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Level Of Service Criteria Of Indian Urban Roads In A Future Smart City

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Abstract

India is a country with high population density. It has the second largest road network in the world. As population boasts, there are thousands of different types of vehicles added to Indian urban roads, so crowds are increasing with Zip, Zap and zoom speed. Service level (LOS) can not be defined for heterogeneous traffic flows with various operational functions. Essentially, the depiction of LOS is a matter of classification. In this research, diligence of cluster analysis is the most effective ability to solve such a problem. In this algorithm, adaptive algorithm, genetic programming, maximum likelihood method, expected value maximization method . Use five cluster validation parameters to check for optimal cluster absence. After obtaining the optimum number of clusters, these four methods are applied to free flow rate (FFS) data to obtain the range of street classes in different cities. Again, these four clustering methods apply to the average moving speed of the street segments to specify ranges of different LOS categories. The speed data used in this survey is collected using a Trimble GeoXT GPS receiver attached to medium-sized vehicles in the five major city corridors consisting of 100 different road areas in the Greater Visakhapatnam area. The results show that the average moving speed of FFS and LOS categories in the city street class is lower than that caused by HCM 2000 due to physical and environmental characteristics. In addition, the average moving speed in the LOS category was expressed as a percentage of the city street class FFS, which proved to be different from what was mentioned in HCM 2010.

Key Words: Urban Roads, Level of service (LOS), Clustering Analysis, adaboost algorithm, Genetic programming (GP), Maximum-Likelihood Method (ML), Expectation-Maximization Method, (EM) and Free Flow Speed (FFS).

1. INTRODUCTION

1.1 INTRODUCTION

The definition of a simple or cities may Urbanism: union organization or neighboring communities started to make use of a common meeting for worship, security, and so on; Here, the body established by the state or political community as a. Where cities also can be defined as the generation of cells, neighborhood, or community where people work together for the common good. Types of urban areas can vary greatly according to different activities of include: the production process and all kinds of goods, skills, transport, provision of goods, services, or a combination of all of these activities. A third definition that urban areas are places where there is an opportunity for a different living environment and lifestyle range. People who live, work and enjoy social and cultural relations that are provided around the

local towns. in urban areas can be simple or complex. They can taste the countryside or in the exchange industry. They can be in any kind of conflict or filled. They can be small and easy to maintain, or qawadsanaayeen strife and economic problems in full. According to the survey, made by the Government of India, there were 83 cities in India by the end of 2003, with a population of more than 0.25 million. Current needs are cities 443- billion passenger kilometers. About 80 percent of needs are expected to be met by the road transport system based on (Datla, 2004). At the moment there is no way to correct it is available to evaluate the Level of Service (Los) provided by India on rural roads. It is important to develop methods of analysis appropriate level of service roads. Greek philosopherHeraclitus once said that the problems confronting the human society was to combine a degree of freedom without law is tyranny, with a degree in law, without which freedom becomes license. democracy in Athens, CARTA Magna in England, and the constitution of the United States made essentially the same amarba. Our society is organized on the basis of a set of regulations established in order to guide people's behavior. The people of America created the domain of big business and the major cities and industrial planning and defining the appropriate level of service in terms of roads built. It is shocking to note that 32 percent of these vehicles are to leave the cities and surrounding areas only, which comprise about 11 percent of the total population (MORTH, 2003).

