Traffic Guidance for Inclement Weather using GPS Navigation System

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***Abstract*— This work mainly focuses on the concept of guiding the Traffic during inclement weather conditions. Inclement weather effects the movement of vehicles leading to Traffic Congestion. Due to the inclement weather changes, roads get blocked which leads to delay in the movement of vehicles. To avoid these issues, GPS Navigation System is used where in, the user is guided to use an alternative path to their destination. GPS Navigation System , provides the alternative route to the user based on their source and destination points. Alternate path is indicated through intermediate point locations between the source and destination of the user. Intermediate locations are also checked to be unblocked and traffic free. Navigation in this GPS Navigation System is done mainly with help of Google Maps API.**

Index Terms — Alternate Path, Google Maps API, GPS Navigation system, Inclement weather, Traffic Congestion.

1 INTRODUCTION

Weather is the state of the atmosphere, to the degree that it is hot or cold, wet or dry, calm or stormy, clear or cloudy. Most weather phenomena occur in the troposphere, just below the stratosphere. Weather refers to day-to-day temperature and precipitation activity, whereas climate is the term for the statistics of atmospheric conditions over longer periods of time. When used without qualification, "weather" is generally understood to mean the weather of Earth.

Weather is driven by air pressure, temperature and moisture differences between one place and another. These differences can occur due to the sun's angle at any particular spot, which varies by latitude from the tropics. The strong temperature contrast between polar and tropical air gives rise to the jet stream. Weather systems in the mid-latitudes, such as extra tropical cyclones, are caused by instabilities of the jet stream flow. Because the Earth's axis is tilted relative to its orbital plane, sunlight is incident at different angles at different times of the year. On Earth's surface, temperatures usually range ±40 °C (−40 °F to 100 °F) annually. Over thousands of years, changes in Earth's orbit can affect the amount and distribution of solar energy received by the Earth, thus influencing long-term climate and global climate change.

Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time (i.e., decades to millions of years). Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions (i.e., more or fewer extreme weather events). Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, and volcanic eruptions. Certain human activities have also been identified as significant causes of recent climate change, often referred to as *global warming*.

Four Extreme Weather Changes Rising temperatures have something to do with it — and here's how.

1. Rain patterns are changing:
The combination of more moisture in the atmosphere from a warmer world and changes in circulation patterns contribute to more rain. The same atmospheric phenomena that cause the dry zone are also behind the the extreme drought.
2. Rain is more intense:
Heavy downpours are controlled by cloud mechanisms and moisture content, which are both changing as global temperatures rise. Clouds that can dump a lot of rain are more common in a warmer atmosphere. More evaporation has led to more atmospheric moisture, which in turn can lead to more intense rainfall.
3. Droughts are taking hold:

Drought is largely dependent on the state of soil moisture, in which rain and evaporation ultimately determine how moist the soil will be. So although evaporation is increasing worldwide due to warmer temperatures, the increase in precipitation yields a net increase in soil moisture, preventing the risk of drought. A decrease in overall precipitation, along with increasing evaporation, brings drier conditions that spawn or magnify drought. As the soil dries out, the incoming sunlight heats the ground, instead of evaporating water in the soil.

4. Floods are also taking hold, in some regions

Although the potential for flooding depends on a number of factors, land-surface conditions do play a considerable role — generally speaking, the higher the soil moisture, the higher the chance that there will be more runoff from rainfall. Soil moisture is increasing (along with rainfall rates), and flooding events are on the rise.

