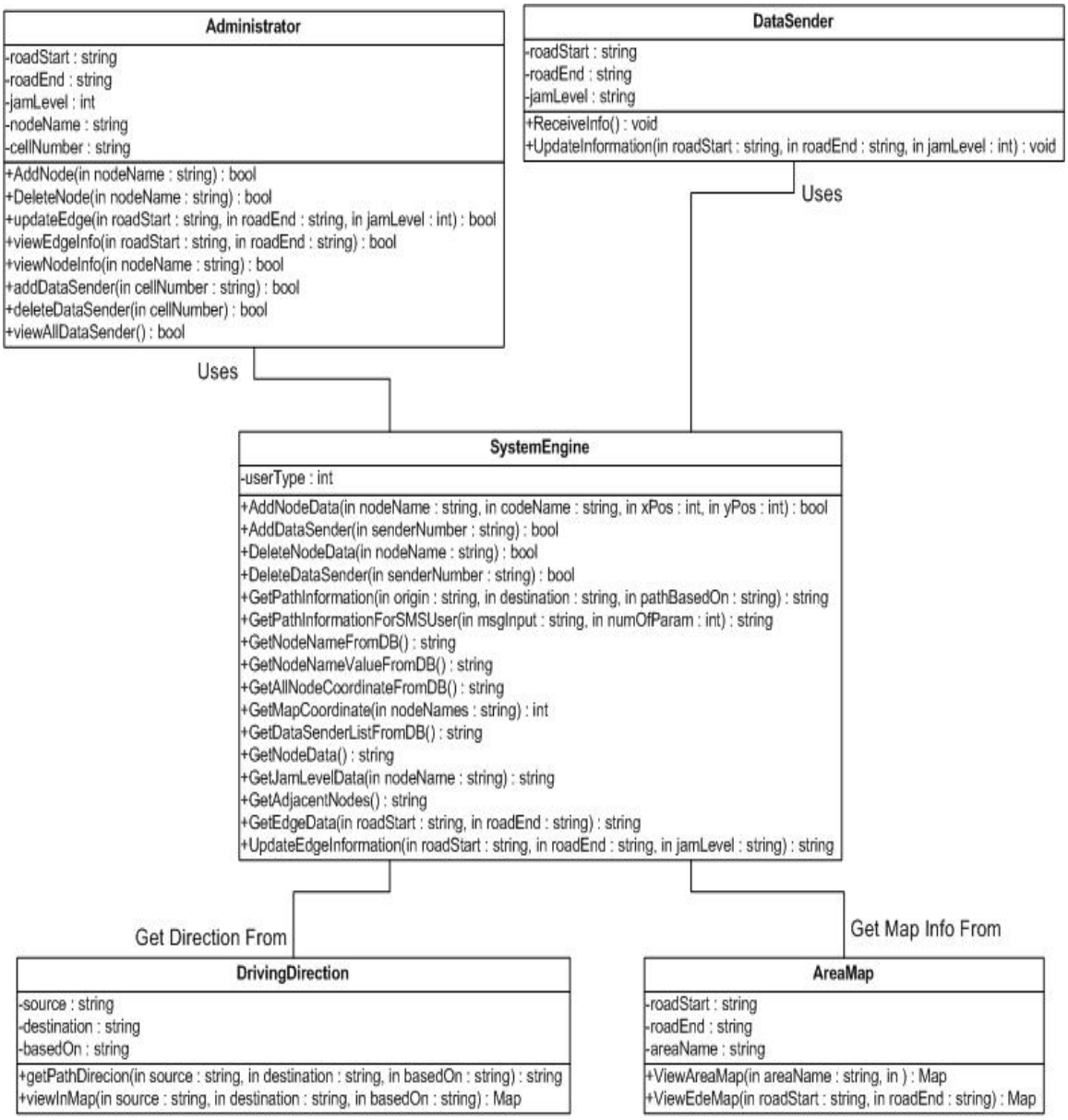



Figure-3 : Class Diagram of Web Application

### 2.5.1 Generate Route Direction

User will get the option to select origin, destination and the parameter to choose the path. The parameters are Time (default option) and Distance. User has further option to view the generated path in two different modes: "Text Based" and "Visual (Map) Based".