2 LITURATURE REVIEW

The level of service concept (Los), first proposed in 1965 a version of the manual power. In this perspective, it is recognized that in view of the driver transport system is also important to consider. It has become more important to not only measure, but as a form of activity Los important steps such as the length of the line or the average speed. it has become necessary to expand the area of the analysis point to the part, and then make the right half of the two-dimensional space. And then finally got on one system, integrated multimodal transport. The 1950 board was prepared only to fulfill the needs of traffic engineers, who participated in the planning, design, and touch the specific sections. According to the 1965 board, the level of service described by six class "A" to "F" defined based on a combination of time travel and the ratio of the level of traffic to the power sector. The "1965 HCM concept has been explained several traffic conditions 1985 version of the highway book capacity of the speed of travel, the level of traffic and the density of traffic in each type of traffic. There was in 1985 HCM in Los measure and given by Baumgartner (1996), Cameroon (1996) and Brilon (2000). Baumgartner (1996) found that the rapid growth of urban populations, ownership of the car, the length of the trip, and the number of trips has led to an increase in relative volumes transport. as a result, the status of the trip to see how intolerable in 1960 is considered normal that people today, especially in the passenger Cameron (1996) said that it was not unusual to wait three minutes as crossing a congested urban average robbery often have two minutes. Later various researches have been done, because the characteristics of the six or nine service a lot.

3. STUDY AREA AND DATA COLLECTION

Five important urban road corridors of the port city Visakhapatnam of AndhraPradesh state, India are picked out for this study. Greater Visakhapatnam is a coastal city with a linear pattern of transport network having prevail north-south commuter movements. Passengers move towards south for work trip in the morning hours and return back towards north in the evening hours.

Figure- 3.1: Map showing selected corridors of Greater Visakhapatnam

The probe vehicles featuring mid-sized car was tallied with Trimble Geo-XT GPS receiver, adequate to logging speed data unremittingly at time intervals of one second. GPS furnishes both spatial and time/distance based data from which various traffic parameters were deduced, letting in travel time and travel speeds. In order to bring forth unbiased data sets three mid-sized cars were employed and assist of three drivers on different days of the survey work was chosen. Essentially three types of data sets were accumulated.

The first type is roadway inventory contingents, for which a data dictionary was geared up using path finder office 3.0. Throughout the accumulation of inventory contingents, proper segmentation technique was implemented, which is just afterwards signalized intersection to just afterwards next signalized intersection. Contingents on segments like segment number, number of lanes, median types, pedestrian activity, road side development, access density, construction activity, speed limit, separate right turn lane, number of fly overs, date and day of data accumulation and segment length wereaccumulated.The second type of survey conducted was to break through the free flow speed. Before going for the free flow speed data collection, we should know when the traffic volumes of less than or equal to 200 vehicles per lane per hour. An elaborated 24-hour traffic volume count survey was carried out by the group for western sea link (VSL) project. The traffic volume data are accumulated on 45 stations in seven screen lines. Of the survey data traffic volumes per lane per hour was deliberate for roads coming into the study area. It was established that free flow traffic condition (less than 200 veh / in / hr) is forthcoming in 12 mid-night and all road sections are having free flow traffic conditions 1: 00-05: 00. Thus free flow speed for all the corridors are accumulated during the hour.The third type of data accumulated was congested travel speed. Congested travel speed survey was composted, both top and off pick hour on both directions of all corridors. Number of trips extended for each direction of travel and for the study hours (peak, off-peak and free flow) is at least three and sometimes it is up to six trips. Then data has been

accumulated in the field; It has been transported back to the office computer by using path finder Office version 3.0. Accuracy of field data are significantly amelyorated through a process called Differential correction.Basically three types of data sets were collected such as roadway inventory details, free flowspeed and travel speed during peak and off peak hours. A GPS receiver logs information in the form of features and attributes. A feature is a physical object or an event in the real world for which we want to collect position and descriptive information. A feature is of point, line or area type. We can define a set of attributes for each feature type. An attribute is a piece of descriptive information about the feature. Attributes are of menu, numeric, text, date and time types in data dictionary. Segment number, number of lanes on roadways, median type, parking conditions,pedestrian activity, road side development, access density, commercial activity and speed limits etc. were collected during inventory survey.The second type of survey conducted was to find the free flow speeds on all these corridors.