The 2015 South Indian floods resulted from heavy rainfall generated by the annual northeast monsoon in November–December 2015. They affected the Coromandel Coast region of the South Indian states of Tamil Nadu and Andhra Pradesh, and the union territory of Puducherry, with Tamil Nadu and the city of Chennai particularly hard-hit. More than 500 people were killed and over 18 lakh (1.8 million)

TABLE 1: Changes in Climate and Weather Relevant on US Transport [6]

Change in Climate or Weather	Likelihood
Decreases in very cold days	Virtually certain
Increases in Arctic temperatures	Virtually certain
Later onset of seasonal freeze and earlier onset of seasonal thaw	Virtually certain
Sea level rise	Virtually certain
Increases in very hot days and heat waves	Very likely
Increase in intense precipitation events	Very likely
Increases in drought conditions for some regions	Likely
Changes in seasonal precipitation and flooding patterns	Likely
Increases in hurricane intensity	Likely
Increased intensity of cold-season storms, with increases in winds and in waves and storm surges	Likely

people were displaced. With estimates of damages and losses ranging from nearly ₹200 billion (US$3 billion) to over ₹1 trillion (US$15 billion), the floods were the costliest to have occurred in 2015, and were among the costliest natural disasters of the year.

On 8 November 2015, during the annual cyclone season, a low pressure area consolidated into a depression and slowly intensified into a deep depression before crossing the coast of Tamil Nadu near Puducherry the following day. Because of land interaction and high vertical wind shear, the system weakened into a well-marked low pressure area over north Tamil Nadu on 10 November. The system brought very heavy rainfall over the coastal and the north interior districts of Tamil Nadu. On 15 November, well-marked low pressure area moved northwards along the Tamil Nadu coast, dropping huge amounts of rainfall over coastal Tamil Nadu and Andhra Pradesh with 24-hour totals peaking at 370 mm in Ponneri. Chennai International Airport recorded 266 mm of rainfall in 24 hours. On 28–29 November, another system developed and arrived over Tamil Nadu on 30 November, bringing additional rain and flooding. The system dropped 490 mm of rainfall at Tambaram in 24 hours starting 8:30 am on 1 December. Very heavy rains led to flooding across the entire stretch of coast from Chennai to Cuddalore.

The early works often focus on the correlation of weather and traffic in some particular roads where devices have been deployed to continuously collect traffic data. By analyzing the traffic change in different weather conditions, the traffic prediction can be better performed considering the weather forecast. However, the weather-traffic correlation covering most roads throughout a city (known as *regional weather-traffic sensitivity index* or for simplicity *weather-traffic index*) is still an open problem vain in spite of the practical value in our daily life. One essential reason is the lacking of effective traffic monitoring system in city-wide scale. Another open problem is how to disclose the key factors behind the weather-traffic index, to explain the reason why some regions in a city are more vulnerable to inclement weather and others are not.Table 1 accounts the climate and weather changes relevant on Us Transport.

We have addressed a series of techniques challenges in this work, and the central contributions are summarized as follows:

- The proposed system takes the reviews from the users and further updates the status of roads using Sentiment Analysis.
- It performs region partitioning based on sentiment analysis to obtain regional information using Voronoi Diagram.
- The system improves the GPS Navigation system using Intermediate locators by Alternative Graph method.
- Google Maps API key along with GPS is used in the system to generate the alternate path for the users.

In the rest of this paper, we outline the related works in section 2, and show the framework of the proposed system in section 3.Then, the data preparation component of the system is introduced in section 4, the implementation is presented in section 5,the experimental results are detailed in section 6.. Finally, this work is concluded and future works are presented in section 8

2 RELATED WORK

Traffic Guidance often focus on a particular city problem, such as traffic congestion, energy consumption, and pollution,
based on the data of traffic flow, human mobility, and geographical data, etc. For example, in a system, they inferred the real-time and fine grained air quality information throughout a city, based on the air quality data reported by existing monitor stations and a variety of data sources observed in the city. In another system, they tried to identify the hot spots of moving vehicles in an urban area via a novel,