In the form the choice of origin and destination location is load on two dropdown lists. The parameter to generate path direction is differentiated using another two dropdown list and this two are used to select the catagory of output. This form is shown in Figure: 4.


Fig: For inter city Bus


Figure-4: for intercity Train

### 2.5.2 View Specific Node and Edge Information

User will get options to get specific information about any particular location (node) and edge (between two nodes) directly in map. User will get the opportunity to interact in the map using mouse pointer by clicking and pointing. In interactive mode user can get the latest visual picture of any location if the picture is available.

To perform this task user have to choose "View Area Map" link. In the form user will given three options:

- View Area in Map
- View Edge in Map
- Interactive Map

To view any particular node information use have to choose "View Area in Map" link. The form will then load where in a dropdown list all node names will be loaded. User has to choose desire node name from the loaded list and click on the button "SHOW". Same approach is applied to design the form for "View Edge in Map". To interact with Map user have to choose "Interactive Map" Link..

The i Map is shown in figure 5.


Figure-5: Map of Node

## 2.6 SMS Application:

The design of the entire SMS application is divided into two parts: "User SMS Engine" and "Data Sender SMS Engine". The associated class diagram obtained from analyzing the Use Cases is shown in Figure-1 and 2. Then design of each individual part is further divided into two parts:  "Pattern design" and "Engine design".