3.2 Cluster Analysis

Cluster analysis or clustering is the task of allocating a set of objects in groups (called clusters) so that the objects in the same groups are similar (in one way or another) to each other in other groups. Clustering is a major task of exploratory data mining, and a general technique for statistical data analysis used in many fields, including machine learning, pattern recognition, image analysis, information retrieval and bioinformatics. Cluster analysis group data objects based only on information found in the data describing the objects and their relationships. The purpose is that the objects within the group are similar to each other and differ from objects in the group. Different types of group analysis are there. Four methods are used in this research. Commonly known as Adaboost Algorithm, Genetic Programming, Maximum Probability Method and Expectation-Maximization Algorithm.
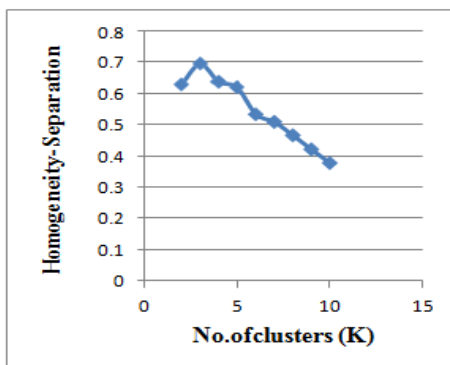
4. RESULT:

In this chapter the results and observations of the tests conducted are presented, analyzed and discussed. Average travel speeds were calculated direction wise on each segment. Four advanced cluster analysis techniques (Adaboost, GP, ML& EM) were applied in two stages. Firstly, clustering methods were applied on average free flow speeds of all segments and free-flow speeds were classified into four groups. Each range of free flow speed found out indicates to an urban street class of I to IV. Secondly, clustering methods were applied on average travel speeds that were collected during peak and off peak hours on street segments for each of the urban street classes. In the second case, speeds were classified into six groups (A to F) forsix categories of levels of service; thus speed ranges for level of service categories were defined in Indian context.
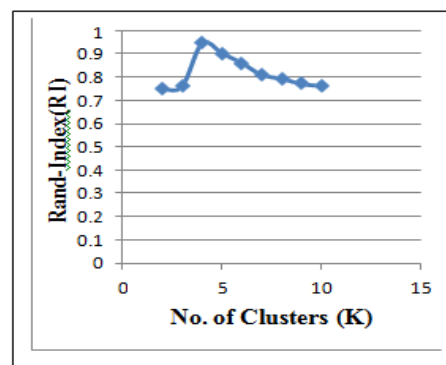
Table-5.1: Urban Street Speed Ranges for different LOS Proposed in Indian Conditions by ADABOOST Method

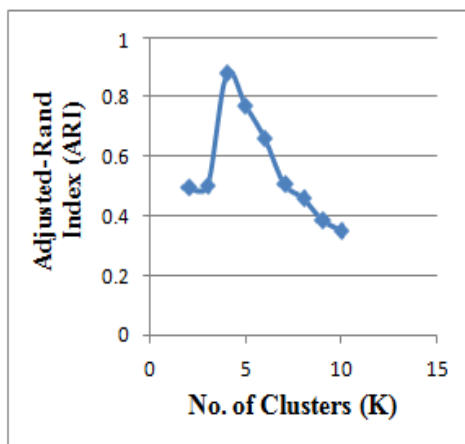| Urban Street	I	II	III	IV
Range of Free Flow Speed (FFS)	65 to 95 km/h	49 to 65 km/h	33 to 49 km/h	25 to 33 km/h
Typical FFS	72km/h	58km/h	39km/h	27 km/h
LOS	Average Travel Speed (Km/h)			
A	>68	>52	>45	>32
B	>55-68	>45-52	>37-45	>25-32
C	>40-55	>40-45	>33-37	>14-25
D	>31-40	>28-40	>25-33	>10-14
E	>22-31	>13-28	>11-25	>8-10
F	$\leq$22	$\leq$13	$\leq$11	$\leq$8