non-density-based approach, called mobility-based clustering. In another system, they proposed a framework, called DRoF, to discover regions of different functions in a city using both human mobility among regions and points of interests (POIs) located in a region. In yet another system, the authors tried to sense the refueling behavior and citywide petrol consumption in real-time, based on the trajectories of vehicles. In some systems, they tried to discover the traveling companions and gathering patterns of vehicles, respectively. Being an important topic in urban computing and crossdomain data analytics of a system, the early research on the relation between weather and traffic is mainly based on quantitative analysis and statistical methods. For example, in [3], they presented an algorithm for forecasting physical road surface conditions based on weather and road surface data they have collected, and aim to identify icy roads during a cold weather in advance in order to predict the impact to traffic. In [4], they proposed a crash likelihood prediction model based on both real-time traffic flow variables measured through series of underground sensors and the rain data collected at weather stations in order to alarm potential crash occurrence in advance. In another system, they developed a neuro wavelet prediction algorithm to forecast hourly traffic flow considering the effect of rainfall. The experiments show that the rainfall data successfully augments the traffic flow data as an exogenous variable in periods of inclement weather. The early works focus on some particular roads where devices have been deployed to continuously collect traffic data. [1] investigates the weather-traffic correlation throughout a city and conduct analysis of the key factors behind the regions whose traffics are highly influenced by inclement weather. FIg 1.shows the risk due to natural diasters which can possibly occur in India.

Fig.1 Risk Map of the natural disasters occurred in India

3 PROPOSED METHOD

This work aims to develop a *Traffic Guidance system* which performs the following tasks :

To design and develop an efficient system for traffic guidance using GPS Navigation .

To divert various possible paths blocked to the destination based on user reviews using Sentiment Analysis.

To generate alternative path to the confined destination using Google Maps API

3.1 SYSTEM OVERVIEW

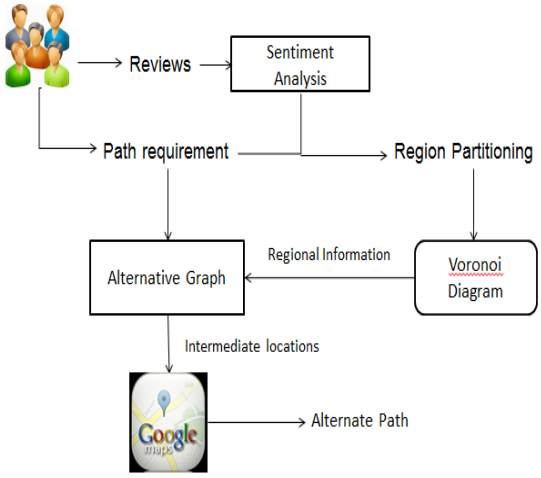

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Fig.2 Framework of the Traffic Guidance system

A. Predefining Intermediate Path

Admin Predefines an Intermediate Path linking the major areas of any particular city using alternative graph method. Also, User registers and then logs in to give the either source and destination details or the Review for an area.

For the reviews given, sentiment analysis is executed to analyze human emotions and feedback.

B. Blocked Road Detection

System collects User review of road status that is both blocked and unblocked status and proceeds to Sentiment Analysis. Voronoi Diagram performs Region Partitioning based on the output of the Sentiment Analysis.

User reviews limited to a threshold value are taken into consideration for the Sentiment Analysis.

C. Providing Alternate Path

The regional information along with the Intermediate locations predefined through the alternative path method is combined to differentiate the user requirements with the blocked paths.

Further, Google Maps API is used to provide an

alternate path to the user. If unblocked, provides the original path to the user.

4 DATA PREPARATION

This section, gives the introduction the data preparation component which partitions the city into fairly distributed regions, and collects relevant source data for each region.