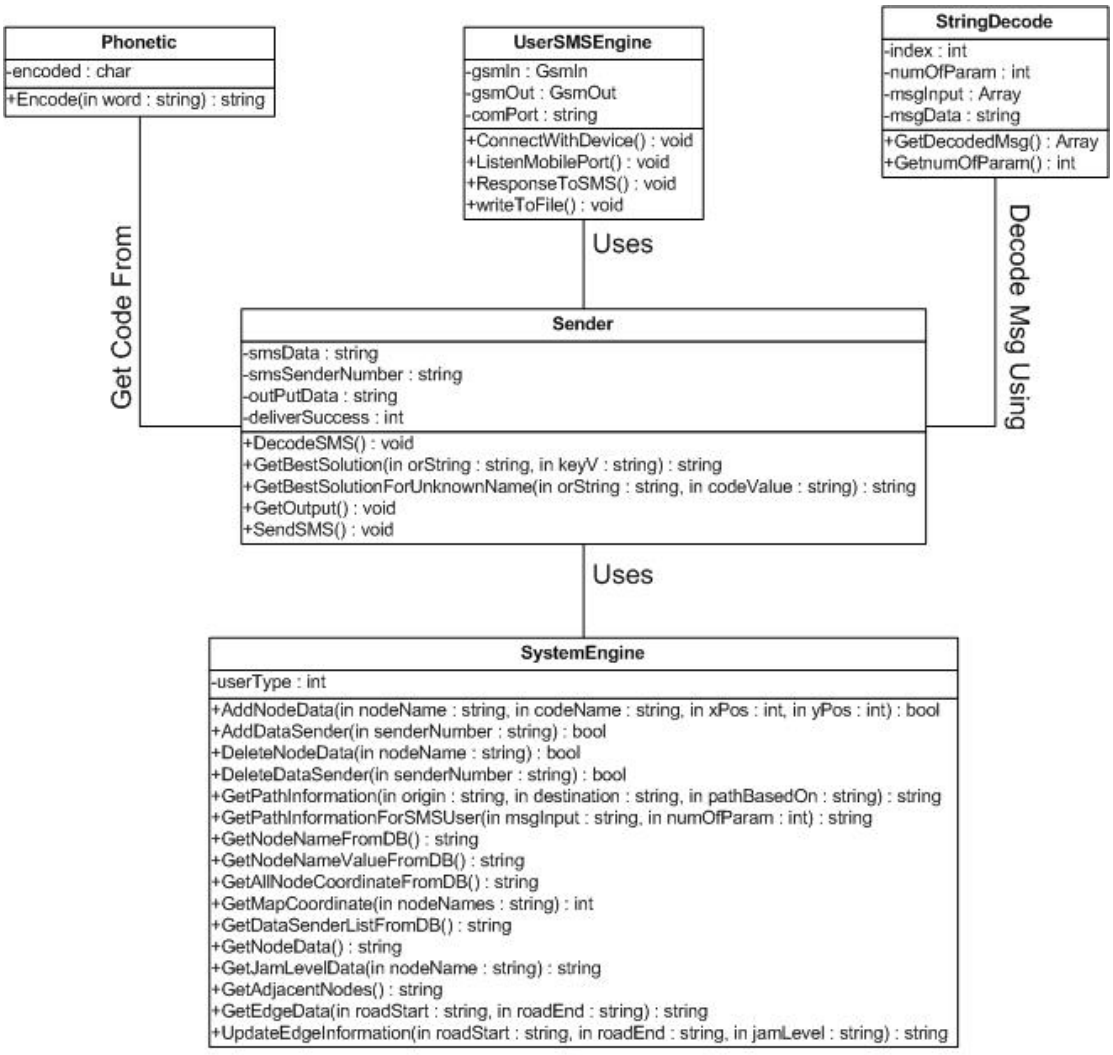



Figure-6: Class Diagram of User SMS Engine

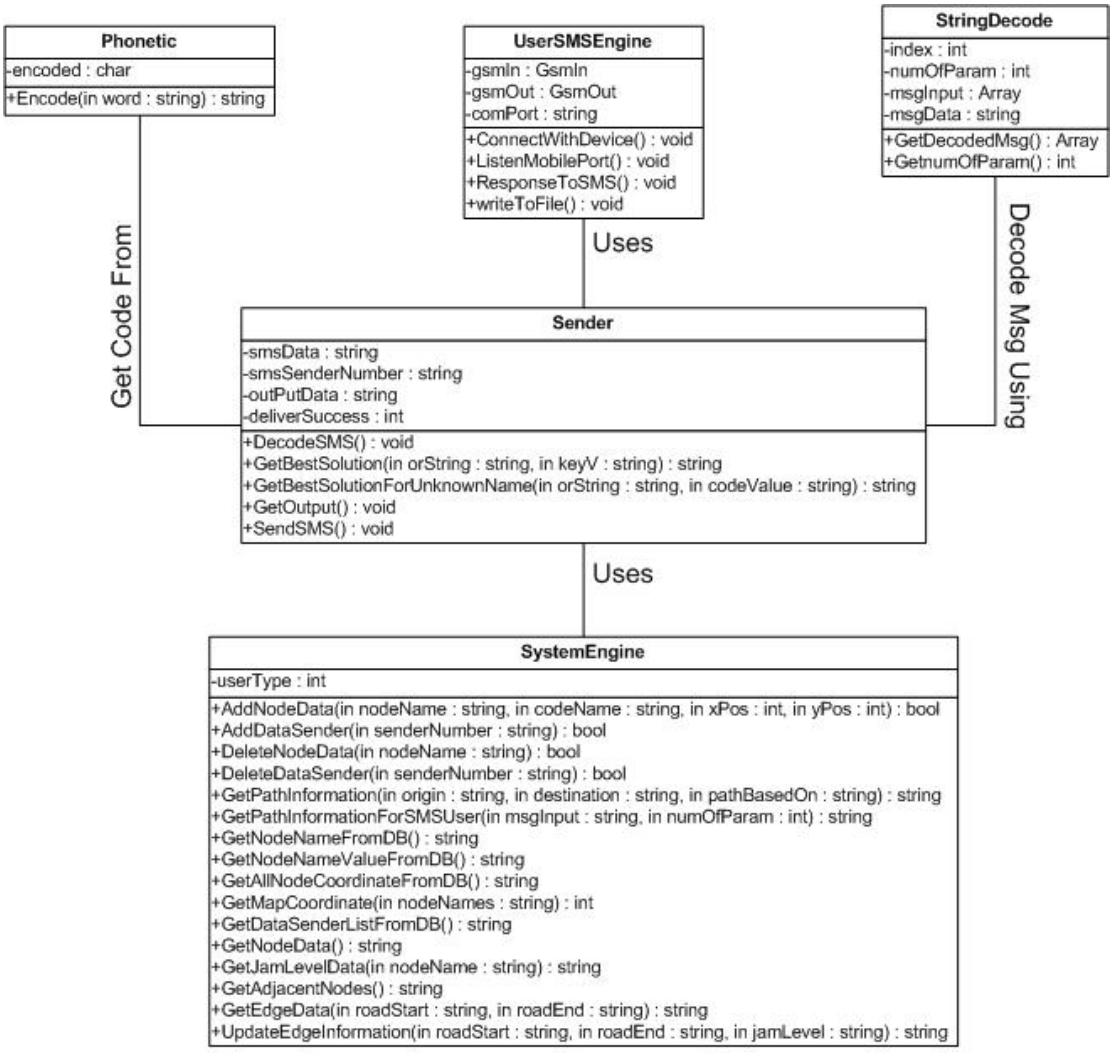



Figure-7: Class Diagram of Data Sender SMS Engine

Engine design is related to the system internal operation. We design each engine as a multithreaded application. It can receive and send SMS concurrently under different thread. It will continuously run on a pc and a thread always monitors and listen to the port. It will receive the SMS and check for any receiving error. If there is no error then it saves the SMS into a processing QUEUE and then pass the control to another thread used for handling the SMS. The SMS handler gets the SMS from the QUEUE. It then decodes the SMS and check for error. If there is error in the format of the received SMS then it reply to the SMS sender and ask for appropriate format. If no error then it gets corresponding output according to the decoded SMS using the functionality of the System Engine. At last it sends the output to the sender of the SMS. In case of failure to sending the reply it puts the SMS back to the QUEUE for resend. If the SMS come from data sender then it updates the database.

It was a challenge to design the SMS pattern for the users of this service. Our major concern was to provide maximum flexibility. Like all other SMS push pull services we also design few terms for the usage of the service. The rules are as follows:

1. The source must come before destination and they must be separated by a space.
2. Dhaka city
3. Msg: “Source Destination”
   Example: Gulshan-1 Farmgate.

4. Inter city
5. For inter city bus and Train Services user have to ByBus or Train He/she wants to travel. Also the ticket class and travel time.
   Msg: “ Source Destination ByBus Class Time”