In this research five validation parameters were used. Value of validation parameters were obtained for 2 to 10 number of cluster and were plotted in following Figures.
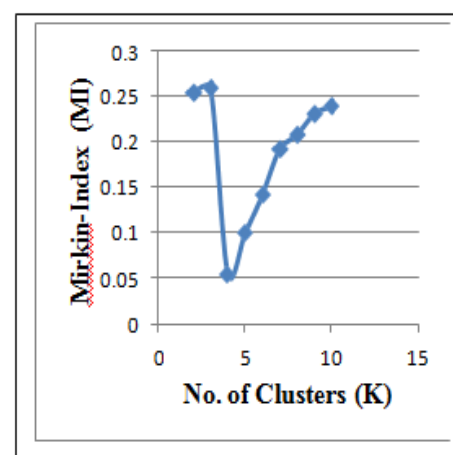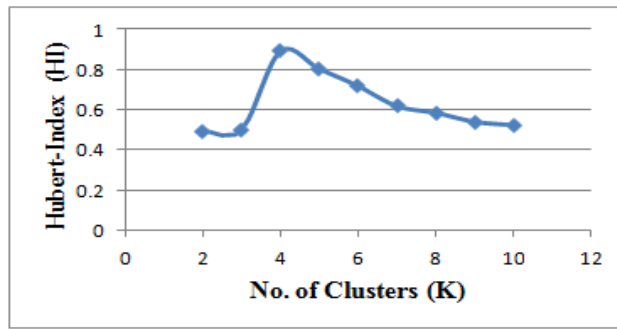

A: HSI Vs No. of cluster

B: RI Vs No. of cluster

C: ARI Vs No. of cluster

D: MI Vs No. of cluster

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E: HI Vs No. of cluster

Figure-4.1: Validation measures for optimal number of clusters using Adaboost Method

Representation of Free Flow Speed in Radar diagramA radar chart is a graphical method of displaying multivariate data in the form of a two- dimensional chart of three or more quantitative variables represented on axes starting from the same point (Georg von Mayr1877). The relative position and angle of the axis is typically uninformative and also radar chart is a chart that consists of sequence of equi- angular spokes is called radii. With each spoke representing one of thevariable