4.1 REGION PARTITIONING

A straightforward region partitioning method is region-oriented partitioning such as in [8] where the city region is split into equal size grids. However, this partitioning method is improper if the traffics of road networks in grids are concerned. The reason is that the road networks in a city are often distributed unevenly. For example, the road networks are typically much denser in the urban areas than that in the rural areas. As a consequence, the road networks in some grids are highly dense and in some grids are highly sparse. This situation motivates us to apply a different region partitioning method.The method is to partition the city region using Voronoi diagram . As shown in Fig 3, a Voronoi diagram is a partitioning of a plane into regions (or *cells*) based on the distance to points (or *seeds*) in a specific subset of the plane, and the shapes and sizes of the cells differ from each other. In this paper, we choose road intersections as the seeds. We call such partitioning method as *road-intersection-oriented partitioning*. In particular, if several road intersections are very close to each other, for example within 50 meters, they are grouped together as a complex intersection. So, each cell includes at least one road intersection and the road segments connected with this intersection. The indices of all cells are obtained following the equal procedure no matter they are in dense and non-dense areas.

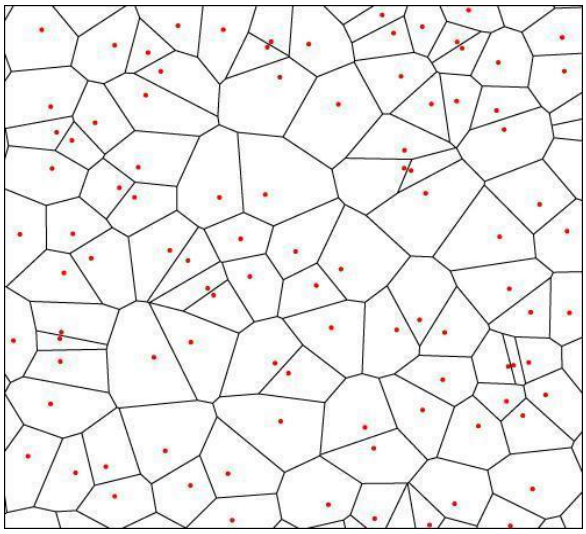

Fig 3.The Voronoi diagrams partitions .

4.2 SOURCE DATA

The input of the system includes the road networks and regional features in the city of interest, and the weather data in the same period of time. A road network $G(V,E)$ consists of a set of road segments E and a set of road intersections V. A road segment in E is associated with its type, length, speed limit, two end points and other meta information. A road intersection in V is associated with its location (i.e., latitude and longitude) and type. The carriageway between two road intersections in E may consist of multiple edges in E connected in sequence.

Weather is the state of the atmosphere, to the degree that it is hot or cold, wet or dry, calm or stormy, clear or cloudy.

5 IMPLEMENTATION

Inclement weather effects the movement of vehicles leading to Traffic Congestion. Due to the inclement weather changes, roads get blocked which leads to delay in the movement of vehicles. In such conditions, to avoid the traffic congestion and the delay caused due to it, alternate path is required. To provide this, navigation along with the advancement in the Global Positioning System (GPS) is used named as GPS Navigation System. In this system, the user is guided to use an alternative path to their destination. GPS Navigation System, provides the alternative route to the user based on their source and destination points. Alternate path is indicated through intermediate point locations between the source and destination of the user. Intermediate locations are also checked to be unblocked and traffic free. Navigation in this GPS Navigation System is done mainly with help of Google Maps API.

Initially, Admin Pre defines an Intermediate Path linking the major areas of any particular city using alternative graph method. Also, User registers and then logs in to give both source and destination details and the review for an area.

For the reviews given, sentiment analysis is executed to analyze human emotions and feedback.

Initial input involves the user registration details and the requirements for a path. System collects the Source and Destination of the user and accordingly pre defines an intermediate location for the path.

Further, system collects User review of road status that is both blocked and unblocked status and proceeds to Sentiment Analysis. Voronoi Diagram performs Region Partitioning based on the output of the Sentiment Analysis. User reviews limited to a threshold value are taken into consideration for the Sentiment Analysis. Sentiment analysis follows a sequence of steps to analyse the input given by the user in the form of a text or emoticons.