   Msg: “Source Destination ByTrain Class Time”

For user flexibility we keep all possible combination of spelling of Source and Destination in sms database.

| **PO_NAME** | **Name_or** |
|---|---|
| Farmgate | Farmgate |
| Faromgate | Farmgate |
| Firmgate | Farmgate |
| Pharmgate | Farmgate |

*Table:1 Example of encoding for the variants of ‘Farmgate’*

All these techniques discussed above for name searching and matching are applied in the application ensure the performance of the ‘User SMS Engine’ to the highest degree reliable.

We have another SMS Engine that work almost similar fashion and need less effort in case of name searching because only adjacent names are required to search or match.

# CHAPTER |||: IMPLEMENTATION

We implemented the system as web service so that any third party can use our system in their own application. The system is implemented using PHP and Visul Basic language. Database is designed with MYSQL and Microsoft Access 2000 and Auto CAD used for map manipulation e. To implement the application for SMS Engines smstools Software is used that can send and receive SMS messages via a GSM modem and GSM phones. It supports windows COM port which can be used to connect with the GSM phone.

To visualize the path direction we drew a GIF image on which we highlighted the optimum path and provide Transport information. We also built up SMS engine to provide the service through SMS. This engine takes a SMS and then decodes it to pass Source and Destination to the web service.

# CHAPTER |V: TESTING

Testing is the final part of the software development life cycle. Here we again used “NUnit” for testing classes and functions. We performed unit test, integration test and system test.

