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Data Collection and Modeling of Heterogeneous Traffic – A Review

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Abstract: ***In modeling of a traffic stream, the most tedious work is the collection of the traffic data which became more difficult in case of heterogeneous traffic. The various types of vehicle add the complexity in the categorization of vehicles for analysis. Starting from manual methods nowadays we use video graphics technique to collect traffic data. Modeling aspect in the design of road network leads to use of various simulation software development which includes various microscopic parameters to generate the best simulation of stream flow.***
Keywords*:* ***Heterogeneous traffic, Traffic stream modeling, Traffic data collection, VEVID, TRAZER.***

I. INTRODUCTION

Traffic is becoming a great problem to deal with in all major cities especially in developing countries like India. In developing countries rapid increase in the volume of traffic with a wide range in the variety of vehicles on road form a more complicated problem to deal with for city planners and road network designers. The lack of lane discipline and heterogeneity in traffic makes it difficult to express the traffic stream flow mathematically because of an increased number of variables in the equation to express the flow accurately. This imparts the reliability of the data predicted by the developed model to produce an economical and effective design which can satisfy the expected traffic requirement of a city.

II. COLLECTION OF TRAFFIC DATA

The collection of traffic data needs extensive manual labor or an expensive infrastructure in place which also affect the economy of the project. A manual count is the oldest available method but not considered accurate due to a possibility of human error and limitations. Then the time-lapse photography came in the picture with a variable number of frames/min but extraction of useful data is highly time intensive and require a lot of manual observation.

The most recent method used is video recording which is initially expensive and lack in the quality of footage produced but currently with evolution in technology a high definition video recording can be obtained with any simple handy-cam or even a smartphone which can be played at any speed with zooming capability at a very economical price. The data collected can be analyzed at any place and times with any number of repetitions so various parameters for modeling can be collected even for the heterogeneous traffic.

III.TRAFFIC STREAM MODELING

Modeling of traffic can be done at various scales like sub-microscopic, microscopic, mesoscopic and macroscopic but macroscopic modeling of traffic stream is preferred over others because of less amount of observation involved in extracting the modeling parameters which are density, flow, and speed. The traffic stream model represents the mathematical relation between above-stated parameters for a particular stretch of the road which will act as a basic data for traffic flow model of an area.

The heterogeneous traffic brings a range of static and dynamic vehicle characteristics under consideration such as the area of a vehicle, lateral and longitudinal distance with no lane discipline leads to higher order model development which can simulate the actual traffic in stream mathematically.

IV.LITERATURE REVIEW

Arasan and Koshy (2005) consider vehicle generation, vehicle placement, and vehicle movement as major modules of a simulation model. They classify the data with most accuracy as no categories are merged together and speed was calculated with the values of acceleration on the stretch of road under consideration. Thereafter they validate the model for homogeneous as well as heterogeneous traffic by simulating the speed-volume relationship. They did not consider the effect of passing or intersection in between the stretch under consideration.

Wei et, al (2005)used a personal computer software called Vehicle Video-Capture Data Collector-VEVID which uses AVI file, generated from data collection infrastructure. It can capture various vehicle trajectories on the complete width of road simultaneously at any instant of time along with various microscopic parameters of a traffic stream. The major advantage this software had over other data collection methods are the capability to vary a number of frames per second and producing data without any manual observation with a very low cost. The only limitation of data collection system lies in the limit of a camera to record only limited length of the road.

Deyet, al (2006) collected the traffic speed data at 17 different sections and plotted unimodel and bimodal distribution curve for speed rather than using conventional normal distribution. They introduced a new factor Spread Ratio while considering both slow and fast moving vehicles traversing the same road space. They observed that as the congestion increased the proportion of slow-moving vehicles increased due to reduced LOS and space available for free maneuvering of the driver.

Chunchu and Rao (2009) developed a system to process offline images which can classify and track vehicles successfully even under extreme congestion or heterogeneous traffic. It is named as Traffic AnalyZer and EnumeratorR –TRAZER. It used a cascade of boosted classifiers for vehicle detection and have an accuracy of 95% moreover in classification it came down to 85%. It produces the data of various microscopic parameters with acceleration and retardation under the detection zone. This can be upgraded to use for real-time and online image processing with increased accuracy.

Chunchuet, al (2010) used TRAZER for the collection of microscopic data for heterogeneous traffic. They collected the trajectory data of vehicles which are classified in four categories named two-wheeler, auto, LMV, and HMV. Thereafter considering microscopic characteristics they generate two parameters occupancy and area occupancy which are used to understand the gap maintaining behavior of vehicles under heterogeneous traffic.

Thankappanet, al (2010)attempted todevelop an empirical traffic stream model to simulate heterogeneous traffic on the road without considering the lanes on the road. They used video graphic technique to collect data and extract parameters like flow, speed, and occupancy in attempt to establish a relationship between occupancy and density. This relationship is intended to bring the effect of heterogeneity in the equation to make the model more acceptable and accurate for simulation and forecasting.

Mallikarjuna and Rao (2011) described a method for modeling of heterogeneous traffic using customized video image processing based data collection technique to generate a model based on cellular automation. They consider various types of vehicles in their model like 2-Wheeler, 3-Wheeler, car etc. with consideration of lack of lane discipline to accurately model heterogeneity of traffic.

TRAZER, had been utilized for collection and classification of traffic data therefore including new micro and macroscopic parameters such as area occupancy, lateral and longitudinal gaps with lateral distribution and trajectory became possible.

Thankappan and Vanajakshi (2015) used video graphics technique for collection of traffic data and classify it manually to plot the relation between basic parameters of traffic. They attempted the various combination of two regime models to simulate the flow and able to find fairly accurate results but they remain unable to express the heterogeneity of traffic stream flow in their model. They conducted the study in Chennai which had highly heterogeneous traffic and congestion so the results became less effective for any kind of implication.