For the user reviews given, regions are partitioned using the Voronoi diagram method. This region partitioning generates the regional information. The regional information along with the Intermediate locations predefined through the alternative path method is combined to differentiate the user requirements with the blocked paths. Google Maps API is

used to provide an alternate path to the user. If unblocked, provides the original path to the user.

6 EXPERIMENTAL RESULTS

PREDEFINING INTERMEDIATE PATH:

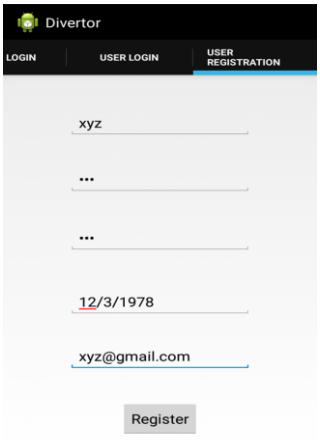

Fig.4 User Registration

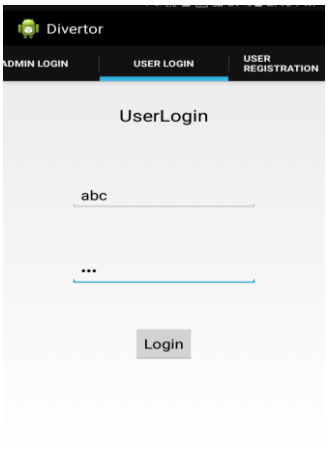

Fig.5 User Login

Fig.6 Defining Places

Fig.7 Location pointers

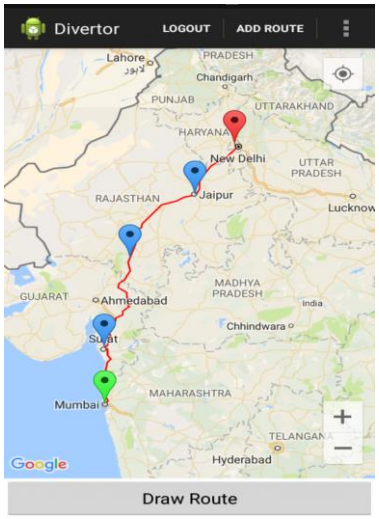

Fig.8 Predefining Intermediate path

User registers first and then goes logs in to give the either Source and Destination details or the Review for an area.Admin Pre defines an Intermediate Path in Fig.8 linking the major areas of any particular city using alternative graph method.

BLOCKED PATH DETECTION:

1. BLOCKING ROUTE PROCEDURE:

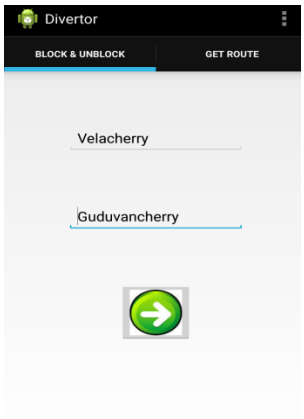

Fig.9 Enter the route to block

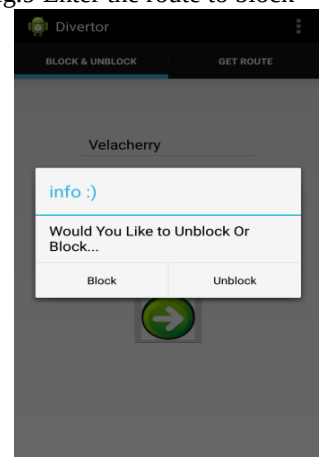

Fig.10 Block or Unblock

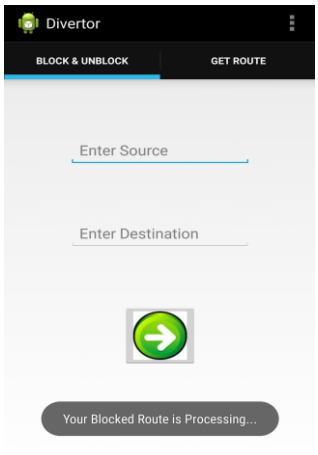

Fig.11 Route is blocked

Enter the source and destination and select the choice to be blocked. Once selected, request is processed and when reached the threshold value, blocks the route in Fig.11.