## 4.1 Unit Test

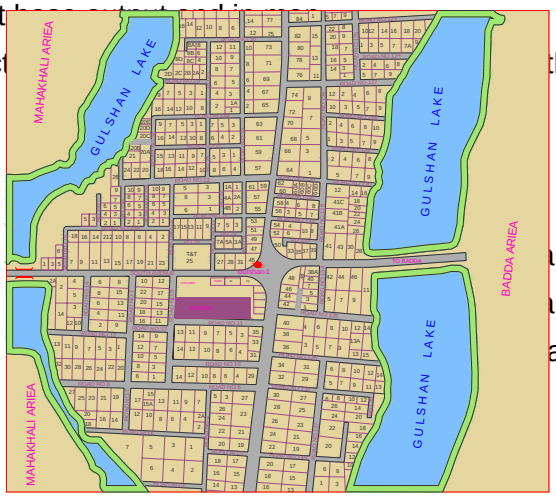
Unit test is performed by NUnit. Check the function’s output for particular input.

## 4.2 Integration Test

Integration test is performed by putting together all the modules in top-down fashion.

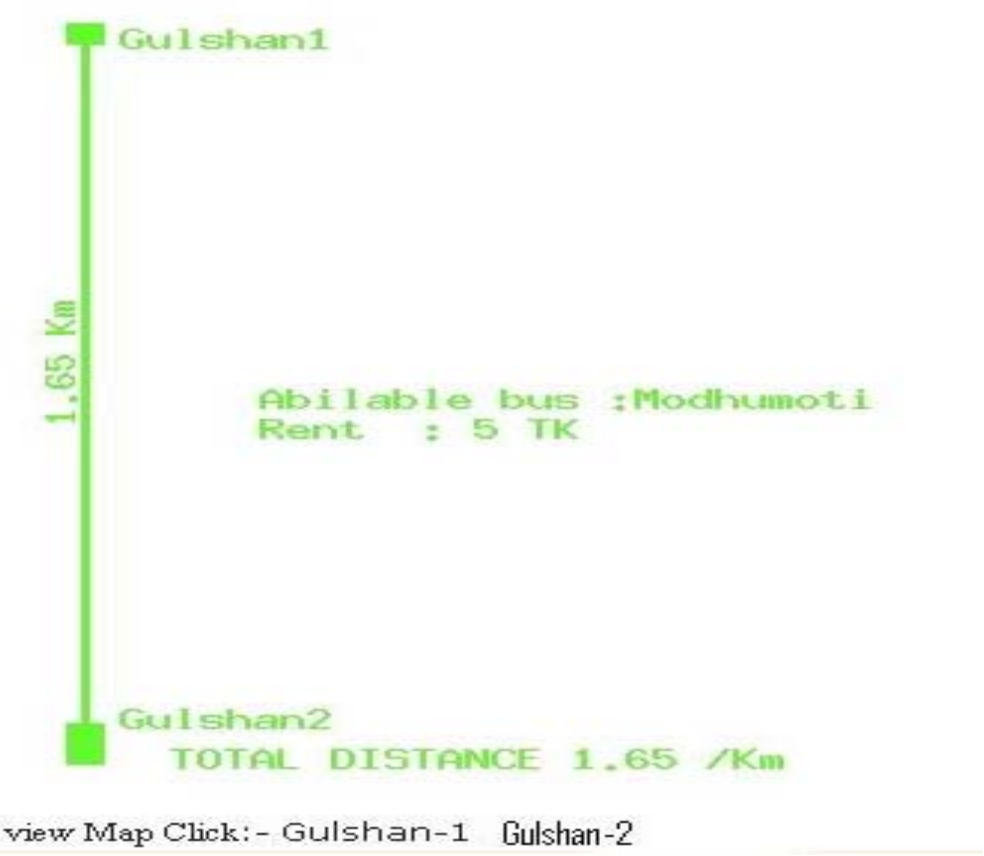
## 4.3 System Test

Putting all the programs together that a system comprises and test the system functionality. For example after integrates the whole system we perform a sample test to get path direction in text
After clicking “Get Direct th estimated time to each destination.




an-1
an-2
an-1-- Gulshan-2

We get the Available Transport information with rent
In a GIF Image



After clicking “Gulshan-1” we get the following map


The output we got above is exactly the desired output for source location “Gulshan-1” and destination location “Gulshan-2”. So the system works perfectly.

## 4.4 SMS Application Test

The SMS Engines that is a multithreaded application always listen to the port. If there is no new message within a specified time then it shows it by printing “No More New Message”. All events related to receive and send message is shown in the interface for the Engine. The testing result is shown in Figure 8 and 9.