Chow et, al (2015)conducted dynamic traffic stream modeling of the first order and highlighted the modeling difficulty during congestion on road with prepared fundamental diagrams of flow, density, and speed. They found more than 20% variation in projected data in dynamic CTM simulation which force them to consider Cassidy's approach to aggregating the traffic data. This resulted in considerable improvement in the accuracy but create a problem of loss of information in the recording of transient traffic behavior on the stream. The challenge is establishing the balance between accuracy and size of an interval in set allowed.

Verghese et, al (2016)used theKalman filter approach to increase the efficiency of a signal to control the congestion by using traffic density and speed data of downstream and midblock sections in the macroscopic modeling. They use an integrated VISSIM-MATLAB simulation environment to check the developed model and found it suitable to use it for real-time traffic congestion control.

V. FUTURE SCOPE

A. For accurately model a traffic stream various software's are used but achieving the real-time data collection and modeling for heterogeneous traffic remains a challenge with high cost associated equipments.

B. Various set of parameters are used to include the heterogeneity in the model but a fixed set of parameters must be standardized to bring an uniformity in heterogeneous modeling.

C. A basic method must be developed to design the road network for small cities having heterogeneous traffic where costly infrastructure cannot be employed.

VI. SUMMARY AND CONCLUSION

Traffic stream modeling for heterogeneous traffic is essential to accurately plan a road network in developing countries which was tried to be achieved by parameters like longitudinal gap, lateral gap, spread ratio, trajectory tracking, occupancy, area occupancy and various other microscopic parameters. The developed models are simulated using various software's which show a considerable increase in accuracy in predicted data but there are still chances to achieve a better accuracy by developing improved modeling technique with high-tech data collection and analysis equipment which is made available at various premiere research institutes in India.

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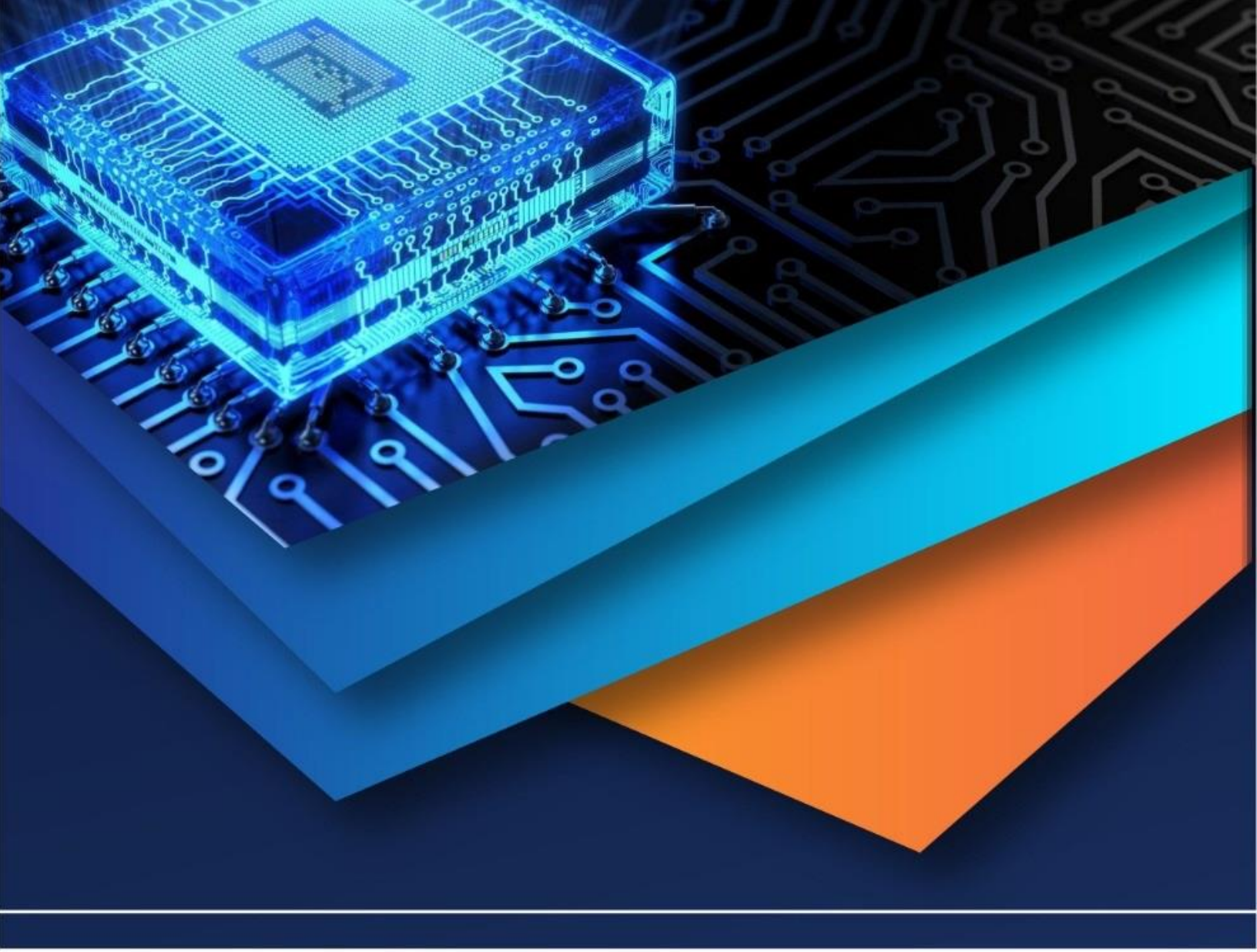

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