2.UNBLOCKING ROUTE PROCEDURE:

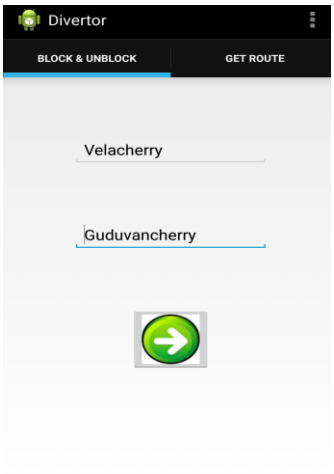

Fig.12 Enter the route to unblock

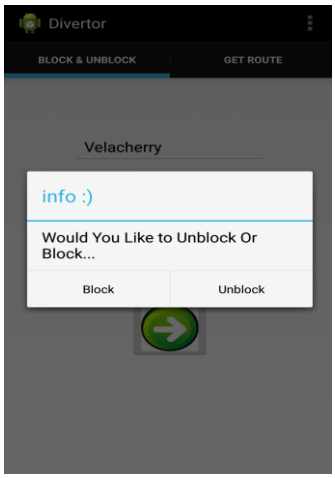

Fig.13 Block or Unblock

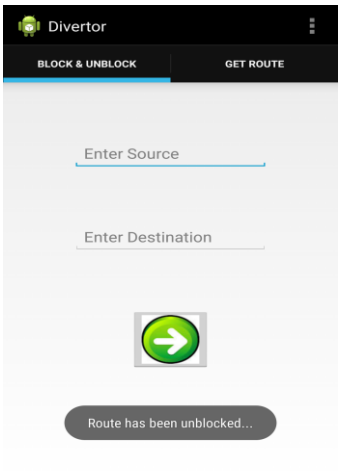

Fig.14 Route is unblocked

Enter the source and destination and select the choice to be blocked. Once selected, request is processed and when reached the threshold value, blocks the route,as shown in Fig.14.

3.PROVIDING ALTERNATE PATH:

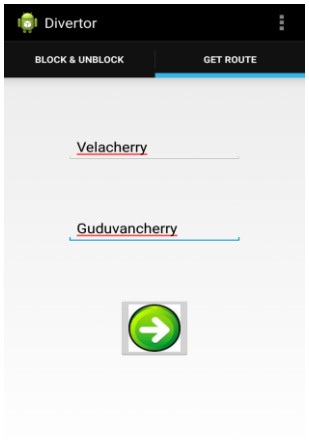

Fig.15 Get Route

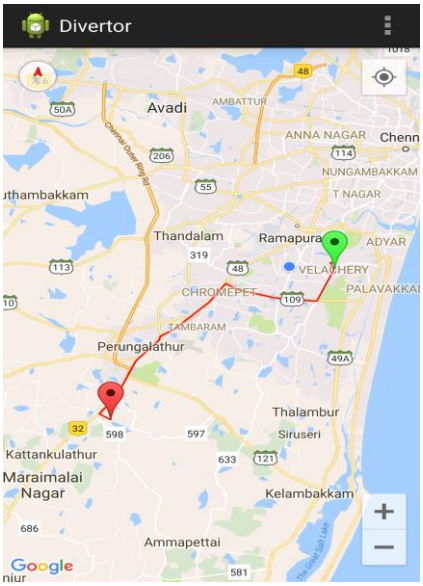

Fig.16 Alternate Route is displayed

Display of Alternate path to the user for their respective Source and Destination after eliminating the Blocked roads. When a user requests for the path, system checks automatically for the blocked or unblocked status.
If the requested path is blocked, system provides the alternate path,as shown in Fig.16.