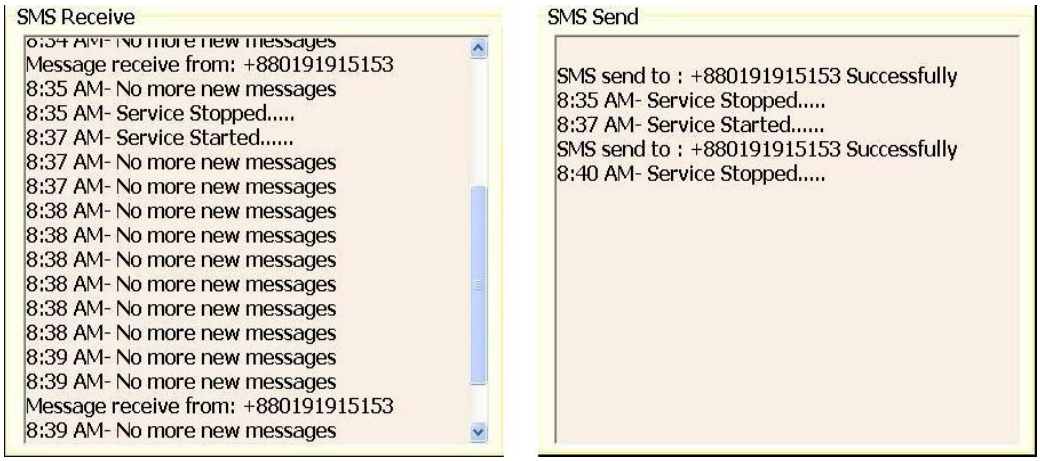



Figure-8: Test result of User SMS Engine

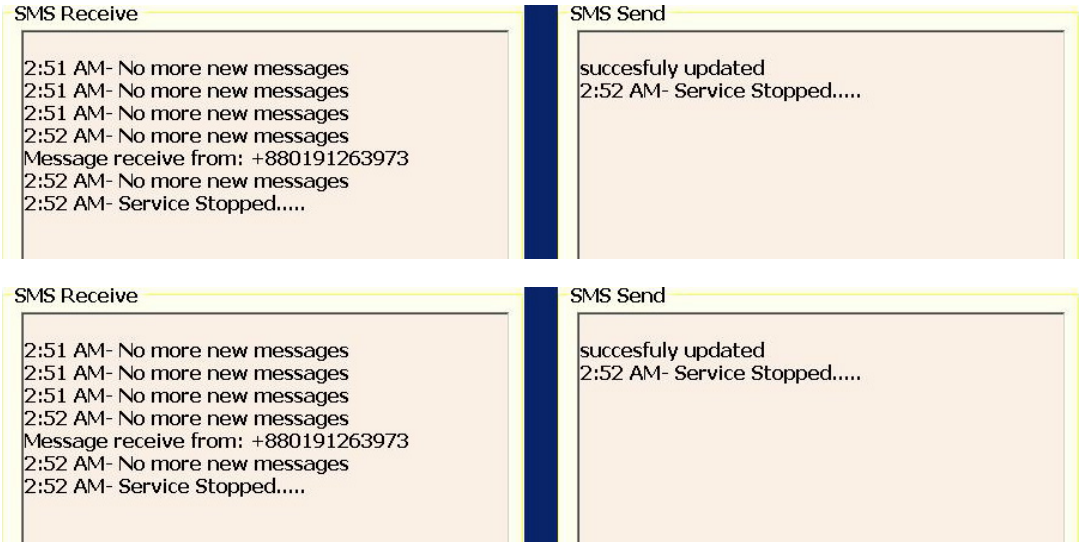



Figure-9: Test result of Data Sender SMS Engine

Test results of different SMS patterns are shown in following figure .

1. Specify only Source (start location) and Destination (End location). The output (Shortest Path) will generate according to Distance. Here the source and destination must be separated by ‘ “space” ’.