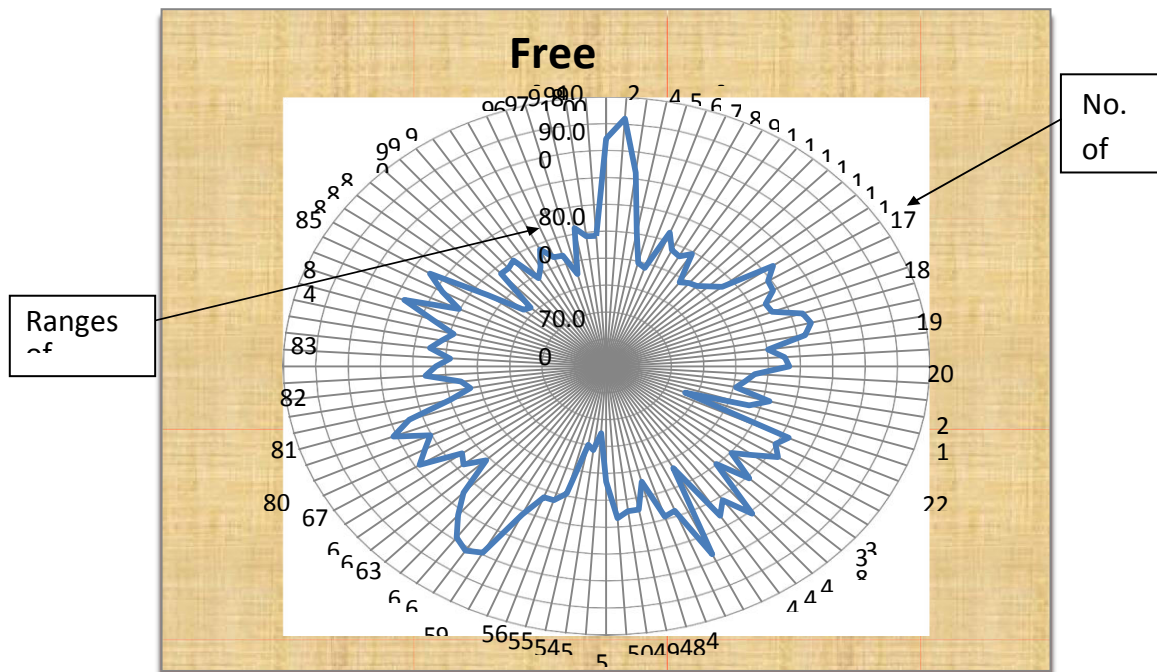

FIG 4.2 Represents of free flow speed (ffs) in radar diagram

5. CONCLUSION

The following conclusion are listed below in this research work in defining level of service criteria of roads in urban Indian context.

- Various cluster validation measures, based on their applicability is used to find the optimal number of clusters for Adaboost, Genetic Programming, Maximum Likelihood Method, Expectation Maximization Method. After thorough analysis itwas decided to classify urban street into four classes (I-IV) in Indian context. Free flow speed ranges for different urban street classes were found out and for each algorithm the range was found to be different. The speed ranges were lower than that mentioned in HCM-2000. Heterogeneous traffic flow and roads having varying geometric and surrounding environmental characteristics are the major reasons for these lower values inFFSs.

- After determining the FFS ranges of different urban street classes, speed ranges of LOS categories were also found using the four different clustering algorithms. These speed ranges resulted from different clustering algorithm were found to be

- significantly different from each other. In order to get the most suitable clustering algorithm in defining LOS criteria a thorough study of method of classification errorswas carried out. The four clustering method such as adaboost, genetic programming, Maximum-Likelihood and expectation-maximization were tested to find out the classification error rate in the classification error process. The least classification error rate in between the four methods indicates the best clustering methods. The classification errors showed GP to be most suitable clustering algorithm for this study. So GP is selected as the best clustering method in defining LOS criteria in Indian context. Speed ranges obtained from GP clustering is decided to be most relevant in Indian context.

- From this research, it was witnessed that the urban street speed ranges valid in Indian context are proportionately lower than that shown in Highway Capacity Manual (HCM2000).InHCM2000,theFFSrangesare(90-70)km/hr,(70-55)km/hr,(55-

- 50) km/hr and (55-40) km/hr for class I, II, III, IV respectively. Whereas, by enforcing the Genetic Programming in the FFS data, it resolves that the speed ranges are (67-90) km/hr, (57-67) km/hr, (45-57) km/hr and (25-45) km/hr, which are comparatively lower than shown in HCM 2000.

- FFS range of urban street class IV in particular is very low because of highly heterogeneous traffic flow on urban roads with varying geometry and surrounding

- environmental features. . For similar reasons it is observed that speed ranges of poor LOS categories such as "E" and "F" under urban street classes III and IV are very low. This implies that the road networks comprise some segments on which traffic moves at stop and gocondition.

- From this research output it is found that average speeds of LOS categories (A-F)

> expressed in terms of percentage of FFS are 90 and above, 75-90,60-75,40-60,30-40,less than equal to 30 respectively. In HCM (2010) these values are shown as 85 and above, 67-85, 50-67, 40-50, 30-40 and less than equal to 30 respectively for LOS categories "A" to"F".

> Also it is observed from this study that average travel speed expressed in terms of percentage of FFS for LOS category "C" varies from 40 to 60, which is significantly different from that expressed in HCM (2010). The finding implies that large volume of traffic travel at average kind of quality of service on Greater Mumbai road. This result suggests that the road network needs geometric improvements to produce better quality ofservice.

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