7.PERFORMANCE ANALYSIS

Mobility: The ability to easily move and transport between different locations.
Average speed is considered as the main factor for mobility measurement.
Reliability: Defined as day-to-day change in travel times experienced by travelers.

In this work, according to the Fig.17,the mobility analysis is shown. The location of a few places with respect to average speed of vehicles is considered and plotted in a graph.In fig.18,the reliability analysis is shown.The location of a few places with respect to travel time is considered and plotted in a graph.
Hence we find the mobility analysis and reliability analysis to be varying according to the values and there is an improvement of performance result compared to the existing system.

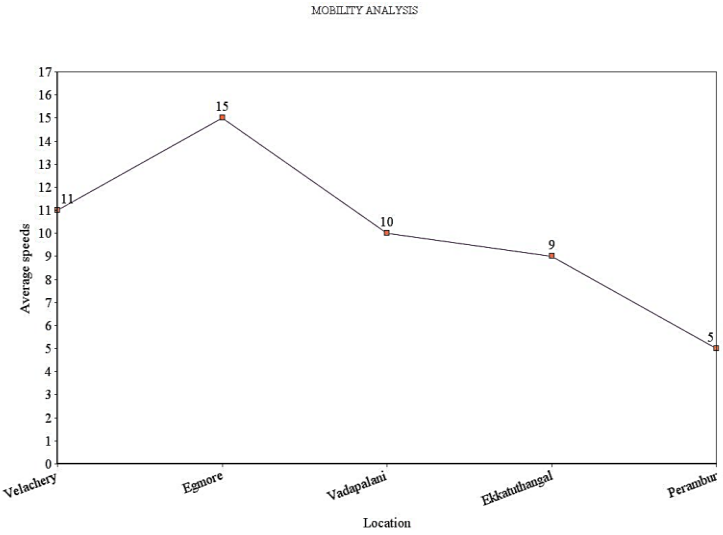

Fig 17.Mobility Analysis of location with respect to average speed

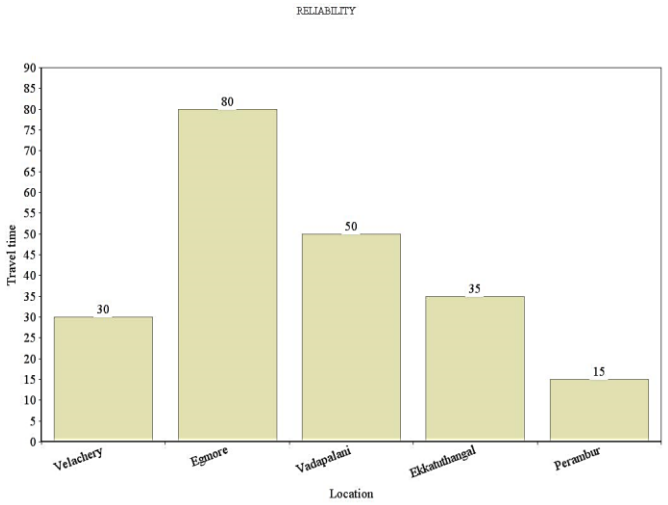

Fig 18.Reliability analysis of location with respect to travel time

8 CONCLUSION AND FUTURE WORKS

This work fills the gap in the study on the impact of weather to traffic from few locations to all road networks throughout a city, more importantly, the regional features leading to the vulnerability of traffic in local areas to inclement weather are systematically revealed. The achievement in this work will benefit government agent to understand the functional character of districts throughout a city, to improve traffic prediction and to learn the key factors in the traffic urban planning, etc. This system when integrated with Google Maps provides an efficient alternate path when blocked. At last, the investigated problem has important practical value, but the research is still in its early stage. We are working on to incorporating more data sources to continuously improve the results.

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