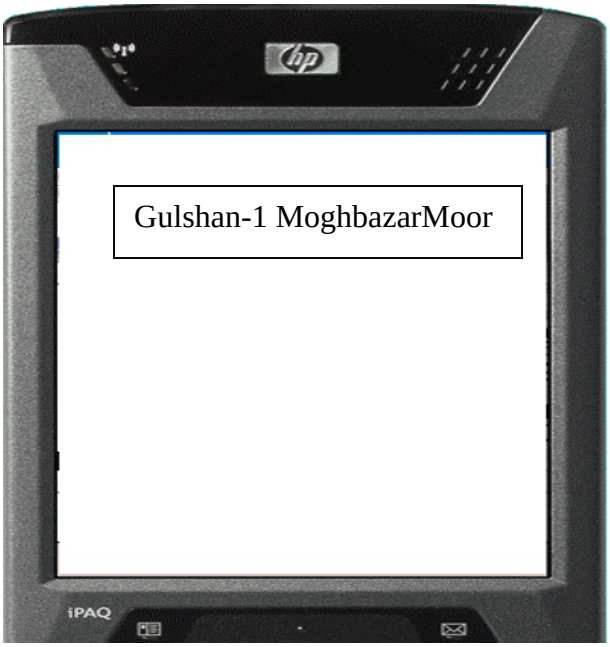
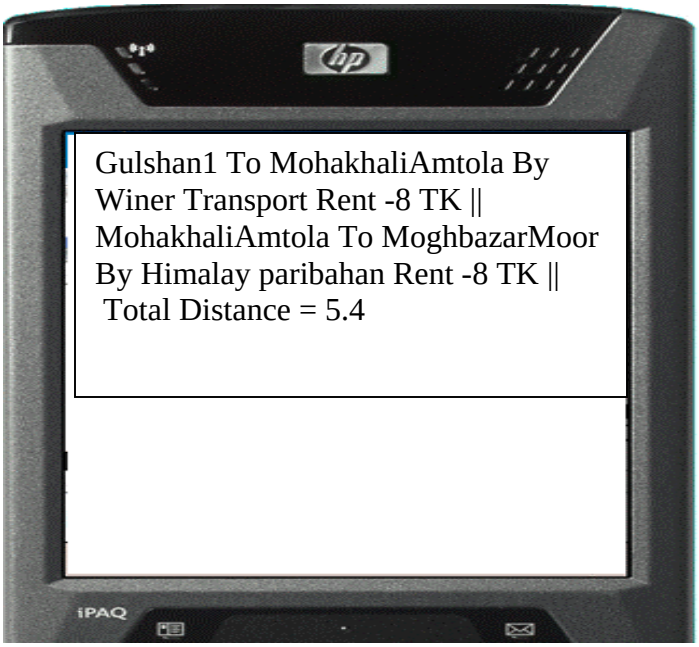



Figure-: Two required Parameters (Source and destination)



2. For any incorrect message from user the service will reply to the SMS sender asking for valid choice.


Figure-: Incorrect SMS and corresponding output

# CHAPTER V: LIMITATIONS OF THE SYSTEM

Due to time limitation, unavailable resources, equipments and technologies some features can not be implemented and some are not implemented with full power. A complete investigation on the existing process and comparison with the other Traveler Information Systems finds out the following limitations.

## 5.1 Data Collection And Manipulation

- No effect for incidents in the path calculation: Information about the incidents and special events like road reconstruction, road block due to meeting is kept separate without effecting the output path calculation. So this may lead to the generation of suboptimal path.

- Incident and special event information obtain manually: Unlike some other applications, this system does not use any incident detection algorithm and similar approaches to detect the incidents and events. It totally relies on the data sources to collect this information.

- No differentiation among vehicles: This system is unable to differentiae various types of vehicle and provide output based on the consideration of only two type of vehicle (Bus and Train).

- Inadequate Geographical Information: Right now the geographical coordinate information that is used in the map to locate different location is not properly organized. Only the direction of the locations is properly maintained. As GPS similar technologies are unavailable so we are not concerning about the actual coordinates.

## 5.2 Data Output Process

- **Limited media to broadcast information:** The system is build up according to the highly available and usable Medias. Right now the system is phone (voice), web, and SMS service enabled. There is no GPS, WAP service, VMS, PDA and pager service.

- **Lack of user interaction:** The system can ensure limited user interaction into its core operation. In web based service the users must have to choose location from the available names in the dropdown list. Users are restricted to enter the origin and destination locations according to their own choice.

- **Provide only specific node and edge info:** At present the system is capable to provide information about limited nodes and edges where the number is quite small compared to the total number of locations of the entire city.

- **Unable to control congestion:** the system does not play any significant role to control the congestion in the road.

- **Only one output path:** The system suggests only one path direction as output against user request. No alternate ($2^{nd}$ option) path information is provided. So sometime it is not sufficient for the travelers to take appropriate decision for their journey.

- **Limited area coverage:** At present this system covers only some specific portion of the city for testing purposes. So all locations will not be available right now.

- **SMS cost in case of large output:** Output length is variable for different choice of source and destination. The cost of SMS depends upon the length of output. Yet there is no suitable option to resolve this problem.

- **Limited Usage of the Service:** At present the system only perform to response user request for the shortest path for any specific source and destination. Unlike many other existing traveler information system this system has no usage on different purpose like application for emergency response and long term disaster recovery, traffic management and congestion control, finding out the vulnerable point of congestion etc.

# CHAPTER VI: FUTURE VISIONS

As Future implementation our primary target to overcome the limitations of the existing service. Then we will focus on to add features that will ensure the service of the system more sophisticated and user friendly. This will enhance and improve the usability and reliability of the system to a higher degree. Keeping this in mind the following features may be added to the system:

## 6.1 Include congestion control:

Now our System do nothing for congestion control. By congestion control we can develop our system such a way that can give real time transport information.

## 6.2 Integrating the System with the different Transport Company.

By integrating the system with different transport company both bus and train we can provide the services of ticket booking to the user. Which will help user to buy tickets from home.

## 6.3 Enhance usability of the system by including more media

The usability and reliability of the system will increase if we can enhance the service for more accessible Medias with the advancement of technologies and new equipments. So users can easily go through the service and benefited by it. The possible enhancements are discussed below.

- **Interactive Map-based Service:** The Map-based service will be enhanced so that user can get output by only interacting with the Map with the help of mouse pointer. Users don't have to write anything to get output from the service. To find desired output, users need only to locate their origin and destination using the interactive dynamic mapping features with "point-and-click". User can get several type of output using the same type features. The Map will have the property to show the real time data by continuous interaction with the central database.

- **Incorporate Interactive Voice Response (IVR) Service:** An Interactive Voice Response (IVR) service will allow users to interact with our system using the cell

phone or telephone. IVR will use to enable the users to get output from the service. It also enables the data sender to provide traffic information into the system. It will help the users to avoid the complexity to write SMS. The output will be in Voice Message (VM) format. So the implementation of IVR system will be a replacement of existing Voice (phone) service.

- **Ensure Support for PDA, Pagers & WAP enable service:** We will implement our system to support the usage of PDA, Pagers & WAP service. Users with regular and web-enabled cell phones or personal digital assistants (PDA's) can access the service via wireless media. WAP web pages are served in a similar manner to the web pages used by Internet. Some scaled down web pages will be written specifically for WAP-enabled devices. Pager media will also support. Unlike portable computers, most PDAs began as pen-based, using a stylus rather than a keyboard for input. So the Interactive map-based service will be the most flexible and user-friendly service for PDA users.

- **Incorporate GPS enabled service:** GPS enable service can enhance the usability of the system to some significant degree. To use the service users have to send only the destination to the system. The current location (source) will be determined by the system itself from the coordinate of the source. So the system will be capable of generating the desired path direction only from the specified destination. If the GPS device is graphics enable then user will get a visual map that will show the path direction with the locations.

# CHAPTER VII: CONCLUSION

Here we present a complete Transport Information System that facilitates the travelers to choose their comfortable transport, reduce ravel time by guiding them to travel through a shortest path to go their desired destination. Users can access this system through different available and flexible media. The comparison between the existing status of research and development of Transport Information System and the system that we proposed indicate that yet we can enhance and improve the service through many different ways based on the availability and applications of current technology, equipments and resources. The limitations and future visions discussed here provide a complete guideline in these concerns.

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